## Remarks:

Sections 1, 5, 9 and 10 along with the Testing Procedures (Blue Sheets) contained in the *Construction Manual* have been revised. Please remove and replace the outdated material with the revised as described below. Changes are effective upon receipt.

In addition, please **retain pages 1-25 and 1-26** from the existing Chapter 1 in order to retain instructions on how to administer overruns and underruns on contracts advertised **prior to December 2, 2002**.

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For questions regarding the content of this revision, contact Dave Mounts at (360) 705-7831 or e-mail MountsD@wsdot.wa.gov

## Instructions:

Page numbers and corresponding sheet-counts are given in the table below to indicate portions of the *Construction Manual* that are to be removed and inserted to accomplish this revision.

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# Chapter 1

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Chapter 1

1-1 General Information

1-1.1 Purpose and Scope of Manual

This manual is published by the State Construction Office primarily as a resource for construction engineering personnel. It is intended as a convenient guide to requirements for Washington State transportation projects. The manual recognizes established standards and describes accepted engineering practices. The guidance provided by this manual is intended to identify desired results, establish standardized requirements, and serve as a general guide for the administration and construction of transportation related contracts.

Construction engineering staff responsible for work on construction contracts will want to be familiar with the guidance and instructions included in this manual. The guidance presented by this manual is intended to complement the requirements of the Standard Specifications and the contract provisions and to promote uniformity of results among all Regions of the Washington State Department of Transportation (WSDOT).

Suggestions for corrections, additions, or improvements to this manual, and to the Standard Specifications or General Special Provisions are welcomed and encouraged. Any means of communication with the Construction Office will be accepted and reviewed promptly.

1-1.2 Definition of Terms

In using this manual, the interpretation of words or terms should be considered the same as set forth under “Definitions and Terms” in Section 1-01 of the Standard Specifications. If a conflict should occur between the guidance or instructions offered by this manual and the specifications or provisions identified in the contract, the latter should always prevail.

1-1.3 WSDOT State Construction Office

The State Construction Office strives for consistent, cost-effective, quality construction through direct support of WSDOT’s Regional construction program. The Construction Office coordinates the development of policies and standards, provides training, guidance, oversight, technical expertise and advocacy, introduces innovation, and coordinates and shares information on construction issues.

1-1.3A State Construction Engineer

The State Construction Engineer reports to the Director of Environmental and Engineering Programs and is assigned the responsibility for all WSDOT contract construction projects, except those contracts executed by the Director of Washington State Ferries Division. The State Construction Engineer is responsible for all matters pertaining to contract administration and represents the Director in managing the performance of these contracts. In addition, the State Construction Engineer acts for the Director in approving increases or decreases of work, changes in the work, changes in materials incorporated into the work, authority to accomplish work by force account, extensions of time, and the assessment of any liquidated damages. The State Construction Engineer is responsible for providing guidance and direction to the Regions and State Construction Office personnel who are investigating construction claims and is responsible for the approval of all claim settlements. The State Construction Engineer establishes WSDOT policy relative to inspection and documentation and ensures uniform interpretation and enforcement of the Standard Specifications and contract provisions throughout the State. The State Construction Engineer is assisted by three principal assistants for construction as outlined in the Table of Organization shown in Figure 1-1.

1-1.3A(1) Administration

The Construction Engineer, Administration, acts for the State Construction Engineer in setting requirements for contracting, policy, and responding to questions from the regions on all issues pertaining to Division 1 of the Standard Specifications and Chapters 1 and 10 of the Construction Manual. These include, but are not limited to, time extensions, external civil rights contract changes, prevailing wage issues, documentation, and claims resolution. The Construction Engineer, Administration, also represents WSDOT on task forces with contractor organizations, other public agencies, and at the legislature regarding public contracting issues.

The Construction Engineer, Administration, is assisted by:

- The Assistant Construction Engineer, Administration, who reviews time extensions and liquidated damage assessments, is responsible for prevailing wage issues, and represents the Construction Office on external civil rights issues. The Assistant Construction Engineer for Administration also acts as liaison to various external stakeholders and suppliers.
- The Documentation Engineer, who provides guidance for contract documentation and contract payments, as well as providing support to Region Documentation Engineers. The Documentation Engineer resolves issues of material documentation deficiencies for all federal aid projects.
- The Specification Engineer, who is responsible for maintaining the Standard Specifications, the Construction Manual and the Equipment Rental Rate Blue Book. The Specification Engineer is also responsible for preparing contract acceptance packages.
• The **Construction Administration Support Engineer**, who is the CCIS System Manager, the Construction Office Liaison to MIS, supports the Region and Project Engineer offices by providing training in the use of CCIS and the CCIS Sequel Database. This position also maintains the Construction Office intranet web page.

### 1-1.3A(2) Roadway

The Construction Engineer, Roadway, acts for the State Construction Engineer in matters of highway construction such as grading, drainage, surfacing, paving, signing, guard rails, illumination, traffic signals, landscaping, rest areas, and other projects as assigned.

For the purpose of establishing uniformity between the Regions, the Construction Engineer, Roadway, is responsible for establishing accepted practices for construction, construction engineering, and contract administration for work performed within these fields. Some of these responsibilities include inspecting projects, evaluating reasons for contract changes, approving change orders, conducting or assisting in contract negotiations, investigating complaints and claims, and providing recommendations on major changes to the State Construction Engineer.

The Construction Engineer, Roadway, is assisted by three professional engineers.

### 1-1.3A(3) Bridges

The Construction Engineer, Bridges, acts for the State Construction Engineer in matters for bridges and related structural construction, and other projects as assigned. For the purpose of establishing uniformity between the Regions, the Construction Engineer, Bridges, is responsible for establishing accepted practices for construction, construction engineering, and contract administration of work performed in construction of bridges and other related structural construction. Some of these responsibilities include inspecting projects, evaluating reasons for contract changes, approving change orders, conducting or assisting in contract negotiations, acting as a resource to the Regions for resolving construction related problems, investigating complaints and claims, and providing recommendations on major changes to the State Construction Engineer.

The Construction Engineer, Bridges, is assisted by two professional engineers.

### 1-1.4 Materials

The Materials Engineer acts for the Director of Environmental and Engineering Programs by directing the materials testing, inspecting, and acceptance functions of WSDOT. Subject to the approval of the Director of Environmental and Engineering Programs, the Materials Engineer; formulates and recommends policies and procedures; directs operating methods to be followed in providing precontract soils, foundation, and materials analysis and testing; recommends and/or approves Pavement Designs; furnishes counsel and technical assistance to the Regional Construction Manager in conducting required materials tests and analysis and provides for periodic review of these test methods and procedures to ensure their conformance to established policies, procedures, and methods; and provides a program that verifies the uniformity of all testing and sampling procedures.

The Materials Engineer is assisted by a staff of professional engineers, administrative personnel, engineers, and technicians.

### 1-1.5 Region Organization

#### 1-1.5A Regional Administrator

The Regional Administrator represents the Secretary in a geographic area, organizes and supervises a staff of personnel which perform administrative duties and supervise location, design, construction administration, and maintenance of the transportation system within the Region.

#### 1-1.5B Regional Construction Manager

In supervision of construction, the Regional Administrator is assisted by a Regional Construction Manager. The Regional Construction Manager assigns Project Engineers with appropriate supporting personnel and provides training and guidance to the Project Engineers. It is the responsibility of the Regional Construction Manager to ensure that sufficient personnel are provided on all projects at all times to ensure adequate inspection, documentation, and quality controls.

### 1-1.6 Relationship With Other Agencies

#### 1-1.6A Federal Highway Administration

The Federal Government provides transportation funding to Washington State through the Federal Highway Administration (FHWA), a division of the United States Department of Transportation. These funds are subject to applicable Federal law, Executive Orders, regulations, and agreements.
The WSDOT contact with FHWA for Construction Administration matters is the State Construction Office. In preparing and approving standard specifications, general special provisions, and this manual, the Construction Office seeks the review and approval of FHWA. Use of approved provisions and meeting the required outcomes described in the manual become the basis of federal reimbursement.

FHWA provides oversight of WSDOT work on some projects and has delegated that responsibility to WSDOT on others. In accordance with the Construction Monitoring Plan, which is part of the WSDOT/FHWA Stewardship agreement, project type and size determine whether FHWA, the Construction Office, or the Region will conduct the inspections and reviews necessary to verify adequate compliance with the Federal rules, regulations and procedures.

1-1.6B Local Agencies

Cities, counties, and other municipalities within the state may also perform work funded with Federal dollars. When this happens, the money is passed through the Department of Transportation and we will have entered into agreements with the local agencies to provide services. For example, WSDOT will allow the use of testing facilities by a local agency.

1-1.6B(1) Project Engineer Administering Local Agency Project

Occasionally, a WSDOT Project Engineer may be assigned to provide engineering and inspection services on a local agency project. The duties of the Project Engineer will be determined by the actual contract provisions and by any specific agreement made between the Region administration and the local agency. The provisions of this manual may or may not apply, depending on the situation.

1-1.6B(2) Local Agency Administering Its Project on State Right of Way

In some cases, WSDOT may grant approval for a local agency to construct a facility on State Right of Way using local agency staff and contractors. (For example, a city funded overpass of an interstate). When this happens, a Project Engineer will be assigned to provide oversight of the local agency work. The Project Engineer is expected to assure that the local agency provides the same level of engineering and inspection that State employees would accomplish. All the requirements of the Standard Specifications and this manual must be met.

1-1.6C Other Federal, State, and Local Agencies

The design and construction of transportation improvements often incorporates locations and features that fall within the jurisdiction of other agencies. It is the policy of WSDOT to cooperate with all agencies as partners in the completion of each project, recognizing and complying with each agency’s legal requirements. The Project Engineer shall cooperate with local authorities to help ensure that the contractor complies with local laws, ordinances, and regulations. However, unless specifically allowed in the statutes and the contract documents, no WSDOT employee shall engage in any kind of enforcement of laws, rules, regulations, or ordinances which are the responsibility of other agencies. As WSDOT attempts to earn confidence and build trust with resource agencies and the public, it is critical that we take the proper actions when we are aware of an issue. When WSDOT employees observe something which is questionable or appears to not be in compliance with local laws, ordinances, and regulations, it shall be brought to the Project Engineer’s attention. The Project Engineer is responsible for bringing it to the Contractor’s attention for proper action. Rely on the Regional and Headquarters expertise and the appropriate agencies when dealing with complex issues such as environmental compliance, safety, or hazardous materials.

1-1.6C(1) Highways over National Forest Lands

WSDOT has entered into a Memorandum of Understanding (MOU) with the United States Forest Service (USFS) and the Project Engineer is required to do the following when performing work on National Forest Service Lands:

1. Designate a project manager who will represent the department in all matters pertaining to the project.
2. Inform the USFS of the project advertisement and award.
3. Notify and obtain approval from the USFS for any changes in the project that will affect National Forest System Lands, beyond that of the original contract.
4. Notify the USFS when the project nears completion, at which time the USFS will indicate if they choose to participate in the final review of the project.

1-1.7 Relating to the Public

Public confidence is enhanced by WSDOT personnel being responsive to reasonable requests for information, providing timely advanced notice of possible impacts, and reducing inconvenience to traffic while maintaining worker safety. When possible, the Project Engineer should rely on resources such as Regional Public Information Officers and the State Office of Communications and Public
Involvement. If there is concern or reason to question the confidentiality or sensitivity of the information requested, consult with your supervisor or seek the advice of the Attorney General’s office.

1-1.8 Safety

Safety is not optional in WSDOT. No employee will be permitted to disregard applicable safety and health standards of the State Department of Labor and Industries or other regulatory agencies.

Since WSDOT employees on transportation construction projects are routinely exposed to a variety of hazards, they must take adequate safety precautions at all times. The following items are emphasized as they represent common activities that workers or work crews may encounter.

- The employee shall ensure that an area is safe before entering it for the purpose of inspection. For example, a deep trench must be adequately shored and braced before entering it.

- Aggregate production and material processing plants should be inspected for safety hazards. Corrective measures should be called to the attention of the Contractor or producer. Corrections must be completed before WSDOT personnel will be permitted to proceed with entry or work upon the premises.

- The employee must at all times watch for backing trucks and not depend upon hearing alone for warning. The noise of plants and other equipment often make it impossible to hear trucks approaching and the truck driver’s vision area is restricted when backing a truck.

- Parking WSDOT vehicles too close to the path of construction equipment, behind standing equipment, or in other hazardous locations is not permitted.

- Where traffic is maintained in work zones, care must be taken to avoid approaching traffic when it is necessary for inspectors and others to step onto or cross the traveled portion of the roadway. Whenever possible, work activities, ingress and egress, should be conducted within the relative safety of the work zone.

- WSDOT employees working on foot in the highway right of way and other areas exposed to vehicular traffic must comply with the same high visibility clothing requirements imposed on the contractor by Section 1-07.8 of the Standard Specifications.

- When the engineering crew is working under the protection of the Contractor’s flaggers and signs, other signs may not be needed, but a “STOP” / “SLOW” paddle should be available for use in special situations. Good communication with the Contractor and Flagger is needed to ensure that they are aware of crew activities within the work zone.

- A survey crew is typically exposed to traffic hazards and should conduct survey work under approved TCPs from the Work Zone Traffic Control Guidelines for Survey Operations booklet or the Traffic Control Guidelines book. The Region Traffic Office will assist survey crews with TCPs for situations not covered in these publications.

- During blasting operations, employees are instructed to seek cover at least 500 feet from the location of the blasting.

In addition to the above requirements for workers and work crews, supervisors also have the following responsibilities:

- Each supervisory employee is charged with the responsibility of providing safety leadership at all times and safety enforcement when necessary.

- Supervisors shall give thorough instructions to employees under their jurisdiction on the safe use of tools, materials, and equipment and the safe prosecution of work on construction projects.

- The Washington Industrial Safety and Health Act requires that every foreman, supervisor, or other person in charge of a crew have a valid first aid card.

- When employees are injured on the job to the extent that the services of a doctor are required, the Regional Safety Officer shall be notified immediately.

- When traffic control measures are necessary, approved Traffic Control Plans (TCPs) should be used in conformance with the Manual on Uniform Traffic Control Devices, as adopted by WSDOT. Supervisors should ensure that the appropriate TCP is used and that the necessary signs, devices and equipment is available.

1-1.9 Archaeological and Historical Objects

It is both National and State policy to preserve historical or prehistorical objects and ruins. These objects and ruins may include sites, buildings, artifacts, fossils, or other objects of antiquity that may have particular significance from a historical, cultural, or scientific standpoint.
If there is a known probability of encountering historical objects, the contract will have included provisions for archaeological and historical salvage. If this provision is included in the project, the Project Engineer should inform the Region Environmental section when clearing and grubbing operations are to begin so arrangements can be made with the Eastern Washington University representatives to either be on site during clearing and grubbing or on call if objects are discovered.

If provisions for archaeological and historical salvage have not been made in the contract and it appears that significant historic or prehistoric objects or ruins have been or are about to be encountered, the Project Engineer should immediately take steps to preserve and protect the objects or ruins. Once the objects or ruins have been sufficiently protected, the Project Engineer should immediately notify the Region Construction Manager, who will provide any necessary initial assistance to the Project Engineer. Where the Region determines appropriate, the Project Engineer will contact and inform through existing Region contracts and Region affiliations, Eastern Washington University, the State Historic Preservation Officer (SHPO), and FHWA of the discovery. The Project Engineer will also help facilitate any on-site meetings for the appropriate parties should either FHWA, SHPO, or Eastern Washington University believe it necessary. If it is determined that the Region will conduct a meeting of the appropriate parties, the actions detailed in the Memorandum of Understanding between FHWA and the Heritage Conservation and Recreation Service (HCRS) should be taken.

1-1.10 Construction Work in International Boundary Strip

The International Boundary Commission of Washington, D.C., by treaty with Canada, has the exclusive jurisdiction of the 20-foot boundary strip, 10 feet on each side of the International Boundary. Any construction work within this strip must be with the exclusive permission of the International Boundary Commission (IBC). Boundary monuments are not to be moved or disturbed in any manner without the expressed approval of the IBC. It is expected that permission for all work within the boundary strip will be obtained from the IBC during the design stage of a project. However, it is the Project Engineer’s responsibility to ascertain that permission has, in fact, been obtained from the IBC for all work performed within the boundary strip. The Region shall be immediately notified if, upon construction, it is found that permission has not been obtained in order to relocate boundary markers or perform construction work in the 20-foot boundary strip.

1-2 Contract Administration

1-2.1 Proposal and Award of Contract

1-2.1A Contract Proposal and Bids

When the design phase of a project is completed and funding has been secured, the public is then notified that WSDOT is ready to accept bids for completion of the work involved. This notice is accomplished by publishing an advertisement for the project, along with an invitation to bid the work, in the “Daily Journal of Commerce”. The advertisement includes a specific date and time for the opening of bids along with the necessary information for obtaining plans, specifications, and bid documents. Once advertised, these plans and specifications are then made available to all contractors who wish to study the project. Contract proposal forms or bid documents are also furnished, but only to those prospective contractors who have been prequalified to bid on the types and quantities of work involved. Once bids have been opened, an announcement in the “Daily Journal of Commerce” will also be made identifying the “Apparent Low Bidder”. Specific information regarding the advertisement phase and bidding procedures can be found in the Ad & Award Manual, M 27-02.

If the Project Engineer determines that prospective bidders may have difficulty locating the project or determining the project limits, the Project Engineer may choose to post the project limits. If this is determined necessary, signs similar to those illustrated in Figure 1-3 should be used.

Section 1-02.4 of the Standard Specifications requires that all requests for explanation or interpretation of the contract documents be submitted in writing. Anytime the answer to a question from a prospective bidder would provide additional information that would not be available to all bidders, the Project Engineer should immediately contact the Region Construction Manager or Region Plans Office in order to facilitate the preparation of an Addendum. Answers to such questions must be provided to all bidders in the same manner. If the question has to do with generic issues such as office procedures (for example, methods of payment calculation or handling requests for information,) the answer may be provided directly to the questioning party without involving other bidders.

All questions from prospective bidders regarding an advertised project should be referred to the Project Engineer listed in the “Notice to All Planholders” for a complete response. The Project Engineer will coordinate the effort to determine if any requested information needs to be addressed by an addendum.
1-2.1B Award and Execution of Contract

Bids for the contract are opened at a public meeting where each prospective bidder’s proposal is read and the Apparent Low Bidder is announced. Within 45 calendar days of bid opening, the proposals will be closely reviewed and the contract will be awarded to the lowest bidder deemed responsive. In accordance with Section 1-03 of the Standard Specifications, the successful bidder is then allowed 20 calendar days to return the signed documents that are necessary to enter into a contract with WSDOT.

After these documents are returned to WSDOT, the contract must be approved and executed. No proposal submitted by a Contractor is binding upon WSDOT prior to the date of execution by WSDOT. No work is to be performed within the project limits or WSDOT furnished sites prior to the execution of the contract by WSDOT. Any work that is performed by the Contractor outside of these areas, or any material that is ordered prior to WSDOT execution, is done so solely at the risk of the Contractor.

In order to ensure timely notification to the Contractor regarding execution of the contract and authority to proceed, the following procedure is used:

1. Immediately after execution of the contract documents by WSDOT, the State Accounting Services Office or (for Region Ad & Award projects) the Region Plans Office will notify the office administering the contract (the Regional Construction Manager’s Office, the Director of Terminal Engineering, or the Architecture Office). The State Accounting Services Office also notifies the State Department of Revenue, State Department of Labor and Industries, and other interested parties that the contract has been executed.

2. The Regional Construction Manager or a representative should contact the Project Engineer’s office as soon as notification is received. The Project Engineer should then contact the Contractor and provide notification of the execution date. The date, time, and method of notification in all instances should be recorded in the project diary.

3. Following the initial contact, the State Accounting Services Office or the Region Plans Office will send executed copies of the contract to the Contractor and the Project Engineer.

1-2.1C Preconstruction Meetings, Discussions

If the Project Engineer decides a formal meeting is necessary in order to successfully begin work on the project, a meeting should be arranged as soon as practical after the contract is awarded and the Contractor has organized for the work. This preconstruction meeting is intended for the purpose of discussing the project and to exchange a variety of information. Depending upon the complexity of the project, this information can be exchanged in any combination of the following methods:

- Information packets provided to the Contractor
- Letters transmitting information
- Informal meetings
- A single multipurpose formal meeting
- Several formal meetings with different purposes

All information exchanged should be documented in the project records, by formal meeting minutes, by file copies of letters, or by diary entries.

The nature, amounts, and methods of communication with the Contractor are left to the Project Engineer. As a minimum, the following subject areas should be covered during the preconstruction time period:

- **CONTRACTOR WSDOT RELATIONSHIPS**
  
  The Project Engineer should begin to develop a positive and effective relationship with the Contractor as soon as the contract is awarded. This is also a good time to introduce the concept of “Partnering” if it has not already been introduced on the project. The Project Engineer should strive to create an environment that encourages a cooperative approach to completing the project. This can be helped by beginning the development of a team consisting of both the Contractor’s and WSDOT’s project people. The level of authority delegated to each member of the Project Engineer’s staff should be discussed with the Contractor. In addition the methods of establishing the Contractor’s Performance ratings can be reviewed (Manual M 41 40) (see Chapter 1-2.8F of this manual for additional information). The Contractor should also be informed that there is an opportunity to evaluate the WSDOT construction process as well.

- **ENVIRONMENTAL COMMITMENTS**

  If there are commitment files for the project, these should be made available and discussed with the Contractor. Any references in the Standard Specifications or the special provisions to environmental requirements or permits should be discussed. The Contractor’s responsibility to obtain any local agency permits should also be discussed. If rock crushers are involved in the project, the State Department of Ecology registration requirements should be discussed (WAC 173-400). In addition, a written record of this discussion should be sent to the regional office of the State Department of Ecology so that they are aware of the timing and location of the rock crushing operation.
• ORDER OF WORK AND TIME SCHEDULES

In order for the Project Engineer to set up the required crews, arrange for any special inspections, provide timely reviews of submittals, etc., the project office must be made aware of the contractor’s schedule of work. In addition the contract specifications may include specific requirements for sequencing or durations for some items of work. The contract requirements for progress schedule or time for completion in accordance with Section 1-08, or as amended by the special provisions, can also be discussed.

• SUBCONTRACTORS AND LOWER-TIER SUBCONTRACTORS

In accordance with Section 1-08.1 of the Standard Specifications, the Project Engineer needs to become aware of the Contractor’s plans to delegate portions of the work to subcontractors. These plans must conform with the condition of award, if any, related to disadvantaged business enterprise participation. The Project Engineer should explain the requirements and process involved for subcontractor and lower-tier subcontractor approval, including the prevailing wage rate requirements outlined in the contract documents (see Chapter 1-2.6 of this manual). WSDOT/Contractor/Subcontractor relationships should also be discussed. The Project Engineer should remind the Contractor that there is no contractual relationship between WSDOT and the subcontractors. All subcontractor correspondence with WSDOT should pass through the Contractor for submittal to WSDOT or vice versa. Contractor representation should also be discussed. It is also necessary for the Contractor to be represented at the job site at all times, even when there is only subcontractor work in progress.

• UTILITIES, RAILROADS, AND OTHER THIRD PARTIES

If the project affects or is affected by third party organizations, the Project Engineer must advise the Contractor about the relationships with the third parties and the expectations they hold regarding the actions of both WSDOT and the Contractor. The Project Engineer may wish to arrange face-to-face meetings with representatives of affected third parties. In the case of utilities, reference should be made to the underground locator services and the requirements to utilize them (see RCW 19.122). If WSDOT has agreed to notification time limits, these should be communicated to the Contractor. If special insurance is required by any agreements with third parties, then these requirements should be pointed out to the Contractor.

• SAFETY AND TRAFFIC CONTROL

The Contractor’s safety program should be discussed as outlined in Section 1-2.2(3) of this manual. WSDOT has an interest in safe operations on the job and the Project Engineer should make clear that this interest will be protected. As part of a discussion of specific safety requirements of the particular work, safety considerations for workers and WSDOT personnel, such as safety zone requirements, vehicle intrusion protection, fall prevention, closed spaces, hazardous materials, work around heavy equipment, etc., should be addressed. The need for control of speed on all construction equipment should be emphasized.

The Project Engineer should describe WSDOT’s traffic requirements. The Contractor’s Traffic Control Manager (TCM), Traffic Control Supervisor (TCS) and WSDOT’s traffic control contact person should be identified and their responsibilities and authorities clearly stated. Any traffic control requirements that are unique or restrictive should be emphasized and addressed by the Contractor with respect to construction operations. Unacceptable delays to traffic should also be discussed.

The Manual on Uniform Traffic Control Devices, as adopted by WSDOT, is the legal standard for all signing, traffic control devices and traffic control plan requirements on the project. These standards have been incorporated into the project Traffic Control Plans (TCPs.) If the Contractor chooses to use these TCPs, they must be formally adopted in writing as required in Section 1-10.2(2) of the Standard Specifications. If the Contractor wishes to use some other traffic control scheme, then that plan must be submitted and approved in advance.

Flaggers and their intended locations must be included in the plans. When Flaggers are utilized, they must have a current flagging card and shall be equipped with hard hats, vests, and standard stop/slow paddles as required in Sections 1-07.8 and 1-10.3 of the Standard Specifications. Overuse of flaggers is not appropriate as “catch all” traffic control and should be discouraged. Safety of flaggers, through use of physical protection devices where practical, proper flagging methods and formulating an emergency escape plan, should be emphasized.

The Contractor and the Project Engineer should establish communication with the Washington State Patrol (WSP) and local law enforcement agencies. Law enforcement advice about traffic control should be considered. Arrangements for all law enforcement agencies to notify the project office about accidents near, or in, the construction area should be established.
Notes:

This plan is typical. Any particular project should be signed to meet the physical conditions.

M6-1 Directional Arrow signs shall be installed as necessary.


Figure 1-3
if possible. If WSP traffic control assistance is to be used, a general discussion of strategy and responsibilities should be included.

Off site hauling can pose a safety hazard to the public. WSDOT will cooperate with law enforcement agencies in the enforcement of legal load limit requirements and the covered load regulations. The Project Engineer should discuss this with the Contractor before any hauling begins.

• CONTROL OF MATERIALS

The Contractor should be reminded of Section 1-06.1 of the Standard Specifications, requiring the Engineer’s approval of all materials prior to their use. In order to expedite these approvals, the Contractor should be encouraged to make these requests as early as possible. The Project Engineer should provide the Contractor with a current copy of the Record of Materials (ROM) for the project. The Project Engineer should discuss the ROM with the Contractor, covering the various requirements for sampling, catalog cuts, shop drawings, certification requirements, etc., which may be needed for approval of materials prior to their use. The requirements of Section 1-06.2 of the Standard Specifications for ongoing acceptance of approved materials prior to their being incorporated into the work, should also be discussed. If fabricated items will be needed, the inspection process for fabricated materials, including shop drawing approvals and notification requirements for fabrication inspectors, should also be outlined. The requirements of Section 1-06.3 of the Standard Specifications that require manufacturer certifications prior to use of the materials should also be reviewed.

The Contractor should be reminded that, in order to avoid deferred progress payments for work completed, all necessary documentation for approval of materials and required certifications must be received and accepted prior to their use.

• OTHER SUBMITTALS

Discuss any other submittals that may be needed during the course of the contract. This may include Falsework and Forming Plans, Traffic Control Plans, Temporary Water Pollution/Erosion Control Plans, Schedules, Installation or Operating Procedures, or other Contractor initiated items requiring WSDOT review and/or approval. There are requirements for a number of submittals which, if not satisfied in a timely manner, could delay the initial progress payment. These include the Statement of Intent to Pay Prevailing Wages, the Progress Schedule, and the Training Plan. There may be others depending on the work to be done and as required by the contract provisions. The Project Engineer should identify and remind the Contractor of these requirements and the potential for deferred payments.

• D/M/WBE PARTICIPATION / EEO / TRAINING

The Project Engineer should briefly discuss and answer any questions the contractor may have with regard to the efforts, reports, and monitoring necessary to ensure successful performance for D/M/WBE Participation, EEO, & Training. Chapter 1-2.7A provides a breakdown of these various programs and the general requirements each contains. However, the specific requirements and contractor performance information are included in the Standard Specifications for Road and Bridge Construction, the Amendments included in the contract, as well as the contract specific special provisions titled Equal Employment Opportunity Responsibilities. If additional assistance or information is necessary, the Project Engineer could also request assistance from the Region EEO Officer, the State Office of Equal Opportunity, or the State Construction Engineer’s Office.

• WAGE RATE ADMINISTRATION

Advise the Contractor of the requirement to pay prevailing wage rates as identified in the Contract. Advise the Contractor that it is their responsibility to work directly with Washington State Department of Labor and Industries (L&I) for approval of the Statement of Intent to Pay Prevailing Wages (SI) and Affidavit of Wages Paid (AWP) and that:

• The SI and AWP will be on forms provided by L&I.

• The forms will be obtained from L&I or can be filed electronically with L&I online at www.LNI.wa.gov/pervailingwage.

• The contractors, subcontractors, lower-tier subcontractors, suppliers, manufacturers, and fabricators that are required to submit SI and AWP will pay the approval fee directly to L&I.

• The Contractor will provide the Project Engineer a copy of the approved forms (SI, before any payment can be made for the work performed and all AWP, before any retained percentage can be released). If payrolls are required, establish submittal deadlines in accordance with Section 107.9(5) of the Standard Specifications. Describe the wage rate interview process. Describe the required job site posters and provide them to the Contractor (See Chapter 1-2.6 of this manual).

On all Federal-Aid contracts, the Project Engineer must remind the Contractor that the work falls under the guidance of Davis-Bacon and Related Acts and the Contract Work Hours and Safety
Standards Acts. As indicated in Chapter 1-2.6C of this manual, the U.S. Department of Labor may conduct investigations to ensure compliance with these Acts.

• FORMS

The Project Engineer should provide the Contractor a description of all required forms, giving the Contractor an initial supply of each. Additional forms required by the Contractor over the course of the work should be provided by the Project Engineer upon request of the Contractor. Remind the Contractor that all form submittals, including those of subcontractors, lower-tier subcontractors, and suppliers, should be routed through the Prime Contractor for submittal to WSDOT.

• SUMMARY

While these issues are to be discussed with the Contractor in some manner at the beginning of each contract, the Project Engineer is free to select the most effective method of doing so. A formal preconstruction conference may or may not be the best solution. Perhaps a single meeting is adequate or several meetings may be required. The entire preconstruction communication may also be covered in a short meeting between the Project Engineer and the Contractor. The Project Engineer is responsible to address the information and inform the Contractor in some manner and maintain a written summary of the preconstruction meetings or discussions for the contract files.

The Contractor and Project Engineer may be knowledgeable about those normal requirements listed above. In this situation, some items need only be listed in a mailing as a convenience to the Contractor’s staff. Unique features, constructibility, and third party coordination should be focused on with as many of the interested parties as can be assembled.

The key is effective communication, getting the right message to the necessary people. Additional meetings may be required as people change, as new facets of the work become imminent, or as the project goes into a second or third season. In order to assist this process, a checklist has been developed as a tool for the project office’s use. It can be used to help identify the issues and track them for completion through the various preconstruction communications. See Figure 1-4.

1-2.2 Project Engineer's Relationship and Responsibilities

1-2.2A Assignment

The Region will appoint a Project Engineer to act as the authorized representative of the Secretary of Transportation for each contracted project. After the contract has been executed by WSDOT, the Region may provide the Contractor with written confirmation of the name and address of the Project Engineer assigned. (The Region may rely on the special provisions and forego this letter, unless a change is made.) If a letter is sent, the Contractor should be reminded to send all correspondence and forms regarding the project to the Project Engineer.

The Project Engineer is then responsible for enforcement of the contract specifications and provisions and the completion of all work according to the plans. The Project Engineer supervises the work of WSDOT personnel assigned to the project and ensures that they perform their work in accordance with the Plans, specifications and all applicable WSDOT policies. The Project Engineer is responsible for keeping complete and accurate records of all construction data and work progress, preparing progress and final estimates, and preparing other records necessary for a complete documentation of the project, including a performance evaluation of the Contractor (see Chapter 1 2.8F).

Changes made to the project or substitutions for work detailed in the contract plans or specifications, must be made in accordance with the requirements of Section 1-04 of the Standard Specifications and the guidance provided by Chapter 1-2.4C of the Construction Manual. The Project Engineer should review the project on a regular basis with the Regional Maintenance personnel so they have an opportunity to present any maintenance problems that may arise.

1-2.2B Responsibility as a Public Official

The Project Engineer is responsible for a project that is affected by Federal, State, Tribal, and local laws, ordinances, and regulations. While no one could be familiar with every requirement, the Project Engineer should seek to understand as much as possible. Beyond that, the prudent Project Engineer will look for guidance and seek information related to whatever current issue is at hand. Legal requirements could affect State employees, those employed by the Contractor in performing the work, the materials to be incorporated, the equipment that is used on the project, or could otherwise affect the conduct of work.

If the Project Engineer discovers that any provision of the contract, plans, or specifications appears to be inconsistent with a law, ordinance, or regulation, the inconsistency should be investigated and, if appropriate, referred to the Region Construction Manager. The Project Engineer should, at all times, strive to comply with all laws, ordinances, and regulations.
1-2.2C Relationship With the Contractor

The Project Engineer must be familiar with the conditions of the contract, special provisions, and specifications for the work. The Project Engineer must attend to any reasonable request of the Contractor, i.e., furnishing grades, stakes, plans, etc., whenever necessary and within reason. In general, the Project Engineer should do all things necessary to enable the Contractor to work to advantage and without delay. The Project Engineer should not set any stakes or furnish to the Contractor any plans which are the responsibility of the Contractor to set or provide. The Project Engineer must ensure that the Contractor performs the work in accordance with the contract provisions, plans, and specifications.

Integrity on the part of all employees is essential. The attitude of the Project Engineer and staff toward the Contractor and the Contractor’s personnel should be one of cooperation, consistent with the requirements of the specifications. It should be recognized that both the State and the Contractor have explicit rights under the contract and that both parties must respect those rights. The Contractor is generally trying to fulfill the contract honestly, and errors or difficulties, which may arise are usually due to a lack of information or a misunderstanding. If conflict should occur, the Project Engineer should make every effort to determine the cause of the conflict and make appropriate corrections.

1-2.2D Relationship With Other Government Agencies

Other agencies responsible for such things as flood control, land development, stream navigation, pollution, etc., may be affected by the work. The Project Engineer should attempt to determine that the Contractor has complied with all regulations known to be in effect. The Project Engineer is encouraged to obtain a copy of commitments from the project design file. This should be available from a region or project design office. This file should contain environmental permits, real estate commitments, utility commitments, design deviations, and other good important information. When the Contractor is specifically required by the contract to obtain an approval document from other agencies, the Project Engineer must confirm that the document was received. Other approvals required of the contractor, but not mentioned in the contract documents should be confirmed to the extent that the requirements are known and the confirmation is possible. If a representative of an agency visits the project, the Project Engineer or an inspector should accompany the representative on the visit.

In carrying out construction work in forested areas, the Project Engineer should encourage the Contractor to comply with all Federal and State forest rules and regulations governing the protection of forests and the prosecution of the work within both national and State forests. The Contractor must take all precautions necessary to prevent and suppress forest fires. The Project Engineer shall report to the nearest forest fire warden at the earliest possible moment, the location and extent of any fire and shall take immediate steps to control the fire if practicable.

Construction work in or near streams, rivers, or other bodies of water may require a permit from the State Department of Fish and Wildlife. In an agreement with the agency, for each project requiring a Hydraulics Project Approval (HPA) (RCW 75.20.100), the State Department of Fish and Wildlife will issue the permit to WSDOT only and not to its contractor. One representative of the State Department of Fish and Wildlife will be assigned to coordinate requirements with the Project Engineer. The permit is specific to the work provided for in the contract itself and will not cover other work in support of the project, such as operations in Contractor staging areas, material sources, or waste sites. When a Hydraulics Project Approval has been obtained for the project, and the permit has not been incorporated into the contract documents, the Project Engineer shall provide copies of the permit to the Contractor and ensure it is properly posted at the work site at all times work is in progress. The Project Engineer should ensure that both the intent and the specific provisions of the permit are rigidly enforced. If the Contractor’s method of operations, weather conditions, design changes, or other factors affect waters of the State in ways not anticipated or represented in the Hydraulic Project Approval, the Project Engineer will work with the assigned representative and the Contractor to modify the existing permit or obtain a new or revised one as appropriate.

The U.S. Department of Labor, Mine Safety and Health Administration, Metal and Non-Metal Mine Health and Safety Division, 3633 136th Place SE, Suite No. 206, Bellevue, Washington 98006, (206) 553-7037, must be notified at the beginning and closing of all mining operations. This includes surface mining, such as our normal pit site operations. Notification is required for all crusher operations and for all pits and quarries, including borrow pits, which are separated from the roadway under construction. The Project Engineer is responsible for this notification for WSDOT furnished pits and must submit the required report as soon as the date of opening or closing can reasonably be determined. The Contractor is responsible for notification for all pits and quarries not furnished by WSDOT. The Bureau of Mines reports are in addition to reports required by the Department of Natural Resources.

Whenever construction work is performed in navigable waterways, it is necessary to obtain a construction permit from the Coast Guard. One of the requirements of the construction permit is regular submission of Bridge Construction Progress Reports. Two copies of the report should be prepared by the Project Engineer sufficiently in advance of the first working day of the month and
Preconstruction Communication Checklist

**Contract Number:**
**Project Engineer:**
**Contractor:**

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<th>Subject</th>
<th>Communication Type (Letter, Min. of Mtg., Info. Packet, Diary)</th>
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transmitted to the State Bridge and Structures Engineer. When a Coast Guard permit modification is proposed (by the Contractor or WSDOT), it shall be submitted to the Bridge and Structures Engineer for processing through the Coast Guard. The time required for approval/disapproval of the proposed permit modification is variable and depends on the nature and significance of the modification. Up to six months may be required. When all construction obstructions to navigation have been removed, the Project Engineer shall report that fact immediately to the Bridge and Structures Engineer indicating the date removal was completed. Upon completion of all permitted bridge work, a final report indicating the date of completion and certifying that the bridge has been constructed in compliance with the Coast Guard Bridge Permit shall be submitted by the Project Engineer to the State Bridge and Structures Engineer.

1-2.2E Relationship With Public and Private Utilities

In some cases, utility adjustments will be completed prior to contract work. In other cases, adjustments are to be made concurrently with the work. The Project Engineer and the Contractor should contact public utility companies, individuals, and others owning or maintaining utility features within the limits of the highway right of way and confirm the relationship and the terms of the relocation agreements. Where the feature will require adjustment during construction, notice should be provided far enough in advance to allow the utility to perform the adjustment without affecting the Contractor’s work schedule.

Utilities should have been given prints of the preliminary plans, prior to awarding of the contract, showing grade lines and right of way to enable them to prepare plans and estimates for making the necessary changes to their facilities in as timely a manner as possible. The Project Engineer should determine that plans for the work have been made, that the relocated facilities will be clear of the construction, and that the utilities coordinate with the Contractor’s operations to the fullest extent possible.

When utilities are known to exist within the limits of the project and are not planned for relocation but may be affected by the Contractor’s construction activities, the Project Engineer and the Contractor should become familiar with the requirements of RCW 19.122, Underground Utilities. The Project Engineer may wish to obtain copies of the RCW for review at Preconstruction Meetings.

The approximate locations of most existing underground utilities are shown on the contract plans. However, the existence of some underground utilities may not have been known or detected during design. If a number locator service is available, the Contractor must utilize it in an attempt to locate all affected utility features. If no one number locator service is available, notice shall be provided individually to those owners of underground facilities known to have or suspected of having underground facilities within the area of proposed excavation. Even areas covered by a one number service may contain utilities not included in the service. If the Contractor discovers underground facilities which are not identified, the Contractor shall cease excavating in the vicinity of the facility and immediately notify the owner or operator of such facilities, or the one number locator service.

1-2.2F Responsibility for Coordination of Railroad Agreements

When railroads are involved within the project limits, an agreement covering the work involved is usually entered into between WSDOT and the Railroad Company. Upon identifying that the contract involves work or involvement by a railroad, the Project Engineer should immediately obtain a copy of the Railroad Agreement or contact the Region Utilities Engineer to determine the status of the agreement and to make sure it contains all elements needed to accommodate the construction of the project. If an agreement has not been made with the railroad, the Project Engineer should coordinate and monitor the development and processing of the agreement through the Region Construction and Region Utilities Engineers. Where notices are required. The Project Engineer should ensure that proper notice is provided to the railroad company and that such notice is acknowledged by them. The Project Engineer should work with the Region Construction and Region Utilities Engineers to resolve any conflicts with the Railroad Company and prevent delays to the Contractor’s operations.

1-2.2G Responsibility for Railroad Encroachment Insurance

Projects which include work on railroad right of way generally require special insurance protection. Pay particular attention to the Contract Special Provisions for project requirements because they vary from project to project. It is the responsibility of the Project Engineer to enforce the provisions. The required insurance documents are to be furnished by the Contractor (usually through the Project Engineer) to the State Accounting Services Office who will (a) review the documents and (b) obtain approval of the insuring documents from the railroad company. Written notification of approval by the railroad company will be furnished to the Project Engineer by the State Accounting Services Office as soon as approval is obtained.

No work shall be started on railroad property until the necessary approvals have been obtained. The railroad insurance must be maintained until the date of physical completion of the project unless otherwise stated. However, the Contractor may make a written request to be relieved of the responsibility to continue all or part of the railroad protective liability insurance before the completion date under certain conditions. The details and conditions for this relief are specifically set forth in the special provisions of
the contract. If the Contractor should make a request for relief, the Project Engineer should contact the Region Construction Manager and Utilities Engineer for guidance and assistance in coordinating this effort with the railroad.

1-2.2H Responsibility for Coordinating Work With Other Contracts

When two or more Contractors are working in the same area, Section 1-05.14 of the Standard Specifications will apply. The Contractor shall not cause any unnecessary delay or hindrance to the other contractors on the work, but shall cooperate with other contractors to the fullest extent. Progress schedules and plans for all contractors involved should be reviewed by the Project Engineer to detect possible conflicts which might be resolved before a delay of work is experienced or extra costs are incurred as a result. If an adjacent project requiring coordination is known prior to holding a Pre Construction meeting, it would be beneficial to invite principals from that project to the meeting.

1-2.2I Responsibility for Enforcement of Safety and Health Requirements

1-2.2I(1) General

All contractors doing work for WSDOT must provide safety controls for the protection of life and health of the Contractor’s employees and other persons, for the prevention of property damage, and for the avoidance of interruptions in the performance of the work under the contract. As the owner contracting agency, WSDOT has the responsibility for enforcement of the provisions of the contract, however, provisions and regulations which are by law the fundamental responsibility of other agencies, both from the standpoint of interpretation and enforcement, should be monitored by WSDOT, but with full recognition as to the responsibilities and authorities of those agencies. The Project Engineer will cooperate fully with the responsible agency.

Any violations noticed by the Project Engineer will be brought to the attention of the Contractor for correction. The Project Engineer will also notify the responsible agency (if that action is deemed necessary by the Region Construction Manager) and utilize such sanctions as are consistent with contract terms in assisting the responsible agency in enforcing laws, rules, and regulations.

The Contractor is obligated by law to comply with both State and Federal safety regulations. State regulations are administered by the Washington State Department of Labor and Industries under the Washington Industrial Safety and Health Act (WISHA). Federal regulations are administered by the Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration (MSHA) of the U.S. Department of Labor, which has jurisdiction over Federal safety requirements for pit and quarry operations up to the point where materials leave the quarry area or go into a batch plant. Inspectors from any or all of these agencies may review the Contractor’s operations at any time. (See Section 1-07.1 of the Standard Specifications.) In order to fulfill WSDOT obligations to monitor contract operations in accordance with the above, the following procedures should be followed on both Federal-aid and non Federal-aid contracts.

1-2.2I(2) Precontract Preparation

- The Project Engineer shall obtain the WISHA manuals, particularly Safety Standards for Construction Work WAC 296-155, General Safety and Health Standards WAC 296-24, and General Occupational Health Standards WAC 296-62, and shall review them with the key field WSDOT inspectors to ensure reasonable familiarity to the extent that they can recognize important requirements.

- The Contract Plans and contract provisions should be reviewed to identify those aspects of the work meriting special attention from the standpoint of potentially dangerous types of work and hazard elimination.

1-2.2I(3) Preconstruction Duties

As part of the Preconstruction Meetings and Discussions (see Chapter 1-2.1C), the Contractor’s safety program should be discussed. Some of the things that the Project Engineer may want to consider are:

- The contractual obligation of the Contractor for complying with State and Federal construction safety standards. (See Section 1-07.1 of the Standard Specifications.)

- The availability of the safety standards that apply to the contract.

- The accident prevention program of the Contractor — organization, staff, names of responsible individuals, meetings, training, reports, etc. A review of specific areas for which plans are required (especially those also affecting WSDOT personnel). These might include Fall Protection, Confined Spaces, Respirators, Hearing, and Hazardous Materials plans. Implementing a mechanism for employees to report “near misses” and/or work zone accidents.

- The Contractor’s responsibility for seeing that subcontractors comply with safety regulations.

- The Contractor’s plans for meeting specific safety requirements and for eliminating potentially critical hazards on the project.
1-2.2I(4) The P.E.’s Role in Safety on the Project

It is difficult to generalize about safety. It’s a judgment call which is dependent on risk, knowledge, authority to direct corrections, etc. As people, professionals and representatives of the State, Project Engineers have an obligation to take action if they become aware of a situation that presents an immediate threat. Project Engineers should advise their employees on what the lines of communication are and what the procedures are for alerting the responsible agencies with regard to serious safety hazards.

Employees should be made aware that the Contractor is obligated to make the work-site safe, to their satisfaction, for inspection activities. Anyone who is uncomfortable with access for inspection should inform their supervisor of the situation and expect resolution. Project personnel should also be made aware of project specific hazards and be trained in specific areas as the project warrants. For example; fall protection, confined space requirements, respirator training, lead paint hazards, hazardous material training, and exposure to medical waste (sharps). It is suggested that the expertise of the Regional Safety Officers or Olympia Service Center Safety Office be utilized as appropriate.

Additional information, such as safety regulations and Department of Labor and Industry (L&I) contacts, are available on the Internet at http://www.wa.gov/lti/. Keep in mind that many WSDOT employees are not trained to interpret and apply safety regulations, however, employees need to have a reasonable understanding of what hazards may be encountered on a project. Many, but not all, of the requirements are listed under Chapter 296-155 WAC, “SAFETY STANDARDS FOR CONSTRUCTION WORK” under the various “Parts A through V”.

State L&I offers consultation service (advise is given) and enforcement (assessment of a violation would result in a citation being issued). A listing of phone numbers for the various L&I field offices is as follows:

- **REGION 1 Offices**
  - Bellingham Field Services Location 360 647-7300
  - Everett Field Services Location 425 290-1300
  - Mount Vernon Field Services Location 360 416-3000

- **REGION 2 Offices**
  - Bellevue Field Services Location 425 990-1400
  - Seattle Field Services Location 206 281-5400
  - Tukwila Field Services Location 206 248-8240

- **REGION 3 Offices**
  - Bremerton Field Services Location 360 415-4000
  - Port Angeles Field Services Location 360 417-2700
  - Tacoma Field Services Location 253 596-3800

- **REGION 4 Offices**
  - Aberdeen Field Services Location 360 533-8200
  - Longview Field Services Location 360 575-6900
  - Tumwater Field Services Location 360 902-5799
  - Vancouver Field Services Location 360 896-2300

- **REGION 5 Offices**
  - East Wenatchee Field Services Location 509 886-6500
  - Kennewick Field Services Location 509 735-0100
  - Moses Lake Field Services Location 509 764-6900
  - Okanogan Field Services Location 509 826-7345
  - Walla Walla Field Services Location 509 527-4437
  - Yakima Field Services Location 509 454-3700

- **REGION 6 Offices**
  - Colville Field Services Location 509 684-7417
  - Pullman Field Services Location 509 334-5296
  - Spokane Field Services Location 509 324-2600

1-2.2I(5) Pedestrian Safety

When the work area encroaches upon a sidewalk, crosswalk, or other areas that are near an area utilized by pedestrians or bicyclists, special consideration should be given to their accommodation and safety. Pedestrians are more susceptible to personal injury in work areas than are motorists. Visibility and recognition of hazards is an important requirement for the safety of pedestrians and bicyclists.

Protective barricades, fencing, handrails, and bridges, together with warning and guidance devices, should be used so that pathways for pedestrians, bicyclists, equestrians, and other non-motorists are safe and well defined. Where walks are closed by construction or maintenance, an alternate walkway should be provided where feasible. Where it is necessary to divert pedestrians into the parking lane of a street, barricades and delineation should be provided to separate the pedestrian walkway from the adjacent traffic lane. Pedestrians should not be diverted into a portion of the street used by vehicular traffic. At locations where adjacent alternate walkways cannot be provided, pedestrians can be diverted across the street by placing appropriate signs at the construction limits and at the nearest crosswalk or intersection. When hazardous work conditions exist overhead, it may be necessary to install a fixed pedestrian walkway of the fence or canopy type to protect and control pedestrians. In such cases, wood and chain link fencing can be used with warning lights and illumination to warn and guide both pedestrians and motorists. These accommodations for pedestrians and bicycles should be included in Traffic Control Plans.

Fences around a construction area are often necessary and may be a requirement of the local jurisdiction building code. They are often constructed in conjunction with a special pedestrian walkway or when there are deep excavations or when pedestrian access to the job site is not desirable. Installation of such fencing must take into account relocation of existing control devices and facilities such as traffic signals, pedestrian signals, traffic signs, and parking meters. The use of chain link fencing which can be seen through may be needed at intersections to provide adequate sight distance.
Relocating a walkway without unreasonable inconvenience to pedestrians, residents, or commercial interest, is the safest practice of all. Remember, however, that pedestrians like to “see what’s going on”. Simply denying them access does not, of itself, prevent their encroachment onto the worksite. Sometimes it is advisable to design and construct a pedestrian observation area for this purpose.

1-2.2J Responsibility for Environmental Considerations

During the precontract period, the Project Engineer should obtain copies of the final Environmental Impact Statement and any special environmental studies related to the project. It is important that all key personnel become familiar with the environmental decisions considered during the design process. The contract documents should include necessary provisions for protection of the environment, including requirements that the Contractor secure permits from and abide by regulations of appropriate Federal, State, and local agencies. Any changes in contract work that may become necessary must also be reviewed to ensure conformance with the original intent, requirements, and commitments established during the environmental design of the project.

1-2.2K Responsibility for Posting Required FHWA and State Labor and Industries Job Site Posters

A combination of both State and Federal laws require that on all WSDOT administered contracts some or all of the posters listed below are to be posted at the place of employment such that all employees have ready and free access to inspect their contents. The Project Engineer must ensure the Contractor complies with these requirements.

- FHWA 1495 and 1495A — Wage Rate Information
- FHWA 1022 — Fraud Notice Poster
- OFCCP-1420 — Equal Employment Opportunity is the Law
- WISHA P416-081-000 — Job Safety and Health Protection
- P242-191-000 — Notice to Employees (L&I)
- F700-074-000 — Your Rights as a Worker
- EMS 9874 — Notice to Employees (Emp. Security)
- Copy of approved Statement of Intent to Pay Prevailing Wages
- Copy of prevailing wage rates from the contract provisions

If Federal funds are involved, all of these posters are required. If only State funds are involved, the first three do not apply. After contract execution and before work begins, the Contractor should be given a package containing the appropriate required job site posters. This package should also be accompanied by either a written or verbal explanation of the contents and include notification that the Contractor, each subcontractor, and each lower-tier subcontractor will have to post a copy of the State L&I approved Statement of Intent to Pay Prevailing wages. This action shall be specifically noted in the project records.

1-2.2L Responsibilities When Working on Tribal Lands

Indian nations have the political distinction of being sovereign. This is different from being designated as having protected group status based on racial classifications. Being sovereign, tribes have the ability to create and enforce tribal ordinances such as Tribal Employment Rights Ordinances (TERO). These are legal requirements pertaining to work within the boundaries of the reservation which are enforced by the respective tribes. When a contract includes work on a reservation, the project should include a general special provision “Indian Preference and Tribal Ordinances” that alerts the contractor to the possibility that TERO requirements may apply and provides a contact person for the tribe. The provision also reminds the contractor to bid any costs associated with TERO compliance into associated items of work. TERO requirements may take a variety of forms, some of which are listed in the noted provision. The provision also notes that complying with TERO requirements shall not be a violation of the contract equal employment opportunity requirements. The end result is that the contractor is expected to comply with TERO requirements as they would any other legal obligations. The underlying intent is to reduce Indian unemployment and most tribes are willing to work with contractors to best meet this goal. We want to avoid creating any contractual requirements that interfere with their ability to do so. Our role is to assist in communication but not become involved in determining or paying the tax.

1-2.3 Construction Traffic Control

1-2.3A Public Convenience and Safety

Under the many special conditions encountered where traffic must be moved through or around construction operations, serious problems of traffic control can occur. Most conditions are temporary and are, therefore, dangerous and difficult to deal with because they are unexpected and not in accordance with the normal pattern of highway traffic. Section 1-07.23(1) of the Standard Specifications requires the Contractor to conduct all operations with the least possible obstruction and inconvenience to the public and to provide adequate
safeguards, safety devices, protective equipment, and any other needed actions to protect the life, health, safety, and property of the public. The responsibility to comply with these requirements is the Contractor’s. It is the Project Engineer’s responsibility to ensure that the Contractor complies.

1-2.3B Public Information and Customer Focus

Most drivers still have the expectation of proceeding to their destination with little or no delay even though traffic conditions on many of our highways are deteriorating, primarily due to increased traffic volume. This increased volume may create congestion, delays, accidents and aggressive driving during normal daily operation. Highway construction will usually require a more restricted roadway to accommodate work zones and can further reduce traffic mobility and safety. Even some of our lower volume rural highways can present a challenge due to factors such as drivers not expecting construction work and seasonal/recreational traffic increases. Construction and user delays present significant costs in addition to costs associated with crashes and worker safety. These delays and costs can be minimized by implementing a traffic control strategy based on traffic conditions and construction requirements, and which includes public information and customer focus considerations.

Our goal on every highway construction project should be to provide the best overall balance of work zone safety and traffic mobility while constructing quality highway projects. Much of our effort is directed at engineering responses to safety and mobility issues and is generally included in the contract requirements. Recent customer focused highway construction studies have shown that accurate and timely project information is a valuable element in an overall traffic control strategy. Advance planning and coordination between the project engineer and contractor is necessary to ensure that there is an opportunity to provide public information for all phases of the project that impact traffic. Proper use of public information and customer focused techniques will provide safety and mobility benefits that would not otherwise be gained, as listed below:

- Alert drivers to potential delays by advance notice through project signing and the news media that would allow drivers to take alternate routes, adjust scheduled trips and have better awareness of traffic impacts and how to avoid them.

- Provide benefits to the Contractor from reduced traffic volume and better driver awareness through fewer crashes, less material delivery delay, better worker safety, fewer complaints and overall public acceptance of the project.

- Achieve better driver acceptance, reduced aggressive driving and improved work zone credibility by minimizing delays and providing accurate and timely information.

- Consider innovative construction techniques and shorter term intense work stages with more severe traffic restrictions, such as weekend closures, if possible.

- Closely monitor traffic conditions when traffic is restricted to determine the need for any traffic control or work hour adjustments that would improve traffic flow. Specified working hours and the accompanying traffic restrictions are critical elements of the project traffic control strategy and should not be adjusted without proper traffic analysis.

- Maintain ongoing communication during the life of the project with local law enforcement, emergency services, local agencies, transit groups, affected local businesses, etc.

- Continue use of innovative devices such as portable, changeable message signs, project information signs with information phone number and highway advisory radio systems.

The Regional Construction Manager, Traffic Engineer, and Public Information Officer should be involved in the project traffic control strategy and may be able to offer assistance.

1-2.3C Work Zone Traffic Control

1-2.3C(1) General

The primary function of work zone traffic control is to move vehicles and pedestrians safely through or around work zones while protecting on-site workers and accommodating the Contractor’s construction operations.

The “General” requirements for traffic control (Section 110.1 of the Standard Specifications) address the responsibility to provide adequate traffic control measures at work zones as follows:

- No work shall be done until all necessary signs and traffic control devices are in place and/or conflicting and confusing signs are covered.

- If the Contractor does not provide necessary traffic control, WSDOT may do it and deduct the cost from the Contractor’s payments.

- The Contractor is responsible regardless of whether or not WSDOT orders, furnishes, or pays for necessary traffic control.
It is important for the Project Engineer to ensure that all necessary signs and other traffic control devices are properly placed at all times so that the traveling public is made aware of all deviations from the normal traffic conditions and is furnished adequate direction and guidance to permit safe travel through the construction area.

1-2.3C(2) Traffic Control Management

“Traffic Control Management” (Section 1-10.2 of the Standard Specifications) addresses the requirements and duties of the Contractor’s designated Traffic Control Manager (TCM) and Traffic Control Supervisor (TCS). The Contractor has the responsibility for managing traffic control and providing safe traffic control measures that are appropriate for the type of work and consistent with the requirements of the contract plans and specifications. The Contractor’s traffic control work is a contract item. Just like all other contract items, it must be inspected for adequacy and conformance with the contract. Once it is performed and inspected, it must be paid for. Actions taken by the TCM have a direct impact on the Contractor’s and subcontracts’ work operations. The process for coordinating and approving those actions must be well defined and consistent with the contract requirements.

The TCM and TCS work together with the Project Engineer and WSDOT’s traffic control contact person to address traffic control issues as the work progresses. Planning and coordination of the Contractor’s work efforts with appropriate traffic control measures are the primary responsibilities of the TCM. It is also the responsibility of the TCM to ensure that any Contractor proposed Traffic Control Plans (TCPs) needed to implement the Contractor’s work operations are approved in advance and the necessary resources to implement the TCP are available. The TCS ensures that the traffic control measures shown on the approved TCPs are properly implemented, operating, and documented on the project. The Contractor’s TCS may not be required full time on the project, but is required to perform all the duties required by the specifications. When the Contractor is working multiple shifts, it may be necessary to have more than one person assigned as a TCS.

In addition to the Contractor’s responsibility to designate a Traffic Control Supervisor, WSDOT may designate a DOT employee who is qualified, but not necessarily certified, to serve as the State’s traffic control contact. It is intended to have qualified, trained representatives from both the Contractor and WSDOT work together to achieve safe traffic control operations on the project.

Among the duties of the Project Engineer in the area of Traffic Control are the following:

- **Communication:** About the planned work, traffic control needed and adjustments to the approved Traffic Control Plan. During the work, to stay aware of changes, events and issues.
- **Monitoring:** The activities of the Contractor TCS and traffic control workers. The status of signs and control devices. Conformance with specifications and requirements.
- **Documentation:** Obtaining and reviewing daily reports. Handling Traffic Control Plans and their approvals.
- **Coordination:** With adjacent projects, with DOT Traffic offices, notices to the media.

The Project Engineer may assign these duties in any manner. It would make sense to include the State’s TCS in these activities.

When reference is made to the “Traffic Control Supervisor (TCS) in this manual or in the Standard Specifications, it shall mean the Contractor’s Traffic Control Supervisor unless stated otherwise.

1-2.3C(3) One-Way Piloted Traffic Control Through Construction Zones

The major points to note in Section 1-10.3(6) of the Standard Specifications are:

- The provision does not limit one-way piloting to treated bases, surface treatments, and pavements. Piloting can be used in other operations, such as grading, when appropriate;
- The “pilot car control area” is any one area or section of the project controlled by pilot car operations. There can be more than one area or section and there can be more than one pilot car and driver in each area or section, however, each “pilot car control area” will be addressed separately, accumulating the total hourly payment on the contract;
- When the contract does not stipulate a pilot car operation (i.e., bid proposal does not include such an item,) a new item can be established by change order if the Engineer deems that method of traffic control to be most appropriate; and
- Regardless of any flagging or piloting services furnished by WSDOT, responsibility for protection of the work and traffic remains with the Contractor.
- A careful appraisal of the pilot car operation may indicate the need for adjustments in work zone length or other features that may be contributing to congestion. The Contractor’s work operation should generally be restricted to one side of the roadway and not interrupt the alternating traffic movement.
1-2.3C(4) Construction and Maintenance of Detours

Construction zone detours will normally be detailed in the plans. When detours not shown in the plans are required, the design will be done by the construction office under the direction of the Project Engineer and requirements of the MUTCD. If the detour is a full-fledged roadway, design and traffic reviewers should check the design. Short-term minor detours may be installed and operated without formal review, but the Project Engineer must be satisfied that the facility is suitable and safe for traffic use.

Existing pavement markings on asphalt pavement should never be merely blacked out with oil or paint. Rather, the striped and adjacent areas should be sandblasted or ground in a pattern different from the original marking until the marking is no longer visible. This change in pattern minimizes the possibility that the original marking will still be visible to drivers, especially at night or in rainy weather when covered over stripes have a tendency to shine in contrast to the pavement. Temporary pavement marking tape, either for temporary lane marking or masking of existing markings may offer another option.

Barricades and barriers are inherently fixed object hazards. Therefore, they should not be used unless the combined hazard for the motorist and the workers of operating without barriers is greater than the hazard of striking the barriers themselves. They should not be used as primary delineation to guide traffic. Delineation devices must be maintained, and kept clean. When delineators become covered with grime or are damaged, they become ineffective. The condition and positioning of these devices should be checked daily.

1-2.3C(5) Road/Ramp Closures

When it is necessary to close a road, street, or ramp, the Project Engineer shall submit a request that includes the appropriate closure/detour plan to the Region Traffic Engineer in advance of the need. Per RCW 47.48.010, the Regional Administrator may close a road, street, or ramp.

With proper planning and implementation, road/ramp closures can be an effective and safe method of traffic control. As required by RCW, notice of the closure shall be published in one issue of a newspaper in the area in which the closure is to take place. Signs indicating dates and times of the closure shall be placed at each end of the section to be closed on or before publishing the notice in the newspaper. Publishing the notice and placing of the signs shall be a minimum of three days in advance of the closure. Advance notice using local radio, portable changeable message signs or HAR may be effective in diverting traffic from the closed or impacted locations.

Coordinate with the Region Public Information Officer for assistance with public notification.

In cases of emergency, or closures of 12 hours or less, the road, street, or ramp may be closed without prior notice to the public. If possible, a notice should be posted one working day in advance of the closure.

1-2.3C(6) Traffic Control Plans

“Traffic Control Plans” (Section 1-10.2(2) of the Standard Specifications) addresses the requirements of Traffic Control Plans (TCP). The Contractor, working in coordination with the TCM, must adopt the TCPs appearing in the contract or propose modified TCPs to be used for the project. The Contractor must submit proposed modifications to TCP’s at least ten calendar days in advance of the time the signs and other traffic control devices will be required. Approval of these plans must be obtained before the work can begin.

Minor modifications to the TCP may be made by the Traffic Control Supervisor to accommodate site conditions. Modifications or adjustments to the plan must maintain the original intent of the plan. When there is a change in the intent and/or substantial revisions are needed, a revised TCP shall be submitted for approval through the TCM to the Project Engineer. The Regional Traffic Office should be consulted when this situation occurs.

Traffic Plans should not only address all work zones and standard devices and signs but should also address issues such as:

- conflicting or temporary pavement markings
- maintaining existing operational signs and covering conflicting signs
- staging requirements
- temporary vertical or lateral clearance restrictions
- temporary work zone illumination
- consistency with any work hour restrictions
- position of positive barriers for traffic hazards or worker protection
- vertical drop-offs
- work zone access
- intersection or access control (traffic signals, road approaches)
- pedestrians and bicycles

If the Contractor’s method of operation or the work area conditions require other than minor modification of the specific TCP appearing in the contract or any of the TCP’s previously designated and adopted by the Contractor, the Contractor shall submit through the TCM a proposed modification of the TCP for approval. If the Contractor’s
proposed modifications comply with the MUTCD requirements and is consistent with contract requirements as well as State and Region policy, the Project Engineer may approve these proposed modifications. If the Contractor’s proposed modifications do not comply with the MUTCD requirements, the Project Engineer should consult with the Region Traffic Engineer.

If there is any doubt that the proposed TCP complies with the MUTCD or provides for the safe movement of traffic, the Project Engineer shall consult with the Region Traffic Engineer or the Region Construction Manager.

1-2.3C(7) Conformance to Established Standards

Conformance to Established Standards (Section 1-10.2(3)) addresses the requirements for standards and condition of flagging, signs, and all other traffic control devices. In addition to standards established in the latest adopted edition of the “Manual on Uniform Traffic Control Devices” (MUTCD) and/or as specified in the contract plans, the “National Cooperative Highway Research Project, 350” (NCHRP 350) has developed requirements for safety of four categories of traffic control devices.

Category 1 devices consist of small lightweight devices that generally do not present a hazard. Typical Category 1 devices are cones, tubular markers, and plastic drums with no attachments. Conformance to NCHRP 350 for Category 1 is described in Section 1-10.2(3) and applies only to those devices purchased by the Contractor after January 1, 2000. The Contractor is required to keep the manufacturer’s certification document on file and available for inspection if needed. Inspection of certification documents by WSDOT is not routinely required but should be considered if operational or safety issues are observed.

Category 2 contains devices that are more hazardous due to their rigid construction, such as barricades, portable sign stands, intrusion alarms, and drums with lights. Implementation of requirements for Category 2 devices is presently planned for Fall of 2000.

Category 3 devices are fixed or substantial in mass and could cause significant damage to a vehicle or its occupants. Devices such as barriers, fixed sign supports, and TMAs are included in this category. WSDOT approved devices in this category currently meet NCHRP 350 standards.

Category 4 devices are typically trailer or truck mounted and could cause significant damage if impacted by an errant vehicle. Devices such as arrow boards, PCMS, portable signals, and portable lighting units are included in this category. Implementation of requirements for Category 4 devices is not presently scheduled.

1-2.3C(8) Construction Signs

Construction Signs (Section 1-10.3(3) of the Standard Specifications) divides construction signs into two categories, Class A and Class B, and lists the work required for the Contractor. A specific pay item is provided for the Class A signs. The only payment for Class B signs is for the labor utilized for daily set up and removal.

The Project Engineer will arrange to furnish all necessary standard signs and see that they are erected and maintained in proper condition during the period of need. Before providing the Contractor with State furnished signs, the Project Engineer should reject any signs which are unacceptable as determined by the ATSSA Quality Standards for Work Zone Traffic Control Devices. Inform the Regional Stores Manager of the unacceptable signs upon rejection in order to prompt proper refacing or disposal of these signs. As soon as the need for any sign is ended, the Project Engineer can require the Contractor to remove the sign and return it to WSDOT in good condition. All signs lost, damaged, or destroyed by the Contractor shall be replaced in kind or their value may be deducted from payments due or coming due the Contractor. Some contracts specify Contractor provided signs, where the Contractor is required to furnish the signs as well as perform the installation, placement and removal.

At no time should signs be left in traffic control position during periods when they are not necessary to traffic safety. Indiscriminate use of traffic control signs soon destroys public confidence and respect for the signs. Unnecessary traffic restriction and inconvenience tends to reduce the effectiveness of all signing and causes difficulty in enforcement by authorities. The Project Engineer should ensure that signs are removed or completely covered with metal or plywood during the hours they are not needed, either before or after working hours and on nonworking holidays or nonworking weekends.

Signs needed for moving work zones should be relocated as the work unit moves so that the length of the restriction area is kept to the minimum required. A warning sign too far in advance of the work area has little value. It is also necessary to inform the motorists when they have left the restriction area. If the end of this restriction area is the end of the project, the Class “A” “END ROAD WORK” sign should be sufficient. If the restriction ends within the project limit, a reverse taper of traffic cones ending the lane or shoulder closure or a portable “END ROAD WORK” sign is adequate. If traffic congestion extends past the first advance warning sign, the sign should be moved back or another sign installed to provide adequate warning. Turning signs away from oncoming traffic is not adequate since traffic approaching from other directions may be exposed to the sign.
Signing for nighttime traffic is more difficult than that required for daylight hours. All signs used during the hours of darkness shall be reflectorized. A review of the project signing should be made and recorded during the hours of darkness.

Signs and other traffic control devices should be shown on the contract TCP’s and should be installed with adjustments for work zone and traffic conditions. If typical TCPs are used rather than site specific TCPs, additional signs or devices may be needed to address the actual work zone conditions. The Contractor (TCM and TCS) and WSDOT (TCS) should ensure proper use and placement of signs and devices. For situations not addressed by the TCPs, the Project Engineer will determine who is responsible for preparing a revised TCP. Refer to the Work Zone Traffic Control Guidelines Book, MUTCD, or seek assistance from the Region Traffic Engineer for appropriate TCP revisions. A modified or new TCP may be needed if adjustments to signs and devices do not adequately address existing hazards or resolve observed traffic problems or accidents.

1.2.3C(9) Flaggers, Spotters and Traffic Control Labor

- FLAGGERS

Typically, flaggers have the highest exposure to traffic hazards and are more frequently injured or killed than other workers. Flaggers should only be used when all other forms of traffic control are inadequate to control traffic. When flaggers are used, flagging stations must be shown on the TCP along with the required warning signs and devices. Flagger stations should be protected with a positive barrier, if possible. The flagger should also have in mind an “escape plan” to avoid errant vehicles. It is not recommended to use flaggers at locations, such as freeways, where their primary function of warning or directing traffic is ineffective or not intended. Use of flaggers to exclusively display the “SLOW” message is also not recommended.

Additional guidance on the use of flaggers is located in the “Traffic Manual”, “Standard Specifications” and the “Work Zone Traffic Control Guidelines Book.”

All flaggers working on WSDOT construction projects must have a valid State of Washington flagging card or a flagging card issued by the states of Oregon or Idaho.

- SPOTTERS

Flaggers used as spotters to protect an exposed work crew may be considered appropriate if other worker safety measures are not feasible. Before the Project Engineer approves the use of a spotter, careful evaluation of the hazards involved should indicate that the spotter can actually provide a safety benefit to the work crew without undue risk to the spotter.

TRAFFIC CONTROL LABOR

Workers involved in traffic control labor are required to wear high visibility clothing as specified in Section 1-07.8 of the Standard Specifications. For some projects, labor in addition to the assigned Flaggers is needed to install and remove traffic control in an efficient manner. The item, “Traffic Control Labor” will be measured and paid by the hour for the actual number hours performing work as described in Section 1-10.3(1) of the Standard Specifications. No additional hours will be allowed for relief flaggers when the regular flagger is on break except that when a TCS acts as a relief flagger for approximately 15 minutes or less, both shall be paid their respective rate through the break period. No adjustment in the hourly bid amount will be paid for overtime work.

Portions of an hour will be rounded up to a whole hour.

1.2.3C(10) WSP Traffic Control Assistance

WSDOT has an agreement, GC9131, with the Washington State Patrol (WSP) for that agency to provide troopers and vehicles to help with traffic control on construction projects. WSP traffic control assistance is considered an enhancement to the required work zone traffic control and should be reserved for those work zones that have unusual hazards or a high degree of worker exposure to traffic which cannot be addressed by traditional traffic control means. In areas where GC9131 is not used, the WSP are usually helpful during their normal course of business.

The Project Engineer should ensure that good communication is maintained with WSP troopers assigned to the project and that the appropriate traffic control strategy is applied. On each shift of WSP traffic control assistance, Form 421-045, WSP Field Check List, shall be filled out. WSDOT will fill out the top portion of the form and give it to the WSP trooper on the project to complete. At the end of the officer’s shift, the completed form shall be returned to WSDOT.

The Contractor shall not direct the activities of the WSP.

Instructions for WSP assistance are in Instructional Letter “IL 4008.00” and the Traffic Manual M 51-02.

1.2.3D Speed Reductions

If speed reductions are considered, the Project Engineer shall consult with the Regional Traffic Engineer in advance of the need. Per RCW 47.48.010 and Directive D55-20, the Regional Administrator may post advisory speeds and/or establish a reduced regulatory speed limit. Speed reductions must be determined in accordance with standard traffic engineering practice by the Regional Traffic Engineer.
• ADVISORY SPEED

Within a construction area, there may be short sections of roadway, such as curves or rough roadway, which may not be safely negotiated at the established speed limit. For these areas, an advisory speed sign should be used in conjunction with proper warning signs. The speed shown on the sign is not intended as an enforceable limit but should show, in multiples of 5 miles per hour, a safe speed for normal conditions of weather and lighting. Advisory speed signs should only be used in conjunction with appropriate warning signs.

• REGULATORY SPEED LIMITS

Traffic controls that are designed and implemented for site specific work zone conditions, including actual traffic speed, are generally more effective than a speed limit reduction. Speed limit reductions should be considered at work zones where conditions reduce operational safety to a point where other traffic control measures are not effective.

Directive D55-20 describes the appropriate conditions and requirements to implement advisory speeds and reduced regulatory speed limits.

1-2.3E Records of Construction Signing, Accidents, and Surveillance

Due to the increased damages being awarded by the courts for improper signing, it has become more important that detailed records of signing and delineation be continuously maintained on every project on sections of highway within the construction limits under traffic. The following are recommended procedures and methods of recording the signing on the project:

• Use extensive photographic or videotape records.

• The Contractor’s signing must adhere to the TCP, and the records must confirm that the sign installation is checked against that plan. The Regional Traffic Engineer should only be involved in significant changes to TCPs and need not be involved in minor adjustments.

• Documentation of the Contractor’s activity for traffic control, including signing, should be completed by the Contractor’s Traffic Control Supervisor (TCS). In accordance with the Standard Specifications, the TCS must maintain a daily project traffic control diary, DOT Forms 421-040A, “Contractor’s Daily Report of Traffic Control- Summary”, and 421-040B, “Contractor’s Daily Report of Traffic Control Traffic Control Log,” are provided to the Contractor for this purpose.

The Summary report will typically contain a brief description of the daily activities of the TCS with expanded details of any important happening such as accidents, meetings, decisions, or rapidly deteriorating conditions of traffic or weather. The Summary report is usually sufficient to verify the location and status of Class A signs once they are installed.

• The Traffic Control Log report is used to specifically identify all details of each Class B work zone setup. This includes identification of specific signs used, location of the signs, location of flaggers, location of the work zone, the time it was set up, and the time it was removed. Additional information includes cone layout, if used, comments about piloted traffic, and comments about the relationship of the setup to an approved traffic control plan.

The Project Engineer should make an effort to become aware of any accident that occurs within the project area. Where possible, thorough records should be maintained about the accident, including site conditions and the status of signing and other traffic control measures. In case of an incident investigated by the WSP, do not move signs until released to do so by the trooper. When inspections are made of the work zone, either by project or region personnel, the documentation of these inspections should be maintained in the project files. The 1997 report on Highway Work Zone Reviews contains recommendations for review procedures and reporting format. The report emphasizes the following points:

• Each Region should designate an office or individual responsible for oversight of traffic control issues.

• Regions should conduct regular reviews of traffic control with management involvement and document results.

• Expand discussion of work zone traffic control within the Region.

• Regions will take the lead in scheduling statewide annual traffic control reviews.

• State Traffic Office will prepare an annual summary of the statewide traffic control reviews.

1-2.3F Resources for Traffic Control and Work Zone Safety

The following information may provide additional guidance and more specific detail. Also, this list includes the staff, reference documents and manuals mentioned throughout Section 1-2.3 of this manual.

• Work Zone Traffic Control Guidelines, M 54-44

• Traffic Manual, Chapter 5, M 51-02
Administration

- MUTCD Part VI
- Work Zone Safety Task Force Recommendations
- Quality Standards for Work Zone Traffic Control Devices (ATSSA)
- Work Zone Traffic Control Supervisor's Notebook
- Highway Work Zone Reviews, 1997 (Work Zone Safety Task Force)
- Planning and Scheduling Work Zone Traffic Control (FHWA-IP-81-6)
- Directive D 55-20, Reduced Speed in Maintenance and Construction Zones
- Instructional Letter IL 4008.00, “WSP Traffic Control Assistance in Work Zones”
- Traffic Control Supervisor Evaluation - Final Report
- Region Construction or Traffic Office and Public Information Officer (Traffic Engineer or Work Zone Traffic Control Specialist)
- State Traffic Office (Traffic Specialist or Traffic Control Engineer)

1-2.4 Application of Contract Provisions, Plans, and Specifications

1-2.4A Construction Contracts Information System (CCIS)

The CCIS system is a mainframe application designed to track contract information and generate reports for all WSDOT administered construction projects. The initial setup of contract information into CCIS is done automatically by using information in the CAPS system. However, after the initial setup, the project offices enter the majority of the contract information into the CCIS system. The data entered is then maintained and stored on the mainframe.

CCIS generates the Weekly Statement of Working Days and tracks Change Orders. The system creates the forms for these reports so a preprinted form is not needed. Following is a list of data that needs to be entered into the CCIS database over the life of the project:

**Contract Information**
- Region Administering contract
- Region the contract is located in
- Regional Administrator
- Operations Engineer
- Project Engineer

**Begin and End mile post**
**County**
**Prime Contractor's local address, if applicable**
**Prime Contractor contact person**
**Prime Contractor D/M/WBE type if applicable**
**Prime Contractor ethnic code if applicable**
**Date of Statement of Intent to Pay Wages—Prime**
**Date of Contractor and Subcontractor/Agent Cert. for F.A. Projects**
**Date of Affidavit of Wages Paid**
**Date of Preconstruction Meeting Minutes**
**Date time started**
**Date work started**
**Date Orig. Progress Schedule approved**
**Date of Substantial Completion**
**Date of Physical Completion**
**Final Estimate to Contractor**
**Final Estimate to Headquarters (filled in by Region office)**
**Contract time**
**Request to Sublet**
**Training Program**
**Apprentice/Trainee Approval Request**

**Change Orders**
- Verbal Approval
- Date sent to Contractor
- Date received from Contractor
- Is there Surety consent
- Date of Surety consent
- Dates of approval and execution

**Weekly Statement of Working Days**

Refer to the CCIS Manual for details on using the system.
1-2.4B Order Lists

Contract language requiring an order list can be found in Section 6-05.3(2), which addresses piling other than cast in place concrete and steel piles, and in Section 8-21.3(1), which addresses the determination of lengths of wood and steel sign posts. In other types of work, such as drainage, guardrail, etc., the actual layout will often result in quantities and lengths that vary from the plan estimates. A project engineer could choose to communicate this information in several ways, one of which could be the development of a formal order list. If an order list is used, extra care should be taken to ensure its accuracy. An alternate method of notice could also be a walk through with the contractor representative after staking.

1-2.4C Changes in the Work

- INTRODUCTION

WSDOT reserves the right, under Standard Specification 1-04.4, to make changes to the work, work methods, working days, or quantities, as necessary to satisfactorily complete the project as originally intended.

Adding work beyond the original scope is, in essence, entering into a contract to perform work without the benefit of a competitive bid. There is a statutory (RCW 47.28.050) exception from the competitive bid requirement for work up to a value of $7,500. If the value of the work is in excess of $7,500 it is necessary to go through the competitive bidding process.

1-2.4C(1) Types of Changes

There are several categories of changes that may occur during the course of the work. A change may warrant additional payment to the contractor or a credit for the contracting agency. A change may also warrant an increase or decrease in the working days. Every situation is different. The Standard Specifications are very specific on what additional costs are eligible for adjustment. The balance of this discussion of types of changes is intended to help describe and explain the various categories of changes.

(1) VARIATIONS FROM ORIGINAL BID QUANTITIES

Contracts are set up with estimated quantities. Contractors provide unit prices and actual measured quantities are paid using those unit prices. What happens when the actual measured quantity varies from the estimated proposal quantity? The WSDOT Standard Specifications (Section 1-04.6) require that variations of less than 25% be performed without changes in the bid price, but that variations greater than 25% may qualify for a renegotiation of the contract bid. This distribution of estimating risk is a policy of WSDOT and is also a Federal requirement for any project with Federal funds.

Variations may occur because field conditions cause a different quantity for the planned work than was envisioned during the estimating. Other variations may occur when work is added or deleted by change order and original contract unit items are included as the method of pricing the change order. Finally, quantity variations occur when work is added, deleted or revised without a formal change order (constructive change) and units with unit prices are the only measure of the revision.

As discussed below, quantities included in formal change orders are excluded from consideration of quantity variations. The project engineer who allows constructive changes without formal documentation may find an additional negotiation waiting when final adjusted quantities are calculated and compared with the original proposal quantity.

A unit bid price consists of four different parts. First, and most obvious, are the costs of labor, equipment, materials and services needed to accomplish the work. These are the “direct costs” involved and they vary directly with the amount of work. Second are the variable overhead costs, such as field supervision, field support items (phones, computer rental, payroll clerks, sancans, etc) whose amounts will vary along with the direct costs. Third, and more difficult to assess, are unavoidable, distributed, fixed overhead costs. These are typically long term and exist whether the quantity varies or not. They include things like home office costs, field trailer setup, long term equipment rentals and other fixed costs. These are typically distributed to the project by allocating them to the plan quantity. Fourth, and finally, the unit price will include some amount for profit.

III Section 1-04.6

The standard contract provision calls for the calculation of an adjusted final quantity. This is the method of revising the final measured quantity to allow for proposal item quantities included in agreed change orders. Unit prices as originally bid will be utilized if the adjusted final quantity is more than 75% of the original proposal quantity and not more than 25% greater than the original proposal quantity.

If the final adjusted quantity is outside these limits, then either party to the contract may initiate a renegotiation. If neither party does so, then unit prices will apply to the entire measured quantity of the item. Neither of these actions would be a change to the contract, as the provisions already allow a price change. A formal change order document might well be initiated to show the agreement, however, and would be the mechanism to create new prices.

If a negotiation is initiated, the provision calls for a new price for the quantity in excess of the 25% overrun or a contract price adjustment to compensate for costs and losses associated with an excessive underrun. The
renegotiated price for the overrun portion is not an equitable adjustment and this is an important distinction. The new price is based upon actual costs experienced and is completely unrelated to the old bid price. The typical discussion about “what’s different from the bid work and what number should be used to modify the bid price?” does not apply in this type of negotiation. The underrun compensation is an equitable adjustment, however, and much of the negotiation is related to the bid price and discussions of the actual work costs as opposed to the planned costs.

Other features of the provision include an exclusion of force account items and other items where an amount has been entered solely to provide a common proposal for the bidders. Consequential damages and lost profits are specifically excluded. The effect of any unbalanced allocation of overhead costs is also excluded from compensation under the provision.

Force accounts and calculated quantities are already taking actual costs into account for overruns. Because of the nature of these items, contractors are unable to allocate unavoidable fixed costs to them except as a share of the allowed markup. The contractor is aware of this provision at the time of bid and knows that this item will not be eligible for renegotiation in the case of an underrun.

Consequential damages are those which are separated from the project and which might be presented as part of a negotiation. “Because of your overrun, I was unable to start work on my other project and had to do that other work in the wintertime.” This consequence of the quantity variation is not compensable because of the wording of the provision. Similarly, the profit that the contractor might have made on some other work but for the need to perform the extra work in an overrun is also not compensable.

Unbalanced bidding might result in a significantly higher or lower price for an item than normal. It means that too much or too little of allocated overhead or other costs is assigned to the item. This is not a problem in a low bid situation when all items come in at plan quantity. The problem would arise if an unbalanced item were to be involved in an excessive underrun. This provision allows the project engineer to evaluate this possibility during an underrun negotiation (remember that the overrun pricing takes care of the problem automatically by assessing cost and ignoring the bid price.)

The last element of the provision has to do with contract time. The parties to the contract agree that any variation in quantity that does not qualify for renegotiation will be performed within the original time for completion. An overrun greater than 25% would be eligible for time if the increased quantity of work could be shown to have caused a delay in completion. On the opposite hand, an underrun of more than 25% might well qualify for a reduction in contract time.

[2] Negotiation Guidelines

(a) Adjusted Final Quantity The Standard Specification language is quite clear on this subject. Start with the final measured quantity, the number that would be included in the final estimate for the item. Review all change orders that have been approved and have been accepted by the Contractor (see Section 1-04.5 for a definition of contractor acceptance of change orders.) Identify change order increases in the item and subtract these from the final measured quantity. Identify change order decreases in the item and add these to the result of the previous subtraction. The result of these calculations is defined as the Adjusted Final Quantity.

Compare the Adjusted Final Quantity to the original proposal quantity. If the Adjusted Final Quantity is greater than 1.25 times the original proposal quantity, then the item is eligible for an overrun renegotiation. If the Adjusted Final Quantity is less than 0.75 times the original proposal quantity, then the item is eligible for negotiation of an equitable adjustment due to underrun.

(b) Renegotiation for Overruns The first analysis should be to determine, if possible, where and when the overrun took place. This is not necessarily the work done after the quantity of 1.25 times proposal was reached. In many cases, a review of the work will disclose which part of the project actually experienced the low estimate and the resulting extra quantity. This is more common in physical items that are visible and can be measured by weight or physical dimensions (Roadway Excavation, Culvert Pipe, Select Borrow, etc.) These are often detailed in the plans to the extent that actual work can be compared with the relevant portion of the proposal quantity. When actual overrun work can be identified and when records exist showing the resources utilized for that work, then those records can form the basis for the revised payment amount.

In other cases, the item is a support function, often measured by time, where the plan segments cannot be separated for analysis. This is common in Flagging, Pollution Control items, etc. To analyze these, the only choice is often to look at the actual work that occurred after the threshold was reached and price it. A third method, where records are adequate, is to evaluate the actual costs for the entire item, and apply those only to the overrun units.

Regardless of method of determining direct cost, markups will be allowed. A good place to start would be the force account percentages described in Section 1-09.6. If the contractor is providing other records for overhead and profit, these can be used, if they are reasonable. Any overhead items that are unavoidable, distributed fixed costs should be excluded. Remember that the Contractor has already been compensated for these one and a quarter times over.
The revised price will apply only to the units measured in excess of 1.25 times the original proposal quantity. The overrun units between the proposal quantity and the threshold will be paid, according to the terms of the contract, at the bid price.

(c) Equitable Adjustment for Underruns: The adjustment for an underrun is limited by the contract terms to three factors. The first of these is an adjustment for any increase or decrease in direct costs that result solely from the reduction in quantity. The most common example of this type of cost is the learning curve. “By the time my crew learned how to do this work at this site with these specifications, we were done. They should have been able to apply these skills to an additional 30, 40 or 50 percent of the plan quantity. I experienced the least efficient units and missed out on the most efficient.” In negotiation, this might be demonstrated by production rates, by inspectors’ reports or by the agreed judgment of the negotiators. If such a condition did exist, then an agreed amount for inefficiency during the learning curve could be included in the adjustment.

The second factor has to do with the nature of the work actually done, when compared with the work shown in the plans. The most common manifestation of this is “You deleted the easiest units and left me with the most difficult,” or “You added units that were much more difficult than those shown in the plan.” Compensable, if true. Logic dictates that, if all of the work shown in the plans was performed and, if no work was added except by formal change order, then this factor can have no value. The work that was performed was what was shown in the plans and was what the Contractor bid. If, on the other hand, the project engineer has allowed constructive changes without formal documentation, then this factor could well come into play.

Finally, the negotiation should include a look at reallocation of undistributed unavoidable fixed overhead costs. The contractor has allocated these to 100% of the proposal amount. The bid price is firm as long as 75% of the units are measured and paid. If the final adjusted quantity is less than 75%, then the anticipated contribution of the units not performed (up to 75%) can be identified, negotiated and included in the equitable adjustment.

One final aspect of underruns: There is a reality that, if more units were paid up to the 75% threshold, then there would be no eligibility for negotiation. Because of this, there is a limit to the equitable adjustment. The total paid for the item, including units actually performed and the equitable adjustment cannot exceed 75% of the original proposal quantity, multiplied by the unit bid price.

[II] DELETION OF ITEMS

[II] AUTHORITY TO DELETE: As provided in Sections 1-04.4 and 1-08.10(2) of the Standard Specifications, WSDOT may cancel all or portions of work included in a contract. When deleting work that is condition of award (COA), be sure to also delete that work from the COA requirements by completing the condition of award portion of the change order in CCIS. An adjustment in working days may also be appropriate.

[II] PAYMENT FOR REMAINING WORK: There are some limitations to payment that should be noted under Standard Specification 1-09.5. When work is decreased or deleted by the contracting agency, payment will only be for the costs actually incurred for partially completed work. No profit will be allowed for work that was not completed. Consequential damages are also not allowed. Consequential damages may include such things as: loss of credit, loss of bonding capacity, loss of other jobs, loss of business reputation, loss of job opportunities, etc. In the case a portion of a lump sum item or partially completed unit items, the value of this work will need to be determined. It may also be necessary to negotiate a price adjustment for the work that was performed and paid using a contract unit price if there is a material difference in the nature of the accomplished work when compared to the nature of the overall planned work. Under certain circumstances when the contractor says “you eliminated all the easy work and left the difficult,” there may be entitlement to an adjustment.

In the event that the deletion impacts the critical path for the project, an adjustment in working days may also be appropriate.

[II] PAYMENT FOR MATERIALS: When work is deleted from the project and the contractor has already ordered acceptable materials for such work, Section 1-09.5 of the Standard Specifications controls.

(a) contractor restocks: The first and best method for disposing of the materials is to request that the contractor attempt to return the materials to the supplier at cost or subject to a reasonable restocking charge. If the materials are restocked then, in accordance with Section 1-09 of the Standard Specifications, the contractor’s actual costs incurred in handling the materials may be paid.

(b) contractor purchases: If WSDOT cannot utilize the materials, the contractor may elect to retain them for other work. Once again, in accordance with Section 1-09 of the Standard Specifications, the contractor’s actual costs incurred to handle the materials may be paid.

(c) state purchases and disposes: As a last resort, if the materials can not be disposed of at a reasonable cost to WSDOT, the Department may choose to purchase the materials from the contractor. There are some limitations...
that come with the use of federal funds that may require that the materials be purchased with state funds depending on the situation. The State construction office may be contacted for advice. If possible, such materials may be provided to a future contractor (work with Design) or to Maintenance (work with the Regional Maintenance Office). If the materials cannot be used, they shall be disposed of as described in the manual for Disposal of Personal Property (M 72-91). Once again, in accordance with Section 1-09 of the Standard Specifications, the contractor’s actual costs incurred in handling the materials may be paid.

*** III. CONTRACT MODIFICATIONS***

Changes in Materials, Work Method, or Work Sequence may or may not be a change to the contract. The determining factor is if the change is a modification of a specific contract requirement. If the contract includes language such as “recommends”, “suggested”, or “approved equal” associated with the item or allows the engineer to approve changes, then a change order is probably not required. In essence, this would not be a violation of the contract and therefore, does not require a change to the contract. A common situation is when the contractor proposes a change to a submitted manufacturer’s recommendation, drawing or plan such as a falsework drawing or erection plan. Changes to those drawings/plans may be made by the same authority that approved them the first time. Once again, it is not a change to the contract.

***IV. COST REDUCTION INCENTIVE PROPOSAL (CRIP)***

It is the policy of WSDOT to encourage our contractors to be innovative in planning and performing the work when a cost savings can be realized. When a contractor identifies such a savings and provides a significant portion of the efforts needed to develop the proposal, then WSDOT will share the resulting savings with the contractor. This policy is carried out through change orders containing Cost Reduction Incentive Payments. The Project Engineer should encourage CRIPs and seriously consider the mutual benefits of these proposals brought forth by the contractor as a partner in the contract.

1. **IS IT A CHANGE/CRIP?** A proposal may include material and/or product substitutions, work method changes, work sequencing changes, etc., that normally take place during the construction of a project. Contractor proposals do not require change orders nor qualify as CRIPs when the change does not require modification of the contract. See the previous section “contract modifications”.

2. **AGENCY CREDIT OR NO COST CHANGES (NOT A CRIP)** The contracting agency is not obligated to accept a proposal which is not equivalent or superior to what is required by contract. However, if a contractor proposed change is acceptable and desirable to WSDOT, but is not equivalent or superior to what is specified by contract, then a credit should be considered as part of the change order.

This type of change would not be considered a CRIP. The credit required would normally be 100 percent of the cost or time savings. If it is determined that contract time is not affected and that the cost differential is negligible or to the state’s advantage, then the change might require a “no cost” change order. If, in the opinion of the evaluator, the State is not harmed and there is no windfall savings for the contractor, then a no-cost change would be appropriate.

3. **IDENTIFYING A TRUE CRIP**

A CRIP might exist if:

- the change is the contractor’s idea
- it offers, in effect, the same end result as what is specified in the contract
- savings will be achieved in dollars or time by its implementation

Qualifying actions by the contractor:

- accepts design risk of temporary features
- accepts risk of constructability
- makes a significant effort to develop the proposal
- employs an engineer to assist in development (indicator, but not required)
- prepares all documentation, presentations, and plans
- invests an appreciable amount of time

4. **DEVELOPMENT OF CRIPS** Once a CRIP is identified and developed to the point of conceptual approval, it is treated in nearly the same manner as any other change order. There are some differences, such as the contractor’s responsibility for preparing the documents, and there is a special method of calculating the incentive payment amount. In the interest of uniformity, the following guidelines are to be used for the evaluation of CRIPs submitted by the contractor:

**General Requirements and Principles Applying to CRIPs:**

- The proposed change must alter a contract requirement.
- The proposed change must result in a product that meets the intent of the original design.
- In the judgment of the evaluator, the ultimate life cycle costs to WSDOT shall not be unduly increased.
- The contractor agrees to substitute for deleted condition of award COA work.
Additional Requirements for Time Reduction CRIPs:

- The time saving is a direct result of an actual change in the design or method of work (simply adding more crews would not qualify as a CRIP).
- The original time for completion was realistic (an early finish of a job with an unnecessarily long time for completion would not be a CRIP).
- The project does not already have an incentive/disincentive clause (in that case, the cost of accelerating the completion is assumed to be included in the bid and a CRIP sharing of the cost is inappropriate).

**Step 1: Concept Approval** The first effort in development of a CRIP shall be to achieve concept approval. To this end, the contractor shall submit a written proposal to the Engineer for consideration. The proposal shall contain the following information:

- An explanation outlining the purpose of the change(s).
- A narrative description of the proposed change(s). If applicable, the discussion shall include a demonstration of functional equivalency or a description of how the proposal meets the original intent of the design.
- A cost discussion estimating any net savings. Savings estimates will generally follow the outline below under “Calculating the Incentive Payment”.
- A statement providing WSDOT with the right to use all or any part of the proposal on future projects without further obligation or compensation.
- A statement acknowledging and agreeing that the Engineer’s decision to accept or reject all or part of the proposal is final and not subject to arbitration under the arbitration clause or otherwise be subject to claims or disputes.
- A statement giving the dates the Engineer must make a decision to accept or reject the conceptual proposal, the date that approval to proceed must be received, and the date the work must begin in order to not delay the contract.

A separate copy may be sent to the Headquarters Construction Office to initiate tracking of the progress of the proposal. After review of the proposal, the Engineer will respond in writing with acceptance or rejection of the concept. This acceptance shall not be construed as authority to proceed with any changed contract work. Depending on the nature of the proposal, the review could include Region and Headquarters designers and, possibly, outside consultants. The completeness and quality of the proposal will have an effect on the time needed for the review. WSDOT will make every effort to expedite the review.

**Step 2: Formal Approval** Concept approval allows the contractor to proceed with the work needed to develop the final plans and other information to support the ultimate preparation of a change order. To qualify for an incentive payment, the contractor will normally take the lead in the development effort. The Project Engineer is encouraged to provide whatever assistance is needed. The development of a CRIP is an example of partnering at work in a contract. The contractor’s submittal shall provide the Project Engineer with the following:

- Deleted Work — Calculated quantities of unit price work to be deleted. Proposed partial prices for portions of lump sum work to be deleted. Time and material estimates for deleted work in force account items.
- Added Work — Calculated quantities of unit price work to be added, either by original unit contract prices or by new, negotiated unit prices. Proposed prices for all new items to be negotiated.
- Contractor’s Engineering — Costs of engineering to develop the proposal shall be submitted. Costs of employees utilized in contract operations on a regular basis will not be included.
- Schedule Analysis — If the CRIP is related to time savings, a partial progress schedule showing the changed work. A discussion comparing this schedule with the approved progress schedule for the project.
- Plans and Working Drawings — All drawings and supporting calculations necessary to accomplish the work. Those drawings which include engineering calculations and features shall be prepared by a professional engineer licensed in the State of Washington and shall bear the professional engineer’s signature and seal.

**Step 3: Preparing and Approving Change Order** The change order itself shall be prepared and processed in the same manner as any other change order.

Calculating the Incentive Payment In the interest of uniformity, all CRIP change orders shall include separate payment items as follows:

- Any deleted work, whether at contract prices or at agreed prices.
- Any added work, whether at contract prices or at agreed prices.
- The contractor’s engineering costs, reimbursed at 100 percent of the contractor’s cost.*
- The incentive payment to the contractor.*

*Where added work exceeds deleted work, but time savings make a viable proposal, these two items would be replaced by:
Administration

- WSDOT’s share of added cost to achieve time savings.
- The contractor’s share of savings from deleted work.

The final sum of these shall ordinarily be the savings to WSDOT. However, in some cases, savings may be offset by any increased inspection and administration costs, or augmented by intangible benefits, such as user benefits, or by indirect benefits, such as overhead and engineering savings in time reductions, or by theoretical savings, such as a CRIP that eliminates a large anticipated overrun in plan quantity. In these cases, the benefits would not be expressly reflected in the change document, but should be discussed in the justification letter.

Proposal Savings: The incentive payment shall be one-half of the net savings of the proposal calculated as follows:

(gross cost of deleted work) - (gross cost of added work) = (gross savings)

(gross savings) - (contractor’s eng. costs) - (WSDOT’s eng. costs) = (net savings)

( net savings)/2 = (incentive pay)

WSDOT’s engineering cost shall be actual consultant costs billed to WSDOT and extraordinary in-house personnel labor costs. Project personnel assigned to the field office or who work on the project on a regular basis shall not be included.

Cost to Achieve Time Savings:

(cost of added work) + (contractor’s engineering costs) = (cost to achieve time savings)

(cost to achieve time savings)/2 = (WSDOT’s Share of Added Cost)

If the timesaving proposal also involves deleting some work and, as a result, creates a savings for WSDOT, then the contractor would also receive one-half of the savings realized through the deletion.

(d) Authority to Proceed with Changed Work The need may arise to proceed with changed work before the change order is executed. WSDOT is willing to provide an approval, allowing the work to proceed, if the following criteria has been met:

- Concept approval has been granted.
- The necessary design reviews and approvals have been completed, including plans and specifications.
- The contractor has guaranteed, in writing, the minimum savings to WSDOT.

Such advance approval, if given, shall be in writing and shall constitute commitment by WSDOT to ultimate formal approval of the proposal. Where appropriate, the advance approval may contain a narrative formula of the elements to be utilized in the final cost negotiations. When work has begun under such an approval, detailed records shall be kept of the labor, equipment, and materials utilized and, if ultimate approval is not gained soon enough to provide prompt payment for the work, then an interim change shall be executed to allow partial payments.

(c) Problems Arising After the Agreement The contractor assumes the risk of constructability. However, there will occasionally be problems that arise while the work of the CRIP is being performed. These will be evaluated on a case-by-case basis. The controlling philosophy will be that we entered the CRIP as a team with the contractor and we will approach problems in a similar vein. If the problem is something that could not reasonably have been anticipated in the design work of the CRIP, then the risk shall be shared as will the cost of the solution.

(f) Proposed CRIP is not accepted If the evaluator decides to reject a CRIP proposal, the contractor will be notified in writing with an explanation. Copies of this notice, with an attached analysis of evaluation costs and any other factors, shall be provided to the Region Construction Manager and the Headquarters Construction Office.

1-2.4C(2) Equitable Adjustment

(f) PRICING

Section 1-04.4 of the Standard Specifications specifies that an equitable adjustment (EA) in accordance with Section 1 09.4 will be made when changes cause an increase or decrease in the cost of performing work on the contract. The basic theory of an EA is to leave the parties to the contract in the same position cost wise and profit wise as they would have been without the change, preserving to each as nearly as possible the advantages and disadvantages of their agreement. Although the contractor is entitled to profit on the changed work, the profit (or loss) on the unchanged work should remain unaffected by the equitable adjustment.

- This is an important point, for unchanged work, the contractor is entitled to the profit bid or a windfall, if the work turns out to be easier than expected.
- On the other hand, for unchanged work, the contracting agency is not obligated to make the contractor well for an under bid item.

Consequential damages are never allowed as part of a negotiated equitable adjustment. Consequential damages may include such things as: loss of credit, loss of bonding capacity, loss of other jobs, loss of business reputation, loss of job opportunities, impacts to another project, etc.
UNIT PRICES. An appropriate price may be established using average unit bid prices, citing similar unit bid prices, a determination of market value, by estimating the cost to perform the work, or a combination of these methods. Unit bid price is one indication of an equitable price, however the contracting agency should be prepared to support the price by other means.

FORCE ACCOUNT. When added work is paid by force account, a change order shall be prepared detailing the added work to be performed and the estimated cost. Standard Item Number 7715 is to be used for all force account items that do not have an assigned standard item number. Force account should be a last resort used only if the work can’t be clearly defined.

OVERHEAD. There are two basic types of overhead as follows:

- DISTRIBUTED FIXED COSTS: Offsite “home office overhead” is the cost of running a company. These costs are assumed to be distributed among all the projects performed by the company. Onsite overhead is incurred as a function of time needed to accomplish the project. Onsite costs are assumed to be evenly distributed among contract items. This category of overhead is eligible under an equitable adjustment if working days are added to the contract as part of the adjustment.

- VARIABLE FIXED COSTS: these costs are directly associated with performing an item of work on the project and therefore vary with the quantity, the contractor is entitled to recover these costs as a part of an equitable adjustment.

FORWARD PRICING AND RISK

The first and best option for an equitable adjustment is agreement in advance between the contractor and WSDOT on the increased or decreased cost and time for performance of the changed work. The Project Engineer should expend every effort possible to obtain a satisfactory negotiated equitable adjustment prior to submitting the change order to the contractor for endorsement. The Project Engineer must remember that the contractor is a full participant in the contract and retains all the rights and privileges during a negotiation. When bidding a job, the contractor must be optimistic and take appropriate risks. When negotiating, it is understandable and acceptable for the contractor to be pessimistic and avoid risk, unless compensated. Some key points to remember are:

- A negotiated price will likely be higher than a competitive bid price.
- A proposal which assigns extensive risk to the contractor will likely be more costly yet.

- The contractor may be willing to take on this risk if the price is a bit higher.
- The significant advantage of reaching a price agreement before the work is started (forward pricing) is that the contractor assumes the risk of the accuracy of the pricing assumptions and predicted duration for performing the work.
- (when forward pricing) the Project Engineer may utilize the high end of the estimating range in justification.
- (when forward pricing) an audited overhead rate may be substituted for the markups described in Section 1 09.6. Contractors can usually provide an estimated home office overhead rate which may be checked by an annual audit, if warranted.

PRICING AFTER FACT

When establishing prices after the work has been performed, actual costs should be used to the extent they are available. The following are key points to keep in mind:

- Costs for equipment cannot exceed the rates established by the AGC/WSDOT Equipment Rental Agreement for an equitable adjustment.
- When pricing after the fact, the markups described in Section 1-09.6 are appropriate for measuring time and materials because there is no risk involved in after the fact pricing.

UNILATERAL PRICING

In the interest of being timely, the change order should be a tool to document agreement and not a negotiation tool back and forth. Ideally we will have agreement with the contractor when pricing the work. On occasion, however, due to time constraints and difference of opinion, we can’t always come to agreement. The difference of opinion may be for only a small portion of the work. Standard Specification 1 09.4 (2) provides, “If the parties can not agree, the price will be determined by the Engineer using unit prices, or other means to establish costs”. This is not to say that the contractor is obligated to honor unit bid prices for work that qualifies for an equitable adjustment. This allows us to proceed with changed work prior to reaching an agreement on the price. In the interest of being timely, and provided the Project Engineer is comfortable that the included price can be supported, there’s nothing wrong with issuing a change order to the contractor unilaterally. This orders the work to proceed, establishes the State’s position on cost, and puts the decision to continue negotiations in the contractor’s hands as detailed under 1-04.5. The contractor is obligated to endorse, write a separate acceptance, or protest as described in the specification and a timeline is provided for these actions.
TIME

The completed equitable adjustment should include provisions for any increases or decreases in contract time based on impacts to overall contract duration. The decision on time should be supported by an analysis of the project schedule. Analyzing time in advance encourages communication between the parties allowing the contracting agency to make an informed decision on the true costs. It also enables the contracting agency to mitigate time impacts if that is in the agency’s best interest.

1-2.4C(3) Approval of Changes/Checklist

In addition to noting who can execute a change order, the checklist (see Figure 1-5) further indicates who must approve the change prior to execution. Written approval constitutes agreeing with the general nature of the change and can be granted by memorandum or e-mail. The checklist works as follows: for any item marked “yes”, approval must be obtained as indicated by the columns with the “Xs”. Each tier, left to right, has the authority to decide not to proceed with the change. This approval does not constitute authority to proceed with the work. That authority must come from the person who will execute the change order (see verbal approval). In an emergency, the Region Construction Manager may authorize work to begin on any change order if the State Construction Office cannot be contacted for the required approvals within a reasonable amount of time.

(i) State CONSTRUCTION OFFICE

[1] FHWA APPROVAL On a project with federal funding and for which the stewardship responsibility has not been delegated, written FHWA approval is required prior to beginning work on change orders that will:

- involve new construction on the Interstate
- alter the termini, character, or scope of work
- increase or decrease the project cost by more than $200,000 (except for changes prepared in accordance with Standard Specification Section 1-04.6)

(a) who does what? The State Construction Office will formally submit this type of change order to FHWA for approval.

 ii] CONSTRUCTION ENGINEER, ADMINISTRATION

[a] areas of responsibility Contract Payments and Withholding of Payments; Contractor Assignment of Payments; Contractor Default; Time Extensions; Assessment of Liquidated Damages; Contract D/M/WBE, EEO, and Training Programs (i.e., Division 1 of the Standard Specifications).

[3] CONSTRUCTION ENGINEER, BRIDGE

[a] areas of responsibility Bridges & Structures; Bridge Deck Overlays; Walls: (1) Standard and Nonstandard Reinforced Concrete, (2) Soldier Pile, Tieback, Slurry, Cylinder Pile; (3) Soil Nail Walls (i.e., Division 6 of the Standard Specifications).

[4] CONSTRUCTION ENGINEER, ROADWAY

[a] areas of responsibility Construction Engineer, Roadway—Grading, Paving, Miscellaneous Paving; Culverts and Drainage; Concrete Slope Protection; Bridge Approach Slabs; Lighting; Signing; Traffic Signals; Fencing; Rest Areas; Walls: (1) Gravity Walls—Masonry, (2) Gabion, Rock, and etc., Proprietary Walls—Structural Earth and Geotextile (i.e., Divisions 2, 3, 4, 5, 7, and 8 of the Standard Specifications).

[5] State MATERIALS LAB

[a] areas of responsibility as you will notice from the checklist, the lab plays two roles:

CHECKLIST ITEM #10 the Materials Lab advises whether an alternate material is capable of performing the same function as a required material. However, the State Construction Office makes the final approval based on application of the material, maintenance concerns, etc.

CHECKLIST ITEM #11 the State Materials Lab is the design approval authority for a structural change with regard to roadway sections. Once design approval is obtained, the Region may approve the change order.

[6] BRIDGE TECHNICAL ADVISOR (BTA)

[a] areas of responsibility The BTA is an on call advisor to the Project Engineer on issues related to structural design. The BTA’s role is to act as a resource for the Project Engineer in answering questions relating to design, plan clarifications and “minor structural changes”.

[b] assignment of BTA After the contract has been awarded, the Region may send a written request to the Bridge Design Engineer in the State Bridge and Structures Office for the assignment of a Bridge Technical Advisor (BTA).

[c] delegation of executing authority if BTA is assigned When a BTA has been assigned to the project, the Region may execute certain “minor structural” change orders provided: 1) The BTA’s stamp and signature are on sheet one of the change order, or on a drawing that shows the change; or there is other written structural concurrence from the BTA; and 2) The magnitude of the change is within the Region’s authority to execute. All other requirements of the change order checklist apply with the exception that for "minor structural" changes under item #15 the BTA’s recommendation may substitute for the State Construction Office approval. A “minor structural” change is not easy to
### CHANGE ORDER—CHECKLIST

<table>
<thead>
<tr>
<th>Included?</th>
<th>If Yes, Approval Required</th>
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<tbody>
<tr>
<td></td>
<td>YES</td>
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<tr>
<td>I. Executed by the State Construction Office</td>
<td></td>
</tr>
<tr>
<td>1. A cost or credit equal to or exceeding $200,000.</td>
<td>o</td>
</tr>
<tr>
<td>2. A change in the contract documents beyond the scope, intent, or termini of the original contract.</td>
<td>o</td>
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<tr>
<td>3. Any proposed revision or deletion of work that effects the condition of award requirements.</td>
<td>o</td>
</tr>
<tr>
<td>II. Executed by the Region</td>
<td></td>
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<tr>
<td>4. A cost or credit greater than $50,000 but less than $200,000.</td>
<td>o</td>
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<tr>
<td>5. A change in contract time greater than 10 and less than 30 days must be related to changes implemented by change order.</td>
<td>o</td>
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<tr>
<td>6. A change in contract time greater than 30 working days or a change in contract time unrelated to any change order.</td>
<td>o</td>
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<tr>
<td>7. A determination of impacts and/or overhead.</td>
<td>o</td>
</tr>
<tr>
<td>8. Specification change, involving Headquarters generated specifications.</td>
<td>o</td>
</tr>
<tr>
<td>9. Specification change, involving Region generated specifications.</td>
<td>o</td>
</tr>
<tr>
<td>10. Material or product substitution. (Requires State Materials Lab Recommendation)</td>
<td>o</td>
</tr>
<tr>
<td>11. A structural design change in the roadway section. (Requires State Materials Lab approval)</td>
<td>o</td>
</tr>
<tr>
<td>12. A determination of changed condition.</td>
<td>o</td>
</tr>
<tr>
<td>13. Settlement of a claim submitted under Section 1-09.11(2).</td>
<td>o</td>
</tr>
<tr>
<td>14. Repair of damage qualifying under Section 1-07.13 of the Standard Specifications regarding “acts of God” or “acts of the public enemy or of government authorities”.</td>
<td>o</td>
</tr>
<tr>
<td>15. A structural change for structures (see BTA authority as shown in the Construction Manual.</td>
<td>o</td>
</tr>
</tbody>
</table>

Fill in applicable Verbal Approval dates, if any:

PE Date __________  Region Date __________  State Construction Office Data __________

**Verbal Approval:**
This is approval given by the executing authority (Headquarters, the Region, or the Project Engineer) to proceed with work prior to issuance of the written change order. This approval is warranted on any change where a cost/time benefit to WSDOT can be realized or a cost/time disadvantage to the contractor can be minimized by prompt action.

**Figure 1-5**
identify, therefore when in doubt, contact the State Construction Office for advice. Changes involving specifications, materials, work method changes, repairs and major design changes should be referred to the State Construction Office. The BTA would never become involved in contract administration issues such as payment, determining the existence of a change to the contract or directing the contractor. These would be construction issues. Structural questions which require support analysis exceeding field capabilities or questions regarding geotechnical or hydraulics issues should be referred to the State Construction Office. Any redesign of significance will be managed through the State Construction Office.

(d) BTA duties The Region and the Construction Office have agreed that “minor structural” questions may be referred to the BTA. Those “minor structural” questions which can be resolved on site may be handled directly by the BTA. Documentation will be provided to the Project Engineer in support of the recommendations. The BTA also takes on the responsibility of keeping the Bridge and Structures Engineer advised of any changes, as appropriate.

c) BTA guidelines Specific guidelines for the BTA’s role on site are as follows:

• Be alert to the need for technical advice to the Project Engineer and be available and responsive to the Project Engineer’s requests.

• Develop solutions in accordance with the best structural interest of the project.

• Recommendations should generally be made in writing to the Project Engineer and should include an assessment of the approximate cost of the change.

• Provide the Project Engineer with written documentation to support the recommendations for changes. The Project Engineer will consult with the State Construction Office, as appropriate.

• The BTA has the authority to approve and endorse the structural changes on behalf of the State Bridge and Structures Engineer.

• Keep a written record of activities and recommendations pertaining to the assigned project (project diary).

• Refer/leave contract administration issues to the Project Engineer.

• Conform to the field safety requirements of the Region and the contractor.

• Give the construction project priority but be prudent in the use of time and expenses charged to the project.

The above guides are not meant to be all inclusive, but are generally representative of the scope of services to be provided by the BTA. The BTA’s immediate administrative support on site will be provided by the Project Engineer. The BTA’s technical responsibility will be to the BTA’s regular supervisor in Olympia. Overall determination and monitoring of the assignments will be made by the State Bridge and Structures Engineer.

(e) BTA summary In conclusion, it is the role of Bridge Technical Advisors to advise the project engineer in their area of expertise, which is structural design. The project engineer has the responsibility and authority to administer the contract. Therefore, when it comes to contract issues of payment, work methods, material substitution, etc., it will be the Project Engineer’s responsibility to get the proper approval of those aspects of structural changes.

1-2.4C(4) Delegation of Execution Authority

(l) HIGHWAY CONSTRUCTION

The Change Order Checklist (Figure 1-5), in addition to describing the approval requirements previously described, also outlines who has authority to execute a change order.

The State Construction Office executes the change order:

• if any one of 1, 2, or 3 is true (checklist item # 1, 2, or 3 is yes)

The Region (Regional Administrator or designee) may execute a change order provided:

• 1, 2 and 3 are not true of the change (checklist item # 1, 2, and 3 are no)

The Regional Administrator’s authority to execute change orders may be:

• delegated to the Regional Construction Manager

• further delegated to the assistant to the Regional Construction Manager

The Region’s (Regional Administrator or designee) authority to execute a change order may be delegated to the Project Engineer provided:

• items 1 through 6 are not true of the change (boxes 1 through 6 are marked no)

In the absence of the Project Engineer, the Project Engineer execution authority may be further subdelegated to the Assistant Project Engineer.
(II) WASHINGTON STATE FERRIES
The Director and CEO of Washington State Ferries (WSF) is authorized to approve all changes for terminal construction projects and may consult the State Construction Office for advice. This authority to execute change orders may be:

- Delegated to the Director of Terminal Engineering provided the change does not include a cost or credit exceeding $200,000 nor does it change the condition of award requirements.
- Authority may be further delegated to the Manager of Terminal Maintenance and Construction provided the change does not exceed $50,000 and does not include a time extension exceeding 10 days.
- In the absence of the Manager of Terminal Maintenance and Construction, that Manager’s execution authority may be further subdelegated to the Assistant.

(III) LOCAL AGENCY PROJECTS
When the project being administered includes local agency participation, the project engineer should coordinate with the Regional Local Programs Engineer and the local agency to establish an approval process acceptable to all the parties. Any funding constraints and timelines for reviews and approvals should be established and specified in the contract, if appropriate.

1-2.4C(5) Verbal Approval
The best business practice is to have a signed change order in place prior to proceeding with the work. Verbal approvals should be the exception. A verbal approval might be warranted if it will provide a cost/time benefit to WSDOT or minimize a cost/time disadvantage to the contractor. In the event that the Project Engineer determines that it is in the State’s best interest to proceed with the work prior to having a signed change order, the permission “verbal approval” of the executing authority to proceed with the change under these circumstances must be documented in the file. The executing authority is the person who will ultimately execute the change order. The project engineer must have either an executed change order or a verbal approval in place prior to proceeding with the work.

1-2.4C(6) Documentation

(i) STATE CONSTRUCTION OFFICE ROLE
The State Construction Office will review Region executed change orders and provide appropriate feedback. Four main areas the Construction Office will review are:
- whether the change is appropriate and there is entitlement
- determine compliance with the change order checklist
- check for existence of supporting documentation
- determine if eligibility for federal-aid participation has been addressed

(II) PROJECT FILES
11 CCIS INPUT It is important that CCIS input be accurate and timely. CCIS is used by internal and external customers to monitor project changes and costs. Information on change orders (including minor changes) is readily accessible through a numbering process and is adequate so that everyone involved will understand the need for the change. Some key items to remember are as follows:
- Is there a clear description of the work?
- Is the origin and purpose of the change order must be entered using at least two of the reasons listed in the system?
- Was there an order, other than a signed change order, by the engineer for the contractor to proceed?
- Is there a reference any key documents in the change order file?
- Are any increases or decreases in contract time associated with the change order entered in the appropriate field enabling the Weekly Statement of Working Days to be automatically updated?
- For condition of award change orders, are the appropriate fields filled in to generate the change order and automatically update the condition of award items?
- Are any disclaimers included in the change order and are any agreed upon disclaimers included in the text?

Finally, entries must be made in the appropriate CCIS fields concerning whether or not the change order was avoidable and the degree to which the change adds value to the transportation system. The following definitions shall be used for these purposes:

(e1) avoidable A Change Order shall be considered as “Avoidable” if the cause is under WSDOT control* and if one or more of the following are true:
- The problem could have been discovered or anticipated with a review of known information or with a reasonable effort.
- It resulted from an engineering error or omission.
- The project could have been constructed according to the contract without the change.
- Reviews of Contractor submittals were delayed beyond specification requirements.
*(e.g.: Cause is not an Act of God, was not ordered by an outside agency, etc.)*

**[b] value added** Whether or not the change order is considered “Avoidable”, an element of a Change Order adds value as long as it is not compensating for rework or delay damages resulting from an error or omission and it meets one of the following:

- There is a positive benefit/cost ratio or an improved life cycle cost.
- Completion is accelerated to the benefit of the users.
- There is a benefit to the public or the environment.
- The change is needed to meet the defined or required design service level.
- Needs of outside stakeholders are met.
- Work zone safety is improved.

Value added through change orders will often appear as a “pay now or pay later” cost. It can be seen that, if the work had been included in the original plans, the bid would have been higher (pay now) by more or less the same amount as the negotiated change (pay later).

**[2] TRANSMITTAL** The memorandum transmitting the change order and attachments should include an explanation in sufficient detail so that everyone involved will understand the need for the change, will see that the price is appropriate and that appropriate checks and consultations have been made. The following is a list of items to consider for inclusion in the transmittal when putting together a change order:

**[a] describe the change**
- what is required by contract?
- what is the change?
- how does it solve the problem?
- reason for entitlement/why is this not paid under the contract?
- is there time associated with the change?
- did the contractor concur/ if not why?
- is FHWA participation appropriate?
- does the change affect COA?

**[b] evolution of the change**
- how did the change evolve?
- discussions with associated offices (maintenance, utilities, environmental, budget, design, etc.)
- alternatives considered

- BTA involvement
- design approval necessary
- COA substitutions authorized by State Construction Office
- approvals in accordance with the checklist/date

**[c] payment**
- any increase or decrease in cost
- how it was established (see equitable adjustment)?
- force account must include estimate

**[d] time**
- does the change impact the critical path?
- how was any change in working days established?
- note if a change in contract time affects the amount of liquidated damages

**[e] prior approval**
- was the change order signed prior to proceeding with the work?
- if not/ verbal approval who and when

**[f] attachments**
- checklist
- documentation of verbal approval
- any supporting documentation needed for understanding

**[3] DISTRIBUTION**

**[a] Region-executed** When the Region (PE or Region Construction Office) has executed a change, then copies should be sent to the contractor, the State Construction Office and the State Accounting Services Office, (if necessary, the State Accounting Services Office creates and coordinates new groups in “CAPS” and “TRAINS”) If the change order utilizes the “Minor Change” process, then copies of the single page document substitute for the transmittal and CCIS change order print out.

**[b] Headquarters-executed** If the change is executed at the State Construction Office, copies will be sent to the contractor, the Region, the State Accounting Services Office, (if necessary, the State Accounting Services Office creates new groups and/or items) and, if appropriate, to the State Bridge Office, Design and the Materials Lab.


1-2.4C(7) Minor Changes

(1) **OVERVIEW**

All contracts will have a standard item for “Minor Changes”. This item will be established in every group as a calculated lump sum. Credits, debits, changes in working days and no cost changes may all be processed under the minor change method subject to the listed criteria.

(2) **CRITERIA FOR USE**

Keep in mind that although the change meets the criteria for using the minor change process, the Project Engineer may decide that this process is not appropriate. The use of this item is at the Region’s and the Project Engineer’s discretion. Also keep in mind that the limitations and approvals required by the change order checklist still apply as well as all other change order criteria not modified by this Minor Changes section. The Minor Changes process is limited to changes that satisfy all three of the following criteria:

- non-structural changes (checklist item #15 is no) and,
- the value of the change (credit or debit) is estimated at $5,000 or less and,
- any change in working days not greater than ten days.

(3) **ENDORSEMENT**

In the interest of being timely, the change order should be a tool to document agreement and not a negotiation tool back and forth. The contractor’s authorized signature on the change order is desirable but not mandatory. A phone call or a verbal agreement with the project superintendent may be appropriate if payment is to be made by “Minor Changes”. This may be a good discussion item at preconstruction meetings. The Project Engineer should determine when the Contractor’s signature is required based on when it is in the State’s best interest to document agreement prior to proceeding with a change order. Some situations that may warrant the Contractor’s signature are as follows:

- The contract includes substantial incentives.
- There are mutual benefits associated with the change.
- The change might include impacts to time or other work.
- The change is proposed by the contractor.
- The change is a claim settlement.

In any case, a copy of the Minor Change must be sent to the contractor. If the contractor does not agree with the terms or conditions of a change order, the contractor is required to follow the procedure outlined in Section 1-04.5 of the Standard Specifications. This orders the work to proceed and puts the decision to continue negotiations in the contractor’s hands as detailed in that section. The contractor is obligated to endorse, write a separate acceptance or protest as described in the specification, and a timeline is provided for these actions.

(4) **EXECUTION**

Due to the criteria for the application of minor changes, the Project Engineer has the authority to execute these change orders.

(5) **PAYMENT BY LUMP SUM**

The negotiation of prices for payment under “Minor Changes” is intended to be the same as any other change order. The focus, as always, should be forward pricing such that the contractor controls the work and assumes the risk. However, situations occur where it makes sense to measure portions of the work in a variety of ways such as units, force account and/or lump sum. The method for establishing, measuring and monitoring the total may be by any combination of methods however, the payment will only be by a lump sum under the item “Minor Changes”.

(6) **PROJECT FILES**

11 **CCIS INPUT** “Minor Change” change orders must be entered into CCIS, however the required input is slightly abbreviated. Since a formal change order document as described in Chapter 1-2.4C(6) is not processed, the Work Description section in CCIS requiring a detailed upload of text is not required. However, the Short Description is required and should provide enough detail to identify the content of the “Minor Change” change order. All other information requested by CCIS, including changes to working days or COA, is required.

21 **TRANSMITTAL** Under the Minor Change process, the “Change Order - Minor Changes form # 421-005 EF” substitutes for the transmittal included in the more formal process described above. The information on the Minor Changes form should at a minimum briefly document two key items:

- Reason for entitlement/why is this not paid by bid items.
- Any increase or decrease in cost and time and briefly how it was established.

31 **DISTRIBUTION** When utilizing the “Minor Change” process, the minor change form is substituted for the change order document and the transmittal. In the case of the “Minor Change” process, it is not necessary to route the backup documentation nor a CCIS print out, as part of the distribution. A copy of the form may be used to document the payment.
1-2.4D Force Account

1-2.4D(1) General

When it is difficult to provide adequate measurement or to estimate the cost for certain items of work, force account may be used in order to pay the Contractor for performing the work. Some contract items may be set up to be paid by force account. Some change orders may require payment by force account. Section 1-09.6 of the Standard Specifications describes the boundaries for payment of work performed by the force account method. In any case, the purpose of force account is to fully reimburse the Contractor for costs incurred on the work. These costs may also include indirect segments, such as travel, per diem, safety training, industrial safety measures, overhead, profit and other hidden costs. The objective is to minimize the inclusion of any “contingencies” included in the contract bid in anticipation of costs that may be incurred during force account work and not reimbursed.

When work is added to the contract and is to be paid by force account, a change order will have been prepared describing the added work to be performed. The change order package will also contain an independent estimate of the cost to perform the added work. All non-standard force account items are assigned the Standard Item Number 7715.

Force account payments are typically not authorized for employees engaged in management or general supervisory work. The cost for this type of activity is presumed to be included in the Contractor’s markups for overhead and profit. However a foreman or, in some cases, a dedicated superintendent devoting full time to the force account work is eligible for payment on the force account.

On projects that require the Contractor to employ trainees, these employees may be utilized in force account work.

The Project Engineer should consider a decision to direct force account work with the same degree of caution that would be applied to directing any other work on the contract. The Contractor should have the expertise to schedule the work and determine what equipment is required. In most cases, it is best that we allow the Contractor to propose the method and approach to the work. Our most effective role would be to concur or approve of the Contractor’s proposal or suggest modifications to it. Before any work is performed by the Contractor on a force account basis, the inspectors should review and agree with the Contractor upon:

1. Labor. The classification and approximate number of workers to be used, the wage rate to be paid those workers, whether or not travel allowance and subsistence is applicable to those workers, and what foreman, if any, will be paid for by force account. This agreement will be closely tied to the development of the Labor List.

2. Materials. The material to be used, including the cost and any freight charges whether the material is purchased specifically for the project or comes from the Contractor’s own supply. For materials representing a significant cost, or where the industry experiences fluctuations in price, the contract allows for shopping and the Contractor may be directed to obtain quotations. If time permits and the situation seems appropriate, the Project Engineer may want to do this.

3. Equipment. The equipment to be used including the size, rating, capacity, or any other information to indicate the equipment is proper for the work to be performed whether the equipment to be used is owned by the Contractor or is to be rented. The cost per hour for the equipment to be used. In the case of rented equipment, the Engineer may ask for competitive quotations, provided the request is made in advance and there is time to obtain them.

Payment for force account work should be made on the same timely basis as any other item of work. When money is being withheld from a progress estimate, the criteria for withholding should apply equally to all items of work, not just to force account work, because of its method of payment.

The procedure for record keeping and payment of force account work on change orders shall be the same as for contract items to be paid by force account. Separate records are to be kept for each force account whether it is an item in the original contract or established as a result of a change order.

1-2.4D(2) Payment Procedures for Force Account Work

1. Labor. The specifications require the Contractor to prepare and submit a “Labor List” in advance of force account work. Once approved by the Project Engineer, this list provides the hourly rate for force account calculations until a new list is approved. New lists will not be approved retroactively and calculations previously made from an approved list will not be changed when a new list is approved. If the Contractor fails to submit a list before the first force account calculations are made, then the Project Engineer will determine the rates from the best data available (payrolls on this job, payrolls on other jobs, prevailing wage requirements, union information, etc). Labor list rates will include all the pieces of wage expense — base rates, benefits, assessments, travel, with allocations shown where necessary. Examples of Labor List entries might be:
   Generic Laborer (Straight Time) John Doe, Teamster (Overtime)
Along with supplying prices and invoices, the Contractor may suggest additions or corrections to the Materials List. These suggestions will be reviewed by the Project Engineer and, if appropriate, added before payment is made.

If the Contractor does not have an invoice, as in the case of stockpiles or some warehouse stock, then an affidavit will suffice. The Engineer may review the affidavit and, if it is an unreasonable price that cannot be supported, the Engineer may substitute another price, utilizing the best data available. The reasonableness of the price must consider the circumstances of the purchase and all costs associated with obtaining material from another source.

The specifications allow the Engineer to require competitive quotations, if this is done before the work is started and sufficient time is available. If the Contractor has to divert an employee to obtain the quotations, then that employee may be included in the labor reimbursement for the force account.

3. Equipment. The Project Engineer should review and comply with the rules governing payment for equipment as outlined in the most current AGC/WSDOT Equipment Rental Agreement. This agreement was developed as an interpretation of the specifications and is relatively self-explanatory.

There are three methods of acquiring equipment for use on a force account. “Owned” means that the Contractor controls and operates the equipment. A long term lease arrangement would be the same as ownership. Owned equipment is priced according to the Blue Book. “Rented to Operate” means that the Contractor has obtained a piece of equipment through a short term rental and will operate that equipment with its own employees. Rented to Operate equipment is priced according to the invoice from the rental agency. “Rented Operated” means that the Contractor has obtained a service from an individual or a company to provide a piece of equipment with an operator. An operated rental is not paid as equipment, but rather as a Service. In some cases, the Service will be reclassified as an entity performing in the manner of a subcontractor (see below).

Repair of damage is considered a risk of providing equipment. The cost of this risk is assumed to be in the markup for overhead and profit. Neither costs for repair of damage nor insurance against such damage should be included in the force account direct charges. A common event is the offer of a Damage Claim Waiver by a renting agency. If such a charge appears on an invoice, it should be removed before payment is calculated.

As with Materials, the Engineer may require competitive bids for equipment rentals. Normally, this requirement must be made in advance, before the work is started. However, if the rental is not made in an “arm’s length” transaction, for example when the contractor rents the equipment to himself through some sort of business structure, then after the fact

<table>
<thead>
<tr>
<th>Basic Wage/hr</th>
<th>$21.36</th>
<th>Basic OT Wage/hr</th>
<th>$32.81</th>
</tr>
</thead>
<tbody>
<tr>
<td>FICA (7.65%)</td>
<td></td>
<td>FICA (7.65%)</td>
<td></td>
</tr>
<tr>
<td>FUTA (0.80%)</td>
<td></td>
<td>FUTA (0.80%)</td>
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</tr>
<tr>
<td>SUTA (5.42%)</td>
<td>2.96</td>
<td>SUTA (5.42%)</td>
<td>4.55</td>
</tr>
<tr>
<td>Indus Ins $1.01/hr</td>
<td>1.01</td>
<td>Indus Ins $1.01/hr</td>
<td>1.01</td>
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<tr>
<td>Benefits/HR</td>
<td>5.45</td>
<td>Benefits/HR</td>
<td>8.00</td>
</tr>
<tr>
<td>$30.78/HR</td>
<td></td>
<td>$46.37/HR</td>
<td></td>
</tr>
</tbody>
</table>

These examples show the rate rounded to the nearest dollar, which is permissible. If either party would prefer to use the unrounded amount, that is also acceptable. When deciding how many hours require compensation, the specification allows all hours that are a contractual obligation or are customary payments made to all employees. This means that, if a labor contract calls for 4 hours of pay for any call out, then that is a contractual obligation and the 4 hours would be eligible for reimbursement. (As always, the Contractor is expected to reassign the employees if possible, to avoid the penalty.). In the same vein, a non-Union contractor, who has made call out payments to all employees for years, would be eligible for reimbursement for similar payments in a force account.

2. Materials. Materials also works from a list, but the list is generated in a different fashion. The Project Engineer provides the basic list of materials observed by the inspector. This is done in a timely manner (daily, unless the Contractor agrees otherwise). The Contractor adds prices to the list and attaches invoices or affidavits to support the prices. Once the list is returned and checked, payment can be made.

If a shipment of material is only partially consumed during the force account reporting period, the inspector may choose to include the entire amount in the first report or to estimate the amount consumed during each reporting period. The decision should be based upon the amount of the shipment, the nature and cost of the shipment and the security of the stockpile. A case of empty sandbags to be utilized throughout the winter for pollution control would adapt well to a single report, while a stockpile of galvanized conduit should probably be reported piecemeal as it is used in the work. The Contractor may use copies of the original invoice when the material is reported incrementally. If the Contractor has to restock unused material, restock charges can be reimbursed if the original order was reasonable for the work planned.
Administration

quotations may be obtained from independent rental agencies and the lowest such quotation may be used in place of the rental invoice.

Finally, as a special insertion into this Manual, there is a separate method of paying for Pavement Routers for Crack Sealing. WSDOT has agreed to set aside the Blue Book rate for this equipment and to pay $20 per hour for the operated router.

4. Services. Services billed by invoice will be compensated according to the invoice if that is the typical method in standard industry practice. Billing by invoice does not excuse the service provider from the requirements of the prevailing wage laws, from contract requirements for requests to sublet, or from other requirements. However, the force account payment system will not be used to enforce contract wage or other requirements. Typical industry practice might include specialized technical services, such as Testing Labs and Environmental Cleanup firms. Also included might be unit price invoices, such as Sweeping per mile or Concrete Pumping per cubic meter, or lump sum quotation invoices, such as Remove Danger Tree or Pump Septic Tanks.

The markup for services depends on the nature of the firm’s activities on the project. If the firm is clearly an uninvolved supplier, then the Service markup will apply. If the firm is acting as a subcontractor, then the markup will be made under the subcontractor provisions described below, with the underlying (subcontractor’s) overhead and profit assumed to be embedded in the invoice.

It should be noted that payment of force account work through an invoice does not excuse the Contractor from other requirements of the contract. Wage rate rules, subcontractor approvals and other provisions, while not necessarily required for force account payments, are still contract requirements and must be enforced. Note that the statutes associated with some enforcement do involve the withholding of payment for associated work.

As with materials and equipment rentals, the Engineer may require competitive bids for invoiced services. Normally, this requirement must be made in advance, before the work is started. However, if the service is not obtained in an “arm’s length” transaction, for example when the invoice comes from a subcontractor without sufficient effort to find competitive prices, then after the fact quotations may be obtained from independent service providers and the lowest such quotation may be used in place of the service invoice.

5. Mobilization. Mobilization and demobilization are reimbursable expenses for assembling equipment, materials, supplies and tools for any force account item and then returning those items to the previous location when the work is finished. Demobilization can include restocking costs for materials not utilized. Force account mobilization applies to original bid item force accounts as well as force accounts added through change orders. The standard bid item “Mobilization” is assumed to not include mobilization activities for force account work.

Mobilization may occur within the project limits if special efforts are required to assemble needed items to the force account location. For example, if a lowboy is required to move a bulldozer from one end of a project to the other, then that mobilization effort would be reimbursed.

If off site preparation work is needed, the Contractor must notify the Engineer in a timely enough manner that the work can be observed, if that is desired. Without such notice, that preparation work will not be reimbursed.

The AGC Agreement allows for pro-rating mobilization costs for equipment that will be used in both force account and bid item work. This will be done by negotiation and agreement. For example, if the Project Engineer and Superintendent agree that a mobilized backhoe will be used three hours on regular work for each hour on force account, then 25 percent of the mobilization costs would be paid on the force account.

All mobilization activities can be categorized as Labor, Equipment, Materials, or Services and will be listed under those categories for payment.

6. Other Payments

Permits or Fees
When a force account requires the Contractor to pay for permits or fees (hazardous waste dumping, etc.) that would fall outside the scope of overhead, these costs are reimbursable and may be included in the “Services” section of the force account payment.

Sales Tax
How retail sales tax is handled on the overall project depends on the ownership of the property upon which it rests. Keep in mind that a project may span more than one type of ownership.

STATE AND PRIVATELY OWNED LANDS
Work performed on state or privately owned land falls under Section 1-07.2(2) of the Standard Specifications and Department of Revenue Rule 170. Retail sales tax is required on the total contract amount. The Contracting Agency provides this payment to the Contractor to be passed through to the Department of Revenue. This is the tax noted in the summation of contract payments.

The Department of Revenue considers materials incorporated into the final work (such as concrete, signs, aggregates) to be an integral part of the completed improvement. These materials are purchased for “resale”. No tax is required when purchasing these materials,
therefore, no tax is paid as part of force account payments or as part of pricing change order work. The contractor purchases these materials as tax exempt and, in turn, sells them to the State as a part of the total project and the only tax collected is on the total contract as described previously.

There may be items that the contractor is required to pay sales tax on at the point of purchase. The Department of Revenue considers supplies consumed (such as concrete forms, fuel or tools, equipment purchased or rented) during the performance of the contract to be “consumables”, a part of the overall cost of doing business. The contractor is required to pay retail sales tax at the point of purchase/ rental for these items. These costs are bid as a part of the associated bid items.

When calculating or estimating the cost of force account or change order work, sales tax should be included in the individual invoices for “consumable” items. It’s a fine line; for example, permanent striping is considered “resale” (tax exempt), temporary striping is a “consumable” (taxed). The fact that taxes are shown or not shown on invoices is not a reliable indication of what the contractor is obligated to pay. The contractor may receive reimbursement later or be required to pay additional taxes when the contract is complete. The contractor’s books are audited by the Department of Revenue upon completion of each project to ensure compliance. The Project Engineer must apply these guidelines as closely as possible. Note that, in some cases, it is possible and necessary to pay a tax on a tax.

**CITY, COUNTY, AND FEDERALLY OWNED LAND**

Work performed on city, county or federally owned lands falls under Section 1-7.2(1) of the Standard Specifications and Department of Revenue rule 171. Retail sales tax is not required on the total contract amount.

The Contractor is required to pay retail sales tax on all purchases regardless of use (“consumable” or not). For contract work, this expense is incidental and therefore included in the individual contract items as a part of the bid amount.

When calculating or estimating the cost of force account or change order work, sales tax should be included on all invoices. As stated previously, the fact that taxes are shown or not shown on invoices is not a reliable indication of what the contractor is obligated to pay. The contractor may receive reimbursement later or be required to pay additional taxes when the contract is complete. The contractor’s books are audited by the Department of Revenue upon completion of each project to ensure compliance.

### Exceptions

Construction of the following facilities has been specifically exempted from Department of Revenue rule 171. Work on these facilities falls under Department of Revenue rule 170 even if they are on non state owned land:

- Water mains
- Sanitary sewers, if they are not a part of the road drainage system
- Telephone and telegraph lines
- Electrical power, if such power does not become a part of a street or road lighting system
- Other conduits or lines

### Conclusion

Most of the time, retail sales tax on invoices is required. In turn, we need to reimburse the contractor for the tax (paid or deferred) on force account invoices and include the costs when estimating the value of change order work.

The one exception is “resale” items if the contract falls under Department of Revenue rule 170. “Resale” items under this rule do not require that retail sales tax be paid at the point of purchase.

These rules should be adhered to regardless of whether retail sales tax is shown on the invoice.

### Subcontractor Markup

If work is being performed by a subcontractor (or by a service supplier acting in the manner of a subcontractor), then a supplemental markup will be added. This supplement will be added one time for each payment, even if a lower-tier subcontractor is doing the work. The markup is a graduated step down rate, which gets smaller for each force account item as the amount of work increases.

The amounts on which the rate is determined will be tracked separately for each subcontractor on each force account item included in the original contract or added by change order. If two subcontractors work on the same force account, then the accumulated total will be tracked for each, and markup for work done by each will be according to the respective total. If a single subcontractor works on two force accounts, then there will be a running total of work done by that subcontractor on each account and the markup rate for the same sub on different force accounts could be different.
1-2.4D(3) Records and Source Documents

Accurate daily time records should always be kept when performing force account work. Form 422-008, “Daily Report of Force Account Work”, is provided for the Project Engineer’s use to help facilitate timely, accurate, and complete records of the daily force account activities. Whatever method of record keeping is used, it is recommended that the document be signed by both the Inspector and a representative of the Contractor agreeing on the materials used and the hours noted for labor and equipment. A copy of the daily report must be provided to the Contractor. When the work is performed by a subcontractor, a copy should also be provided to the subcontractor.

The costs for force account work should be determined and entered into the CAPS system in as timely a manner as possible.

All calculations for determining force account costs should be checked, initialed, and dated. After the cost of the work has been computed in the office, a copy of calculations shall be furnished to the Contractor.

1-2.4D(4) Summary

To summarize, the purpose of force account is to fully reimburse the Contractor for costs incurred on the work. The objective of force account administration is to minimize the inclusion of any “contingencies” included in the contract bid in anticipation of costs that may be incurred during force account work and not reimbursed.

Items which are bid or negotiated with a unit price or a lump sum agreement will not be converted to force account unless a change (as defined in Section 1-04.4 of the Standard Specifications) has occurred. On the other hand, any work to be done or the remaining portion of work underway on a force account basis may be converted to unit prices or a lump sum at any time the parties can reach an agreement. Such a conversion is highly desirable and should always be a goal of the Project Engineer.

1-2.4E Differing Site Conditions (Changed Conditions)

There are two types of changed conditions. The first (Type I) is a hidden condition that is different from that indicated by the contract (the borings do not show this rock). The second (Type II) is a hidden condition that is not shown differently in the contract, but is unusual and different from what a reasonably prudent contractor would expect (I’ve never seen this before and nobody else has ever seen it, either). In either case, to qualify for renegotiation, the condition must have a “material” affect on the cost of doing work. In other words, there must be a definable difference in the way the work will now be done and that difference must be significant.

The contractual rules included in Section 1-04.7 are related to fair notice and to giving the State an opportunity to examine the condition and, perhaps, order a different approach to the work. If the contractor takes away this opportunity, then there may be grounds for denying compensation for the different approach to the work. In some cases, the changed situation is not recognized until much or all of the work has been done. In that case, the determining factor for notice is the time when the Contractor knew or should have known of the condition. Whenever notice is served, it must be written.

In a perfect world, a changed condition will be recognized, notice will be given and work will be stopped until all the interested parties can reach agreement on how to proceed. In the real world, we are often faced with traffic closures and safety issues. Contractors work on tight schedules with one activity interdependent on others and it is not in the public interest to stop work while a changed condition discussion takes place. As soon as possible, to the extent possible, and in any manner which accomplishes the intent, the Project Engineer is expected to consult with the Region Construction Manager and the State Construction Office to obtain the approval before agreeing that a changed condition exists or before entering negotiations for price adjustments.

The Department response to a contractor’s assertion of changed conditions, whether agreement or denial, must be written. The Project Engineer must keep accurate time and material records whether the response was negative or positive.

1-2.4F Termination of Contract

Contract termination is divided into two major categories, termination for default and termination for public convenience. Section 1-08.10(1) of the Standard Specifications defines the situations when a contract may be terminated for default (doesn’t happen very often.) Section 1-08.10(2) of the Standard Specifications defines the situations when a contract may be terminated for public convenience.

Keep in mind that the conditions of the termination may be negotiated in the event that the termination is in the best interest of both parties. An example would be if a major change is beyond the abilities of the contractor. Negotiations with regard to conditions of the termination may include pricing partially completed items, mobilization payment, or the State taking possession of fabricated/purchased materials.

In both categories, if federal funds are involved, FHWA needs to be notified and informed of the situation early in the process. Specifically, Federal participation eligibility should be discussed prior to making a decision on termination. Formal notification and discussion should use normal channels through the Region to the State Construction Office. Authority to terminate a contract rests with the same position that had authority to execute the contract.
1-2.4G Subletting Portions of the Contract

Requests by the Contractor for subletting are submitted on Form 421-012 (Request to Sublet) and are to be approved by the Regional construction manager or designee. The request must be approved prior to the performance of any work on the project by either the subcontractor or a lower-tier sub. A copy of the Statement of Intent to Pay Prevailing Wages, executed by the subcontractor or lower-tier sub and approved by Washington State L&I, must be provided to the Project Engineer by the Contractor prior to payment for any work performed by that subcontractor or lower-tier sub. In addition, for Federal-aid projects, Form 420-004 (Contractor and Subcontractor or Lower-Tier Subcontractor Certification for Federal-aid Projects), must be submitted with the Request to Sublet.

If a subcontractor wishes to further sublet a portion of its work to a lower-tier firm, the Contractor must submit the name of the lower-tier firm along with the request to sublet the work to the subcontractor. If more than one subcontractor on a project wants to utilize the same firm as a lower-tier subcontractor, separate requests are required. Section 1-08.1 of the Standard Specifications sets limitations on the amount of work a lower-tier sub may perform for each subcontractor. Section 1-08.1 of the Standard Specifications also sets forth the procedure for subletting portions of the project, and the percentage of the contract which may be sublet. The dollar value to be used for determining the amount of work that must be performed by the Prime Contractor is the total original contract amount less the amount of any specialty items which have been subcontracted. The Project Office will enter data from the request to sublet into the CCIS database. When the Project Office is in a situation where the CCIS database is not utilized during the administration of a project and requires the “hand calculation” of the percentage of amount sublet, the percentage will be calculated for all items except specialty items, using the amount shown on the Request to Sublet or the bid amount whichever is smaller.

When Condition of Award items are sublet, ensure that the total amount is equal to or greater than the amount in the Condition of Award letter and that the Condition of Award items will be sublet to the proper Condition of Award subcontractor. If a bid item shown on the Condition of Award letter is not sublet to the proper D/M/WBE, then the request cannot be approved until the contract is changed.

1-2.4H Contractors’ Shop Plans and Working Drawings

In general, all shop drawings and supplemental details submitted by the Contractor should be checked, in detail, for conformance to all contract requirements before forwarding on for approval or further actions by others. A Change Order is required for any deviation from the contract plans. Any conflicts with the contract plans that have been detected or revisions that may be desired by the Project Engineer should be noted on one copy of the drawings being forwarded to Headquarters for approval. If Change Orders to cover any deviations from the contract plans have been issued, or are being processed, those changes should also be noted.

Figure 1-6 is a list of many of the most common shop plans and drawings, and includes references to the specifications that require them and the section of this manual that covers the procedures for processing them. Use Form 410-025 to transmit all listed bridge and structure plans to the Bridge and Structures Engineer.

The Project Engineer should maintain a log of all shop plans or other drawings received for each contract. Shop plans for items that conform to the contract plans or a standard plan, except those listed in Figure 1-6, should be checked and approved by the Project Engineer.

1-2.4I Relief of Responsibility for Completed Work and Relief of Responsibility for Damage by Public Traffic

Section 1-07.13(1) specifically designates the Contractor as being solely responsible for the completed work or material until the entire improvement has been completed. All work and material, including change order work, is at the sole risk of the contractor and when damaged must be rebuilt, repaired, or restored. When these damages occur to either the permanent or temporary work, and have occurred prior to the contract Completion Date, the costs for these repairs shall be entirely at the Contractor’s expense. However, the specification does provide the contractor exceptions for causes that are generally beyond the contractor’s control.

While the Contractor is fully responsible for the work and materials, the section does provide the contractor some options for relief. Relief is broken into 2 categories. The first category being relief of maintenance and protection for portions of works that have been completed. The second category is for relief of damage caused by the public when it is necessary that the public use the facility during construction. Both options for relief have specific criteria in order to exercise them. While a brief explanation of each option is provided, the Project Engineer should review the entire section 1-07.13 of the Standard Specifications to ensure that the extent of responsibilities are understood and that any relief from responsibility is granted in accordance with those provisions.

Section 1-07.13(2) provides relief to the Contractor from maintaining and protecting specific portions of contract work as they are completed. The Contractor must submit a written request for relief to the Project Engineer. Before granting any relief, the Project Engineer will review the request to ensure that the items of work noted conform to the requirements and limitations outlined in Section
1-07.13(2) of the Standard Specifications and have been fully completed in all respects of the contract. The Regional Construction Manager or designee may approve these requests for relief. Relief may be granted for several specific items, for example: “Item 17, Beam Guardrail, Type I; Item 18, Beam Guardrail Anchor Type I; etc.” Relief may also be granted for all work except certain items, for example: “All work except Item 38, Electrical.” The approval of the Contractor’s request must be in writing.

When it is necessary for public traffic to utilize a highway facility during construction, Section 1-07.13(3) of the Standard Specifications provides relief of responsibility to the Contractor for damage caused to the permanent work by the public traffic. When the conditions specified in this section are met, the Contractor is automatically relieved of this responsibility. However, this section does not provide relief for damage caused by vandalism or other causes. The Contractor will resume full responsibility for both temporary and permanent work if traffic is relocated to another section of roadway. This responsibility will again continue until contract completion unless the section is reopened to public traffic or the Contractor is granted relief under 1-07.13(2).

The first paragraph of Section 1-07.13(3) refers to damage to “permanent work.” This refers to work included in the contract that is being constructed in accordance with the requirements noted in the plans and specifications and is damaged. The intent is to exclude equipment, temporary facilities and temporary materials such as formwork and falsework. Contract features such as “Temporary Traffic Barrier,” are included if they have been constructed according to plan and are damaged by public traffic using an approved traffic plan.

1-2.4J Protested Work

Occasions may arise where the contract may not have fully or clearly defined a work activity or financial responsibility. In these cases, the Project Engineer may determine that, in order to avoid delay of other critical work, protect the traveling public, or other critical circumstances, it may be necessary to direct the Contractor to proceed immediately to complete the work. In some instances, this order may be against the Contractor’s wishes. While acknowledging the Contractor’s verbal protest, the Project Engineer should again direct the contractor to proceed with the work in accordance with Section 1-04.5 of the Standard Specifications. The Contractor should also be advised that, as a separate action, they should follow the guidance in this same section for protest and protest resolution. While these provisions require the Contractor to keep accurate records for completing the protested work, it is not advisable for the Project Engineer to rely on these records to determine what may have taken place when trying to verify costs for protested work many months later. In order to help document the Contractor’s work, the form “Report of Protested Work” (DOT Form 422-007) was developed as a tool for the Project Engineer’s use.

1-2.4K Metric Designed Projects Administered with English Standard Specifications

Some recent projects, whose plans were developed using Metric dimensions, are being administered utilizing the English version of the Standard Specifications. Any dimensions in the Standard Specifications, Amendments, or Special Provisions that are expressed in English terms are to be converted, utilizing a precise arithmetic “hard” conversion method, to equivalent Metric units, when necessary, to be compared to the contract documents, field conditions or Contractor’s equipment or operations.

To accomplish the conversion to English specifications, a series of General Special Provisions have been developed to replace those Metric specifications that contain soft conversions. In all cases, the English specifications have been left intact so that, if items must be added through change order, English units may be utilized with the reference to the Standard Specifications without including all the Metric specs in the change order.

When making payment to the contractor, the project office should measure and pay for the bid item, either Metric or English, indicated as the unit of measure in the contract plan or change order. For example, if the contract calls for “Clearing and Grubbing” to be paid for by the hectare, then the engineer should instruct his crew to measure and pay for the work performed in metric units and the opposite would apply if a change order was written for the project utilizing the English specifications for clearing and grubbing, in this case the bid item would be measured and paid for by the acre.

If a situation arises when a conversion is required for an interpretation, a measurement or a payment from English Units to Metric Units, it will be converted utilizing a “hard” conversion factor. In the case of a payment, the level of precision of the factor will be such that the resulting payment will not vary from the true calculated value by more than one dollar.

1-2.5 Contract Time

1-2.5A General

The length of time allotted to the Contractor for completing the work on the contract is stated in the contract provisions. This time allotment is usually referred to in terms of working days. As a result, the guidance in this chapter pertain to contracts in which time is allotted to the Contractor on a working day basis. The provisions for progress schedules are noted in Section 1-08.3 of the Standard Specifications. The contract provisions may also contain requirements that add to, or supersede, all or part of Section 1-08.3.
<table>
<thead>
<tr>
<th>Working Drawing Type</th>
<th>Const Manual Spec References</th>
<th>Standard Spec References</th>
<th>Number of Copies</th>
<th>Reviewer Prior to Approval</th>
<th>Approving Authority</th>
<th>Distributor of the Approved Drawings</th>
<th>Distribution (surplus copies stay @ PE)</th>
<th>Notes</th>
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<tr>
<td>Cofferdams and Cribs</td>
<td>6-1.5</td>
<td>6-09.3(3)D which refers to Sections 6-01.9 and 6-02.3(16)</td>
<td>6 sets to Bridge 2 sets to PE 4 additional sets to Bridge if RR is involved</td>
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<tr>
<td>Precast Concrete Panels</td>
<td>None</td>
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<td>1 set to State Const. 2 sets to Contractor 1 set to Fabrication Inspector</td>
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<td>Bridge Demolition Plans</td>
<td>None</td>
<td>None, See Special Provisions</td>
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<td>Project Engineer</td>
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<td>6-02.3(16)</td>
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<td>Bridge &amp; Structures Engineer</td>
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<td>Section 6-02.3(16) notes that plans are not required for walls under 8 foot in height or for footings PE Stamp is Req’d</td>
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<td>Plans for Hydraulic Items</td>
<td>7-2</td>
<td>None</td>
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<td>Project Engineer</td>
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<td>2 sets to Contractor 1 set to Region Const</td>
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<tr>
<td>Shop Plans for Luminaires and Traffic Signal Poles &amp; Metal Bridge Rail</td>
<td>8-20.2B</td>
<td>8-20.2(1)</td>
<td>6 sets</td>
<td>Project Engineer &amp; Bridge &amp; Structures Engineer</td>
<td>Bridge &amp; Structures Engineer for light standards and Types II, III, IV, V and SD signal standards. Project Engineer for Types PPB, PS, and I signal standards shown on Standard Plan J-7a.</td>
<td>Project Engineer</td>
<td>2 sets to Contractor 2 sets to Fabrication Inspector</td>
<td>Shop drawings are only required for signal and light standards without pre-approved plans.</td>
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<td>6-2.8</td>
<td>6-02.3(26)A</td>
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<td>Bridge &amp; Structures Engineer</td>
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<td>1 set to State Const. 2 sets to Contractor 1 set to Region Const.</td>
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<tr>
<td>Working Drawing Type</td>
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<td>Shop Detail Plans of Prestressed Concrete Girders, Prestressed &amp; Precast Conc Piles</td>
<td>6-2.7A</td>
<td>5</td>
<td>Project Engineer &amp; Bridge &amp; Structures Engineer</td>
<td>PE can approve standard series I girders and concrete piling on standard plans E-4 &amp; E-4a - all other prestressed concrete products and precast piles to Bridge &amp; Structures for approval</td>
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<td>Project Engineer &amp; Bridge &amp; Structures Engineer</td>
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<td>Project Engineer</td>
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<td>Shop Plans for Sign Structures</td>
<td>8-21.3</td>
<td>6</td>
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<td>Project Engineer for Standard Plans G2 through G9a Bridge &amp; Structures for special design sign structures or sign fittings</td>
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<td>1-2.4H</td>
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<td>Project Engineer</td>
<td>Project Engineer</td>
<td>2 sets to Contractor 1 set to Fabrication Inspector</td>
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<tr>
<td>Shop Plans for Structural Steel for Bridges</td>
<td>6-5.1</td>
<td>8 sets to Bridge 4 additional sets to Bridge if RR is involved</td>
<td>Project Engineer &amp; Bridge &amp; Structures Engineer</td>
<td>Bridge &amp; Structures Engineer</td>
<td>Project Engineer</td>
<td>1 set to Region Const 2 sets to State Mat'l's Lab 2 sets to Contractor</td>
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<td>Treated Timber Structures</td>
<td>6-4.1</td>
<td>6</td>
<td>Project Engineer</td>
<td>Project Engineer</td>
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<td>2 sets to Contractor 1 set to Fabrication Inspector</td>
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<td>Water Distr Conc Cyl Pipe</td>
<td>9-4.69</td>
<td>7</td>
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<td>Project Engineer</td>
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<td></td>
<td></td>
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<tr>
<td>Welding Reinforcing Steel</td>
<td>6-2.6D</td>
<td>7 welding procedure</td>
<td>Project Engineer &amp; Bridge &amp; Structures Engineer</td>
<td>Bridge &amp; Structures Engineer</td>
<td>Project Engineer</td>
<td>2 sets to Contractor 2 sets to Fabrication Inspector</td>
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<td></td>
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<tr>
<td>Welding Steel Piling</td>
<td>6-5.6</td>
<td>7 welding procedures</td>
<td>Project Engineer &amp; Bridge &amp; Structures Engineer</td>
<td>Bridge &amp; Structures Engineer</td>
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<td>2 sets to Contractor 2 sets to Fabrication Inspector</td>
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<td>Welding Structural Steel</td>
<td>6-3.6C</td>
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<td>Project Engineer &amp; Bridge &amp; Structures Engineer</td>
<td>Bridge &amp; Structures Engineer</td>
<td>Project Engineer</td>
<td>1 set to Region Const 2 sets to State Mat'l's Lab 2 sets to Contractor Welding procedures must be submitted with shop drawings. (Section 6-03.3(25))</td>
<td></td>
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</tr>
</tbody>
</table>
Progress schedules should depict, in graphic form, the operations and relationships in order of performance, with sufficient detail that the progress of the work can be evaluated accurately at any time during the performance of the contract. After review and approval of the progress schedule by the Project Engineer, an approved copy should be returned to the Contractor. At a regular interval, the Project Engineer should review the approved progress schedule, comparing it to the current progress of work. When the Project Engineer determines the original or any supplemental progress schedule does not provide the information needed, a supplemental schedule may be requested from the Contractor. The contract provisions may also require supplemental or periodical progress schedules from the Contractor.

The Contractor may begin work as soon as the contract is executed and shall prosecute the work diligently until physical completion has been reached.

The Region will be notified by telephone on the day the contract is executed by WSDOT. Because it can take several days for the executed contract to reach the Contractor, the Region should immediately provide the Contractor with verbal notification of the date of execution so that the Contractor may order materials and make preparation to mobilize onto the project and begin work. The date the contractor actually begins work on the project is to be noted and entered into CCIS.

Between the execution of the contract and the acceptance by the State Construction Engineer, the Project Engineer will likely encounter one or more of several time-related issues. These include Weekly Statements of time charged, Suspensions of Work, Delays to the Work, and Time Extensions.

Contract Completion Milestones

There are four milestones that help identify when the project has been completed or is nearing completion:

- Substantial Completion — When the contract work is completed to the extent that WSDOT has full use and benefit of the facilities, and only minor incidental work remains to physically complete the total contract.
- Physical Completion — When all of the work is physically completed on the project. Not all the documentation required by the contract necessarily needs to be furnished by the Contractor by this date.
- Completion — When all work specified in the contract is completed and all the obligations of the Contractor under the contract are fulfilled. All documentation has been submitted by the Contractor.
- Final Acceptance — When the State Construction Engineer accepts the contract by signature on the Final Contract Voucher Certification.

1-2.5B Working Day Charges

When contract time for the project is expressed in working days, the first working day will be established in accordance with Section 1-08.5 of the Standard Specifications or such other date as prescribed by the contract provisions. Time associated with each phase of work established in the contract is to be shown on the Weekly Statement of Working Days. The Project Engineer is to furnish a weekly statement advising the Contractor of the current status of working day charges against the contract. Weekly Statements are generated by the CCIS computer system. This statement is to be issued in accordance with Section 1-08.5 of the Standard Specifications. The purpose of this statement is to advise the Contractor about the Project Engineer’s decision for each passing day. Was it a nonworking day, a chargeable working day or an unworkable day? In evaluating each day, the Project Engineer should take into consideration the following conditions:

1. The effect of inclement weather on critical activities.
2. The effect of conditions caused by inclement weather on critical activities.
3. Traffic restrictions imposed by the contract or the Project Engineer or other events or conditions beyond the control of the Contractor that affect a critical activity, except where the contract prevents the allowance of unworkable days for specific reasons.

If any of the above conditions prevent work or reduce the Contractor’s efficiency on critical activities on the project, working day charges must be adjusted accordingly. If no work can be performed on critical activities, an unworkable day should be granted. If the Contractor is able to continue work on critical activities but the efficiency is significantly reduced, a partial day may also be charged. However, the use of partial days should be limited to the nearest one half day.

Section 1-08.5 also allows the Contractor to protest working day determinations and working day charges determined by the Engineer. In the event the Contractor submits the required written protest within 10 calendar days following the date of the statement, the Project Engineer will analyze the decision made, identify any discrepancy, and immediately respond to the Contractor by either denying the protest or transmitting a revised Weekly Statement of Working Days.

The Project Engineer will complete Weekly Statements of Working Days throughout the course of the project, showing both workable and unworkable days as they occur. These statements will continue to be completed until the project has reached Substantial Completion and the Working Days assigned to the contract have been exhausted. Following are the three possible scenarios:
The working days are exhausted prior to reaching Substantial Completion. Weekly Statements of Working Days continue until Substantial Completion.

The working days are exhausted on the day Substantial Completion is achieved. Weekly Statements of Working Days cease upon Substantial Completion.

The working days are not exhausted upon reaching Substantial Completion. Weekly Statements of Working Days continue until the working days are exhausted or until physical completion.

With both these milestones reached, preparation of Weekly Statement of Working Days may stop. When Substantial Completion has been achieved the Project Engineer will ensure that the date is entered into CCIS and is also noted on the remaining Weekly Statements of Working Days.

When contract time is expressed in calendar days, the contract provisions should also be reviewed for guidance in the charging of contract time.

1-2.5C Suspension of Work and Delay

When, in the judgment of the Project Engineer, inclement weather, or conditions caused by inclement weather, make it impracticable to achieve satisfactory results on a critical item of work, an order should be issued to suspend the affected portions of the contract work or the entire project. If at all possible, suspensions for weather should be made with the concurrence of the Contractor. If the Contractor does not agree to a weather suspension, the Project Engineer should consult with the Region Construction Manager before issuing a unilateral suspension.

In addition, subject to the agreement of the Contractor and the approval of the Regional construction manager, delays caused by other conditions beyond the control of the Contractor may also warrant an order to suspend work.

Short suspensions of less than a week may be shown as unworkable days on the current Weekly Statement of Working Days. If the suspension is of longer duration, for example during a winter shutdown, the publication of Weekly Statements may also be suspended. Notices to suspend or resume work should be written. Forms 421-006 and 421-007 have been developed for this purpose and may be used. A letter will accomplish the same purpose. If it is determined that some items of noncritical work on the project could be continued unaffected by weather conditions, then those items can be excluded from the order to suspend work. The prime consideration for unworkable days or suspensions is always the ability to work on critical items.

In the event that a suspension of work for weather or for other reasons beyond the control of the contractor is necessary for an extended period of time, the Project Engineer may recommend that the Contractor be relieved of routine maintenance during the period of suspension. Before WSDOT will assume the responsibility for maintenance, the Contractor must have taken all necessary actions to control erosion, pollution, and runoff prior to, and during, the shutdown period. The extent of the project area that will be maintained by WSDOT is the subject for a three party negotiation and agreement among the Project Engineer, the Maintenance Superintendent and the Contractor.

Section 1-08.6 of the Standard Specifications provides that the Contractor may be entitled to compensation and/or time extensions if a delay is caused by WSDOT or, in some cases, when the delay is caused by an outside party.

Anytime that a project is delayed for any cause, the Project Engineer and the Contractor should consider methods of mitigating the delay damage. A common approach is to pursue schedule recovery or acceleration of the work to get the project back on schedule. When the Project Engineer suspects that the State may be responsible for the delay, then compensation for the mitigation efforts may be proposed.

The suspensions described above are related to weather or other causes beyond the control of the Contractor. They apply only to critical work items and, therefore, always result in a determination of an unworkable day. If the Engineer and the Contractor agree to stop working on a noncritical item for one of these causes but to continue critical work, then the agreement should be noted in the records and weekly statements should be issued in the normal fashion.

The contract also gives the Engineer the right to suspend work on any part of the project when the Contractor is not complying with the contract’s terms or the orders of the Engineer. This would be a significant action and, except in an emergency situation, should not be undertaken without the full and informed consent of the Region Construction Manager. It is highly recommended that the State Construction Office also be consulted. If work is suspended under this contract provision, then weekly statements and the charging of workable days will continue in the normal fashion.

1-2.5D Extension of Time

Time extensions are appropriate whenever the critical work is interrupted by a cause that is the responsibility of WSDOT. Time extensions may be related to increases in quantities, to changes in the work or to delays that are the responsibility of WSDOT. In all cases, the increase, change or delay must extend the project duration or an extension is not appropriate.
The contract requires the Contractor to request time extensions within 10 days after the delay occurs. If a delay has been identified, the Project Engineer should enforce this provision. It is acceptable to agree to change order language that defers the discussion of time to a later date. If the delay doesn’t occur at an identifiable time (as in the case of a significant overrun of a critical item), then the time extension discussion will probably take place when the final outcome is recognized. Before discussing a time extension for which adequate notice was not given, the Project Engineer should discuss the situation with the Region Construction Manager seeking guidance. It is very important to recognize extended project duration as soon as possible. The Contractor should be encouraged to identify potential time extensions and bring them to the State’s attention at the earliest opportunity. If possible, all time associated with an overrun would be addressed in a change order responding to Section 1-04.6. All time associated with added work would be addressed in the change order adding the work and all delayed initiated time extensions would be resolved as soon as the delay was noted and State responsibility established. It would be appropriate to act unilaterally to address time if the contractor avoids the discussion.

If these time issues are not addressed concurrently with the work issues, then a time discussion will be necessary at the time of project closeout, prior to the presentation of the Final Contract Voucher.

The State has a responsibility to inform the Contractor’s surety whenever increased time is being considered and the current extension, combined with previous extensions, would exceed 20% of the original allotted time in the contract. This information could be represented by the Surety’s signature on the change order that adds time, by a separate letter from the Surety, or by a notice letter direct to the Surety office. Such notice and surety consent is a legal requirement and will help maintain the State’s rights to be protected by the performance bond.

Any time extension will be documented either in a change order with approval levels defined in Section 1-2.4C of this Manual or in a letter to the Contractor from the State Construction Office.

1-2.5E Substantial Completion

Substantial Completion may be granted when only minor, incidental items of work, replacement of temporary facilities or correction or repair remain in order to physically complete the contract. In determining Substantial Completion, the Project Engineer should consider whether or not:

- The public has full use and benefit of the facility.
- Major safety features are installed and functional, including guardrail, striping, and delineation.
- Illumination, if required, is installed or a temporary system with equal functional capabilities is operating.
- Signals, if required, are installed or a temporary system with equal functional capabilities is operating.
- The need for temporary traffic control on a regular basis has ceased. Only minor traffic restrictions will be needed for the remaining work.
- The traffic is operating in its permanent configuration.

The Project Engineer is responsible for determining the Substantial Completion date. When this has been done, the Contractor will be notified by letter, specifically noting the date on which Substantial Completion was achieved.

1-2.5F Date of Physical Completion

The date on which the Project Engineer determines that all physical work has been completed is noted and then established as the date of Physical Completion. The Project Engineer will immediately notify the Contractor by letter of the date determined for Physical Completion. Copies of the letter will be sent to:

- The State Program Management Office.
- The Railroad companies, if applicable.
- The State Accounting Services Office.
- The Regional Local Programs Engineer on all city and county projects.
- The State Roadway Data Office, MS 47380.
- Any other distribution that the Region deems appropriate.

Actions the Project Engineer should consider taking once Physical Completion has occurred include:

- Initiate a discussion of contract time.
- Identify any unresolved disputes and initiate discussions.
- Initiate a full review of item quantities, seeking contractor concurrence.
- Initiate a final review of materials documentation.
- On Federal-aid projects, initiate a Stewardship Final Inspection.

1-2.5G Liquidated Damages

Liquidated Damages must be resolved before the final estimate can be completed and processed. Guidance for assessing Liquidated Damages can be found in Section 1-08 of the Standard Specifications, and in some cases, in the contract provisions.

Any withholding or assessment made against the Contractor’s payments, is to be preceded by a fair notice written communication to the contractor. For those issues that could be remedied with actions taken or initiated by the Contractor, this notice should also include a reasonable
period of time that will allow the contractor to take action to mitigate or completely avoid the withholding or assessment.

The term “withhold” refers to a temporary deduction shown on a progress estimate. The term “assess” refers to a permanent deduction that could be shown on a progress estimate, but will be shown on the final estimate. Liquidated damages fall into two categories — one deals with contract time and the other deals with miscellaneous provisions such as ramp or lane closures. These two categories are described below.

1-2.5G(1) Contract Time Liquidated Damages

Section 1-08.9 of the Standard Specifications (and, at times, the contract provisions) establishes the amount of Liquidated Damages to be assessed the Contractor for overruns in contract time. These assessments are either:

1. the formula calculated liquidated damages, or the liquidated damages prescribed by the contract provisions;
2. the direct engineering and related costs. All temporary withholding or final assessment of these Liquidated Damages are to be shown as a below the line “Liquidated Damages” deduction on progress estimates and the final estimate.

The State Construction Engineer has not subdelegated to the Region the authority to assess time related damages on progress estimates or the final estimate. However, the authority to withhold below the line “Liquidated Damages” on progress estimates has been subdelegated to the Regions, and may be further subdelegated to the Project Engineer. See Section 1-3.1B(5) of this manual. Liquidated Damages should be addressed whenever it is apparent that the number of working days provided in the contract will be used before Substantial Completion. It is emphasized once again that fair notice and communication is necessary as a legal requirement.

In some cases, there are legitimate reasons for time extensions which would preclude withholding liquidated damages on progress estimates. If the Project Engineer is aware of or anticipates a possible time extension that would preclude withholding liquidated damages on progress estimates, the Region and/or the State Construction Office should be consulted for guidance. If the Project Engineer determines that withholding of liquidated damages on progress estimates would not be appropriate, the reasons for not withholding are to be documented by a memorandum to the files. The following describes the procedures for addressing contract time related liquidated damages in the various stages or phases of the project:

- Phases (Interim Physical Completion Dates). Liquidated damages for phases will be shown in the special provisions. When the contract includes additional phases, and the time for physical completion of a phase has overrun, the overrun should be resolved as it occurs. This involves the Contractor either being granted an extension of time or being assessed liquidated damages by the State Construction Office.

- After Substantial Completion Date of the Contract. If substantial completion is granted after the expiration of contract time the formula for liquidated damages in Section 1-08.9 of the Standard Specifications will be assessed for that period of time between the expiration of contract time and the substantial completion date. Liquidated damages assessed after the date of substantial completion will be only those costs identified as Direct Engineering and related costs that have been incurred by WSDOT. The direct engineering and related costs are defined as field engineering and inspection time charges plus any vehicle, travel pay, per diem, or other charges connected with the delayed contract physical completion. Engineering costs such as computing grades, quantities, etc. which would have been incurred by WSDOT under normal conditions should not be included in the determination of direct engineering and related costs. If substantial completion is granted on or prior to the expiration of contract time, direct engineering costs will only be assessed for that period of time between the date contract time expired and the physical completion date.

- Before Physical Completion. If Substantial Completion has not been established, the formula for Liquidated Damages in accordance with Section 1-08.9 of the Standard Specifications, will be assessed for that period of time between the expiration of contract time and the Physical Completion date.

Working days added to the contract by time extensions when time has overrun shall only apply to the days on which Liquidated Damages or Direct Engineering have been charged, such as:

- If Substantial Completion has been granted prior to all of the authorized working days being used, then the number of days in the time extension will eliminate an equal number of days on which Direct Engineering charges have accrued.

- If the Substantial completion date is established after all of the authorized working days have been used, then the number of days in the time extension will eliminate an equal number of days on which Liquidated Damages or Direct Engineering charges have accrued.

1-2.5G(2) Miscellaneous Liquidated Damages

The contract provisions may provide for assessment of other liquidated damages, such as failure to open traffic lanes within the prescribed time or failure to open ramps within the prescribed time. Any temporary withholding or final assessment of these liquidated damages shall be shown as a below the line “miscellaneous” deduction on progress estimates and the final estimates. The State Construction Office has subdelegated the authority to the Regions to withhold and assess these types of liquidated damages on progress estimates and the final estimate. The Project Engineer shall notify the Contractor in writing when these types of liquidated damages are to be assessed.
1-2.5H Completion Date
Immediately after the Physical Completion date has been established, the Project Engineer is to notify the Contractor of all outstanding documents that are required in order to establish a project Completion Date. Once all the obligations of the contract have been performed by the Contractor, the Project Engineer will provide the Contractor written notice of project completion, identifying the Completion Date established for the contract.
In order for the project Completion Date to be established, all the physical work on the project must be completed, and the Contractor must have furnished all documentation required by the contract, contract provisions, and the Standard Specifications. This includes the signed Final Contract Voucher Certification. (Note: Establish the Completion Date as soon as the last item of paper work is received. The final estimate does not have to be processed in order to establish the Completion Date.) The notice to the Contractor should be prepared and mailed on the same day that is designated as the completion date. A copy of the completion letter must be faxed to the contract payments section of the State Accounting Services Office, (fax number (360)705-6804) on the day the letter is written.

If the Contractor refuses, or is unable to return, a signed FCVC or any of the required documents, the Project Engineer, the Region and the State Construction Office can work together to move the project towards closure by establishing a unilateral completion date allowing WSDOT Acceptance of the contract. See Chapter 1-3.1D for Unilateral Acceptance procedures.

1-2.6 Enforcement of Wage Rate Requirements
1-2.6A General Instructions
Section 1-07.9 of the Standard Specifications outlines prevailing wage responsibilities for the Contractor, subcontractors, lower-tier subcontractors, agents or any other persons performing work under the contract. Additionally, contracts financed in whole or in part with federal funds have the Required Contract Provisions for Federal-aid Construction Contracts (FHWA-1273) included in the contract documents. These provisions identify additional federal wage requirements.
Contracts that are financed by either state or federal funds, or both, will include specific Hourly Minimum Wage Rates and Fringe Benefit schedules from either or both the Washington State Department of Labor and Industries (State L&I) and the United States Department of Labor (USDOL). When both state and federal funds are involved and there is a difference between the two prevailing wage determinations, the Contractor, subcontractors, and lower-tier subcontractors must pay a wage of not less than the higher of the two in order to remain in compliance with both prevailing wage laws. Comparisons that are made between state and federal wage rates must include their corresponding fringe benefits as identified in their respective state or federal wage determinations.

1-2.6B Monitoring of State Requirements
The requirements for the Contractor’s compliance with State prevailing wages are noted in Section 1-07.9 of the Standard Specifications. Specific wage rate determinations for State prevailing wages are noted in the contract itself. Though certified payrolls can be requested regardless of the contract’s source of funds, these are a specific requirement or enforcement of federal wage laws only and are not normally used for monitoring of State prevailing wage issues.

Requirements for State prevailing wages include:

- Section 1-07.9 requires that the Contractor submit a Statement of Intent to Pay Prevailing Wages (SI) prepared on the State L&I form and approved by that agency. Statements are required for the Contractor and for each subcontractor, agent and lower-tier subcontractor. The specification requires that no progress payments be released to the Contractor for work completed by the Contractor, or for portions of work completed by subcontractors, agents or lower-tier subcontractors prior to the Project Engineer’s receipt of the approved statement for the entity performing the work. State L&I will approve the statements and further certify that the documents meet the requirements of State laws.

- After the project has been accepted by WSDOT, the Contractor, all subcontractors, and all lower-tier subcontractors must submit an Affidavit of Wages Paid (AWP) prepared on the State L&I form and approved by that agency. (The form may be submitted earlier by a subcontractor or lower-tier subcontractor should that firm’s work be completed prior to acceptance.) It is the Contractor’s responsibility to obtain and provide all AWP to the Project Engineer for all subcontractor and lower-tier subcontractors performing work on the project. In the event a subcontractor or lower-tier subcontractor cannot or will not provide a completed AWP form, the Contractor should consult or seek guidance from State L&I. Failure to provide all required AWP for all contractors who worked on the project will result in continued withholding of the prime Contractor’s retained percentage.

- A contractor or subcontractor may enter into an agreement with his or her employees to work 10 hours per day without having to pay overtime. This is provided that no employee work more than 4 calendar days a week.

- State L&I has also defined “Contractor” to include some fabricators or manufacturers who produce nonstandard items specifically for use on the public
works project. Additionally some companies who may contract with the Contractor, subcontractors, or lower-tier subcontractors for the production and/or delivery of gravel, concrete, asphalt, or similar materials may perform activities that cause employees of these firms to be covered by state prevailing wage laws.

Specific circumstances that may cause employees of these firms to be covered by State prevailing wage laws are described in State L&I publications. These publications are included in the provisions of each contract adjacent to the State Prevailing Wage listings. Where these firms are covered by State prevailing wage laws, an approved Statement of Intent to Pay Prevailing Wages and Affidavit of Wages Paid must be submitted to the Project Engineer on State L&I forms.

The Project Engineer should monitor the Contractor’s efforts in regards to state prevailing wages by:

• Monitoring to ensure an approved Statement of Intent is received prior to releasing any progress payments for work completed by the Contractor, subcontractor or lower-tier subcontractors as well as any fabricators or suppliers of materials whom L&I may also determine as being covered.

• Monitoring to ensure that Affidavits of Wages Paid have been received for the Contractor as well as each subcontractor or lower-tier subcontractor who performed work on the contract. In addition, AWP are also required of each fabricator or supplier who was also covered by state prevailing wages.

• Monitoring by observing concerns of employees of the Contractor, subcontractors, or lower-tier subcontractors. In particular, the Project Engineer should note any employee complaints regarding specific state prevailing wage violations by the employer.

In the event the Project Engineer identifies or receives a complaint from any employee of the Contractor regarding improper application or nonpayment of state prevailing wages, or improper application of overtime pay, the Project Engineer should immediately notify the Contractor requesting prompt corrective action. All issues of noncompliance involving either the Contractor, subcontractor, and any lower-tier subcontractors are to be addressed through the Prime Contractor for resolution.

Once the Contractor has been informed that an apparent violation of state prevailing wages has occurred, it is expected that a satisfactory correction or explanation will be made within a reasonable period of time. If this does not happen, the Project Engineer should inform the Contractor that the matter may be referred to the Washington State Department of Labor and Industries (L&I) for further action. If the failure to act continues, the Project Engineer should refer the issue to the Region Construction Manager.

Except as noted for missing Statements of Intent, routine monthly progress payments made to the Contractor for work completed should not be deferred for enforcement of state prevailing wage laws. The State Construction Office will refer the matter to State L&I for further investigation that may be appropriate. Should State L&I choose to investigate, L&I will establish the amount of any unpaid wages due employees of the contractor. In order to recover these wages for employees, L&I may choose to file a claim against the Contractor’s retainage held under the contract. State L&I may also choose to recover unpaid wages by requesting that the Project Engineer withhold funds from monthly progress estimates for work completed by the Contractor.


In addition to the requirements of Section 1-07.9 of the Standard Specifications, all contracts financed with Federal-aid funds include the Required Contract Provisions for Federal-aid Construction Contracts (FHWA-1273). These provisions identify federal wage requirements. The federal prevailing wage requirements included in these provisions are also commonly referred to as Davis Bacon and Related Acts (DBRA). It is the responsibility of the Project Engineer to both monitor and enforce these provisions to the degree necessary to ensure full compliance. In order to comply with these requirements, the Contractor must:

• Submit weekly certified payrolls to the Project Engineer for themselves, each subcontractor, and each agent or lower-tier subcontractor. These consist of copies of weekly payrolls along with an signed Statement of Compliance.

• Post wage rate posters.

• Post the wage determinations of the United States Secretary of Labor. These determinations consist of the listing of Federal Wages that are included in the provisions of each contract.

• Allow interviews of employees during working hours by authorized representatives of WSDOT, the Federal Highway Administration, and the U.S. Department of Labor.

The prime Contractor is ultimately responsible for all subcontractor, agent, or lower-tier subcontractor compliance with the requirements for federal prevailing wages.
1-2.6C(1) Federal Prevailing Wage Rates
The Contractor must post the federal wage determination, consisting of the wage listing included in the contract provisions, in a prominent place where it can easily be seen by workers. Standard posters (forms FHWA 1495 and FHWA 1495A) are also to be posted and are available to the Region from the Support Services Supervisor, FHWA, Olympia, Washington. Form FHWA 1495A is printed in Spanish and is to be posted when the project is in an area where there is a possibility that some workers may only speak Spanish.

1-2.6C(2) Certified Payroll Inspection
The “Contract Provisions for Federal-Aid Construction Contracts” (FHWA-1273) require the Contractor, subcontractors, agents or lower-tier subcontractors to submit certified payrolls. These are to be checked by the Project Engineer to ensure the required information has been included and is correct. The Project Engineer should accomplish this by making a complete check of the first payroll submitted on the project by the Contractor, each subcontractor, and each lower-tier subcontractor. Once satisfied that these first payrolls are correctly prepared, subsequent payrolls for that project may be accepted by a random spot checking of approximately 10 percent of the payrolls submitted. If errors are found during any spot-check of the payrolls, a more complete or thorough check should occur until the Project Engineer has determined that the errors detected have been corrected and monitoring can be returned to a spot checking basis. The Contract Provisions for Federal-Aid Construction Contracts (FHWA-1273) identify the required items to be included in certified payrolls. A complete payroll inspection by the Project Engineer should confirm that the following items are present:

- The contract number and contract name noted on the payroll form, together with the payroll number and payroll period. The name of the employer, identifying the Contractor, subcontractor, or lower-tier subcontractor, must be shown.
- A specific minimum wage rate is to be identified for each worker. The Standard Specifications require the Contractor to use word descriptions for the labor classifications that are included in the contract provisions identifying federal wage rates, and are to be used on all payrolls. Section 1-07.9 of the Standard Specifications permits the Contractor to use an alternative method to identify or correlate the labor descriptions used in order that they may be compared to the contract provisions.

- Each employee’s Social Security number and permanent address must appear on the first payroll on which their name appears, or on a separate list attached to the payroll. Changes in address must be reported.
- Payroll deductions must conform to the “Anti-Kickback” Act noted in the Required Contract Provisions for Federal-aid Construction Contracts (FHWA-1273). If payroll deductions are questionable, contact the State Construction Office for assistance.
- Every laborer or mechanic working on the contract must be classified for the proper minimum prevailing wage in accordance with the designated wage determination. If a classification of worker is used that does not appear in the contract special provisions. Section 1 07.9 of the Standard Specifications makes it the Contractor’s responsibility to contact the U.S. Department of Labor for a determination of the proper wage rate. The Required Contract Provisions for Federal-aid Construction Contracts (FHWA-1273) provides a method for resolving this.
- All payrolls must have a statement of compliance signed and in the form prescribed by Section V of the Required Contract Provisions Federal-aid Construction Contracts (FHWA-1273).
- The Contractor, subcontractor, or lower-tier subcontractor, in accordance with the requirements of DBRA, must certify all payrolls. This certification contains four elements:
  - That the payroll copy furnished is a true copy;
  - That the payroll is correct and complete;
  - That the wage rates contained therein are not less than those determined by the Secretary of Labor, and that the classification set forth for each laborer or mechanic conforms with the work being performed; and
  - That the appropriate fringe benefits due each employee have been paid in full.

Subcontractors and lower-tier subcontractors are required to submit payrolls through the Prime Contractor to the Project Engineer. Any payrolls which do not comply fully with the requirements outlined above must be corrected by a supplemental payroll.

1-2.6C(3) Employee Interviews
The Project Engineer must conduct periodic employee interviews. The purpose of these spot interviews is to establish, with reasonable certainty, that the provisions for federal prevailing minimum wages are being complied with and that there is no misclassification of workers or
disproportionate employment of laborers, helpers, or apprentices. The occupation description must be shown on the form used for the employee interview noted under current duties. The occupation description is noted in the wage listing included in the contract provisions.

Some employees may refuse to reveal their rate of pay. This is acceptable and should be noted in the remarks column. Many employees do not know or may guess at the rate. If possible, a determination of the accuracy of the stated rate should be made, and any uncertainty noted in the remarks column to reduce the need for follow up interviews. If either the stated rate (from the employee) or the record rate (from the certified payroll) is below the minimum rate (from the contract wage listing), an investigation by the Project Engineer must be conducted. The investigation may be as simple as a follow up interview with the employee or a more in-depth investigation may result in a requirement for a supplemental payroll. In any event, the matter must be resolved so that the employee interview report describes what corrective action was taken to ensure that the employee has been paid the minimum prevailing wage rate. This corrective action is to be reported under remarks on the form or by attached memo if more space is needed. All discrepancies found must be resolved.

The frequency and extent of these interviews should be sufficient to ensure a representative sampling has been made for all classes of workers employed on the contract. A minimum sampling should include employees of the Contractor and all major (30 percent or more of the contract dollars) subcontractors. The interviews should be made with such frequency as may be necessary to ensure compliance. Employee Interview Report, Form 424-003, is used to record and report interviews.

1-2.6C(4) Complaints

Any complaints regarding violations of minimum wage rate regulations should be referred to the Project Engineer by employees of the Contractor, subcontractor, or lower-tier subcontractors, should be treated as confidential, and should be promptly investigated by the Project Engineer. If there are questions regarding complaints and the application or interpretation of the federal prevailing wage provisions, the Project Engineer should consider referring the issue to the Region Construction Manager or contacting the State Construction Office for further assistance.

1-2.6C(5) Federal Prevailing Wage Violations

In the event the Project Engineer identifies or receives a complaint from any employee of the Contractor regarding improper application or nonpayment of federal prevailing wages, improper application of overtime pay, or any other requirement noted in the Required Contract Provisions for Federal-aid Construction Contracts (FHWA-1273), the Project Engineer should immediately notify the Contractor requesting prompt corrective action. All issues of noncompliance involving either the Contractor, subcontractor, and any lower-tier subcontractors are to be addressed through the prime contractor for resolution.

If the Project Engineer determines the Contractor is in violation of the provision noted in the FHWA 1273 or Section 1-07.9 of the Standard Specifications, the Contractor should be immediately informed and requested to make the necessary corrective actions. Once the Contractor has been informed that an apparent violation has occurred, it is expected that a satisfactory correction or explanation will be made within a reasonable period of time. If this does not happen, routine monthly progress payments made to the Contractor for works completed, may be deferred by the Project Engineer for enforcement of these provisions. If the failure to act continues, the Project Engineer should refer the issue to the Region Construction Manager.

1-2.6C(6) Department of Labor Investigation

The U.S. Department of Labor may investigate compliance with the DBRA and the Contract Work Hours and Safety Standard Act (CWHSSA) when conducting any investigations relative to compliance with the Fair Labor Standards Act or any other acts under its enforcement authority. Investigative action taken by the U.S. Department of Labor with respect to DBRA and CWHSSA do not, in any way, change the degree of authority or responsibility of WSDOT for enforcement of these Acts. Any actions taken by the U.S. Department of Labor should be considered as services we may use to assist us in our enforcement activities but, should not be considered to relieve us of our basic responsibility to investigate fully all potential violations and to apply such sanctions as are deemed applicable under our enforcement authority to ensure compliance.

1-2.6C(7) Fraud Notice Poster

Fraud Notice, FHWA 1022, Title 18 USC 1020, must be displayed on all Federal-aid projects during the course of the work. This notice points out the consequences of any impropriety on the part of any contractor or WSDOT employee working on the project.

1-2.7 EEO, D/M/WBE and Training

1-2.7A Overview

Recent changes in both State and Federal laws have required a variety of guiding requirements. As a result individual contracts may have different guiding requirements depending on what laws were in place at the time the contract was executed and how the project is funded. The special provisions, Standard Specifications, and amendments determine the specific requirements for each project. The Construction Manual is one of many resources available for general information on the obligations and policy of WSDOT with regard to external civil rights. Other resources include:
1. Office of Equal Opportunity (OEO): OEO monitors, maintains, and updates WSDOT Equal Employment Opportunity (EEO) policies and commitments to FHWA. As part of that effort they maintain the following documents which are available through the OEO homepage:

   - Equal Employment Opportunity Compliance Program (EEO and On the Job Training)
   - Disadvantaged Business Enterprise Participation Plan (contract goals, if included in a project, will be mandatory)
   - Title VI Plan (nondiscrimination)

2. Standard Specifications, as follows, apply to all projects:

   - 1-07.11 Requirements for Nondiscrimination
   - 1-08.1 Subcontract Completion and Return of Retainage Withheld

3. General Special Provisions as may be included in the contract include:

   - Minority and Women’s Business Enterprise (MWBE) Participation (included in projects financed with only State funds)
   - Requirement for Affirmative Action to Ensure Equal Employment Opportunity (included in projects with FHWA participation)
   - Disadvantaged Business Enterprise Participation (included in projects with FHWA participation)
   - Special Training Provisions (included in projects with FHWA participation and only if the contract is selected for training)
   - Indian Preference and Tribal Ordinances (TEROs) (only if the project includes work on the reservation and only if the ordinances exist)

While some requirements and provisions apply to all projects, others apply to projects with State funds only and others yet apply to projects that are partially or fully financed with Federal funding.

**1-2.7B EEO (Federally Funded Projects)**

WSDOT has committed to FHWA to perform comprehensive construction compliance reviews to ensure that the requirements of Section 1-07.11 have been adhered to. This review is performed by the OEO on a selected number of FHWA funded projects and may take place at any point during the life of the project or after the project has been completed. A contractor that found in violation of the contractually required affirmative action good faith efforts will be invited to a compliance conference to develop a corrective action plan. Failure to accept and comply with a corrective action plan may result in sanctions. The records that have been maintained at the Contractor’s office will be utilized for these reviews. The FHWA also retains the authority to review the Contractor’s records for EEO compliance. These reviews do not normally involve the project office other than notification of their occurrence and the resulting findings.

**1-2.7B(1) Prompt Return of Retainage to All Subcontractors**

As a condition of receiving Federal funding, WSDOT is required to ensure prompt payment to all subcontractors on all contracts regardless of funding. State statutes (Revised Code of Washington, RCW) pertaining to prompt pay require that the contracting agency make prompt payment to the prime contractor and that the prime contractor, in turn, pass these payments on to subcontractors in a timely manner.

Return of the subcontractor’s retainage held by the prime contractor is required by the Standard Specifications. This is a race neutral effort intended to support and encourage all small businesses. Therefore, in accordance with the contract provisions, the prime contractor is required to release any and all retainage to the subcontractor within a designated time period after subcontract completion. The Project Engineer has no role in this process other than to respond to allegations of non-compliance with this contract requirement as with any other. We need to keep in mind that our contract is with the prime contractor and as a result, we are not a party to the prime contractor’s subcontract documents. We should avoid becoming involved in prime’s relationship with their subcontractors.

In the prime contractor’s effort to determine completion of subcontract work, as required by the contract provisions, the Project Engineer may be asked to determine completion of a portion of the work. While we need to work with the Contractor to comply with the requirements of the specification, we should also take specific care not to issue partial punch lists or to place ourselves in a position of “accepting” portions of the work. In some cases we may provide the Contractor relief under certain conditions as described in Section 1-07.13 of the standard specifications, “Contractor’s Responsibility for the Work.”

**1-2.7C EEO (State Funded Projects)**

The Contractor is required to comply with the EEO requirements detailed in the Standard Specifications Section 1-07.11, Requirements for Nondiscrimination. In general, these requirements include having an EEO officer, developing, maintaining, making known, and utilizing an EEO program. The Project Engineer should be alert for and respond to any indications or accusations of discrimination and if substantiated, take appropriate actions. The Office of Equal Opportunity and your regional OEO staff are available for guidance and assistance in these types of situations.
1-2.7D EEO (Federally Assisted Projects)

The requirements for EEO and nondiscrimination for federally assisted contracts are similar to what’s required for State funded projects. However, additional monitoring, reporting, and authority are mandated by Federal laws as noted in the Federal contract requirements known as the “FHWA 1273.” The “FHWA 1273” is included in every Federally assisted contract. These requirements are reiterated in the Standard Specifications Section 1-07.11, Requirements for Nondiscrimination.

Reporting

- Federal-Aid Highway Construction Contractors
  Annual EEO Report, Form FHWA - PR1391 — This form is required for all Federally assisted projects provided the prime contract is equal to or greater than $10,000 and for every associated subcontract equal to or greater than $10,000. Each contract requires separate reports be filed for the prime contractor and each subcontractor (subject to the above noted criteria.) These forms are due by August 25th each year in which work was performed in the month of July.

  The payroll period to be reflected in the report is the last payroll period in July in which work was performed. A contractor who works on more than one Federally assisted contract in July is required to file a separate report for each of those contracts. For multi-year projects, a report is required to be submitted each year work was performed during the month of July throughout the duration of the contract. A responsible official of the company must sign the completed report.

  Upon receipt, the Project Engineer will forward this annual report to the Region’s EEO Officer by September 17th. The Region EEO staff at the direction of the OEO will compile and report the information noted on the forms. The figures reported must reflect the number of employees, not hours, in each category, with subtotals broken out for women and minorities and grand totals for the category. Tables A through E reflect both apprentices and on the job trainees that were also utilized within each trade. The form must also include the corresponding subtotals in each category, A through E, broken out by both women and ethnicity.

- Summary of Employment Data Report, Form FHWA - PR1392 — The WSDOT Office of Equal Opportunity (OEO) has developed a program for the reporting of WSDOT’s EEO accomplishments. This program, Equal Employment Opportunity Contractor Compliance Program, requires WSDOT to submit a summary of employment data to FHWA for each Federal fiscal year. This Summary of Employment Data Report, PR1392, is prepared from forms PR-1391 (monthly report) that have been submitted to the Region by the Project Engineer’s offices. This summary is prepared by the Region EEO lead or other Region designee for each Federally assisted project. This reporting also includes Local Agency projects administered through the Region’s Highways and Local Programs offices. The completed PR-1392 summary reports, including all forms PR 1391, are then submitted by the Region EEO lead to the WSDOT Office of Equal Opportunity by September 24th each year.

  • Monthly Employment Utilization Reports, WSDOT Form - 820-010 — This form is required for all federally assisted projects if the prime contract is equal to or greater than $10,000 and for every associated subcontract equal to or greater than $10,000. This report includes the total work hours for each employee classification as well as the total number of employees, broken out by ethnicity, in each trade, for each WSDOT project. Instructions for completing the form can be found on the back of the form itself. These monthly reports are to be maintained by the Contractor in the respective prime or subcontractor’s records.

  Where the prime’s contract is valued at $100,000 or more, the Contractor shall submit copies of the prime’s completed WSDOT Form 820-010 to the Project Engineer. The prime contractor shall also collect and submit these forms monthly from every subcontractor who holds a subcontract with a value of $100,000 or more. These reports are to be submitted to the Project Engineer by the 5th of each month. The project office has a responsibility to make sure these forms are submitted in accordance with the contract requirements. Upon receipt, the Project Engineer will forward the report to the Region EEO staff. The region EEO staff, at the direction of the OEO, will compile, report, and take any action necessary with regard to the information provided by these forms. As a result it is not necessary that copies of these reports be maintained in the project files.

Records Retention and Reviews

The Contractor is required to maintain all project records, including the aforementioned EEO records, for three years following completion of the contract.

1-2.7E Minority and Women Owned Business Enterprise (MBE, WBE)

MBE, WBE is the designation for holding State certification as a minority or women owned business enterprise. The State Office of Minority and Women’s Owned Business Enterprises (OMWBE) certifies businesses as either a minority owned business (MBE), a women owned business (WBE), or a combination of both (M/WBE). On projects funded in whole or in part with State funds, the contract...
provisions will include a MBE, WBE special provision. This provision may specify voluntary goals for the Contractor’s utilization of M/WBE. The provision also includes suggested methods for encouraging M/WBE participation. As noted, these requirements are indeed voluntary and there are neither preferences for accomplishment nor sanctions for noncompliance.

**MBE/WBE Reporting**

- **Annual Report of Amounts Paid MBE/WBE Participants** (Form 421-023). In accordance with Section 1-08.1 of the Standard Specifications, an Annual Report of Amounts Paid MBE/WBE Participants (Form 421-023) is required from the prime Contractor for all projects funded entirely by State funds. When a project contains Federal assistance, the Federal quarterly reporting requirements for DBE utilization override the States requirements, eliminating the need for the State’s annual report of amounts paid.

  This Annual Report of Amounts Paid MBE/WBE Participants report reflects the State fiscal year, July 1 through June 30, and is to be submitted to the Contracting agency by the 20th of July each year and/or upon physical completion of the contract. The dollar amounts shown in the report are those amounts paid to the MBE/WBE firms during the reporting period. The final report is to show only the dollar amounts paid since July 1st through the Physical Completion date. The Region is responsible for entering this data into CCIS. The completed form is maintained as a part of the project records and becomes a part of the temporary final records upon completion.

**1-2.7F Disadvantaged Business Enterprise (DBE)**

DBE is the designation for holding Federal certification as a Disadvantaged Business Enterprise. On Federally funded projects there will normally be a DBE requirement of some sort specified by the contract special provisions. This special provision will be one of two types:

**1-2.7F(1) GSP Includes No Goal**

When *No Goal* is specified, the contractor is encouraged to take actions that promote DBE participation. The goal is intended to draw the bidders attention to the opportunity to subcontract with DBE’s. However, these requirements are indeed voluntary and there are neither preferences for accomplishment nor sanctions for non-compliance.

**1-2.7F(2) GSP Includes Condition of Award (COA) Goal**

When a *Condition of Award Goal* (COA) is specified, the Contractor is required to employ DBE participation to at least the extent identified in the contract special provisions.

- **As a Condition of Award**, the Contractor must commit to and follow through on; subcontracting at least the amount identified by the COA goal to certified DBE firms or make a good faith effort to do so.

- **Measurement of attainment** is not simply the payments made to the DBE. Attainment is measured in accordance with the provisions of the “DBE Participation” section of the contract special provisions.

- **Changes to the amounts specified for COA must be made in accordance with the procedures outlined in this section.**

**1-2.7F(3) Additional Execution Documents**

Successful bidders will be required to provide a “Bidders List” to the Department. This list is to include the names and addresses of every firm that submitted a bid or quotation to the Prime, whether or not that bid was used as part of the overall proposal. The Contractor is directed to send this list directly to the WSDOT Office of Equal Opportunity in Olympia and normally the Project Engineer will have no involvement.

**1-2.7F(4) DBE Reporting**

The contract special provisions require the Contractor to submit to the Project Engineer a “Quarterly Report of Amounts Credited as DBE Participation” for each quarter and upon completion of the project. Again, the measurement is not simply the payments made to the DBE, rather it is in accordance with the “DBE Participation” section of the contract special provisions.

**1-2.7F(5) On Site Reviews**

- **Contract Includes Condition of Award Goal** — On site reviews shall be conducted on contracts that include COA goals when the COA subcontractor starts work, during the peak period of the subcontractor’s work, and whenever there is a change in the nature or methods of the work. On site reviews are also required when a COA subcontractor is replaced. The intent of the overall program and hence the review is to document that the DBE is indeed in control of the work and performing a “Commercially Useful Function” (CUF) as described by the specification. The on site review is a “snapshot in time” and should record personal observations, documentation reviews, and personnel interviews as applicable. A copy of the completed on site review form (272-051) should be forwarded to the WSDOT Office of Equal Opportunity. The Condition of Award letter requires that the identified DBE firms perform specific item(s) of work for the estimated dollar amounts included in the proposal. The letter also identifies whether a firm performs as a “subcontractor,” “manufacturer,” or “regular dealer.” DBE compliance issues should be brought to the attention of the State Construction Office.


**Contract Includes No Goal** —

The state has an obligation to make sure the quarterly reports are reasonably accurate. Taking credit for DBE accomplishments in the reports requires the DBE perform a commercially useful function. WSDOT has committed to FHWA to perform the necessary number of on site reviews such that the project engineer is comfortable that the quarterly reports are accurate. It is suggested that at least one on site review be performed on any DBE that performs a substantial amount of work. Reviews should also be performed when the situation warrants such as sharing of resources with the prime.

**1-2.7F(6) Changes to the Condition of Award (COA)**

The Contractor is required to utilize the COA subcontractors, manufacturers, etc., to perform the work as listed in the COA letter. Substitution of another DBE is allowed if:

- A COA DBE firm becomes decertified, or
- The contractor proposes a change to the contract that reduces DBE COA participation, or
- The prime contractor provides documentation that a DBE firm is unwilling or unable to perform the work.

Exceptions to the substitution requirement may be allowed under any of the following circumstances:

- WSDOT deletes the COA firm’s intended work.
- The contractor can show substantial financial loss if a substitution is required.
- The work has progressed to the point where no other work remains to be subcontracted.
- The DBE subcontractor has taken the positive step of graduating from the DBE program.

**1-2.7F(7) Substitution**

Substitutions must meet the following requirements:

- The new firm must do an equal dollar value of work on the contract.
- The change order does not increase the dollar amount of the original goal.

**1-2.7F(8) Condition of Award (COA) Change Orders**

Changes to the contract COA amounts must be made through a change order. The amounts shown in the COA change order should be limited to the credit necessary to accomplish the original contract goal amount as follows:

- An explanation of why the change is necessary.
- Identification of both the deleted work and the added work.
- Revised subtotals for each affected DBE firm.
- Revised total attainment for DBE participation.
- Documentation of a good faith effort to substitute should go in the change order file, (if required, see 1 2.7F(6)).

The State Construction Office must execute change orders that revise and/or change the COA commitment. When preparing the change order in CCIS pending CO’s menu use option 3, “Condition of Award Items.” Include the first three items listed above in the change order document. When submitting the change order to the Contractor for signature, the Project Engineer should also send copies to the affected DBE firms and should advise the Contractor that this has been done.

**1-2.7G On-the-Job Training (OJT)**

**1-2.7G(1) On-the-Job Training Special Provisions — General**

The requirements for training are made a part of the contract by the special provision, Special Training Provisions. The amount of training is set by the WSDOT Office of Equal Opportunity based on the opportunities presented by the work and the needs in the geographical area involved. The requirements for trainee, training plan approval, and trainee payment are all specified in the contract special provisions.

**1-2.7G(2) OJT Required Reports**

The contract provisions allow the Contractor to accomplish training as part of their work activities, or through the activities of their subcontractors or lower-tier subcontractors. However the prime contractor is designated as being solely responsible for the completion of the training requirements as they are outlined in the contract provisions.

- **Form DOT 272-049 Training Program** — A training program is to be completed by the Contractor. The program must be submitted to the Engineer for approval prior to commencing contract work. The Project Engineer’s office may approve Bureau of Apprenticeship Training (BAT) or the State Apprentice Training Committee (SATC) programs provided they meet the requirements specified in the contract provisions. The Region may also approve a non-SATC or BAT program once concurrence has been received from the WSDOT Office of Equal Opportunity (OEO is required to obtain approval from FHWA before concurring.) Regardless, one copy of Region approved Training Programs should always be submitted to the WSDOT Office of Equal Opportunity.
• **Form 272-050 Apprentice/Trainee Approval Request** — Approval of an individual trainee cannot be authorized until an approved Training Program is filed with the Region. This form is to be submitted by the Contractor for each trainee to be trained on the project. When a BAT/SATC apprentice/trainee is first enrolled, a copy of the apprentice/trainee’s certificate showing apprenticeship/training registration must accompany the Trainee Approval Request. Trainees are approved by the Project Engineer’s office based on the criteria in the special provisions.

• **Form DOT 272-060 Federal-aid Highway Construction Annual Training Report** — This report is to be completed annually by the Project Engineer summarizing the training accomplished by the individual trainees during the reporting period beginning June 1 of the previous year and ending May 31 of the current year. This report is due at the Regional EEO Office by June 10th of each year.

**1-2.7G(3) Payment for “Training”**

At progress estimate cutoff time, the Contractor shall submit a certified invoice requesting payment for training. The invoice must provide the following information for each trainee:

- The related weekly payroll number
- Name of trainee
- Total hours trained under the program
- Previously paid hours under the contract
- Hours due for current estimate
- Dollar amount due for current updated estimate

Retroactive payment may be allowed provided:

- The Training Program is approved
- There are no outstanding issues or circumstances that would have prevented approval of the apprentice/trainee

Increases in training hours are allowable and may be approved on a case by case basis by the Project Engineer in consultation with the Regional EEO Officer.

**1-2.8 Control of Work**

**1-2.8A Authority of the Project Engineer**

The Project Engineer is given considerable authority to enforce the provisions of the contract under Section 1-05.1 of the *Standard Specifications*. This authority is tempered by WSDOT’s policies and delegation of authority from the Engineer to the Project Engineer. Accordingly, considerable care and professional judgment must be exercised by the Project Engineer in order to avoid exceeding the authority as delegated and to avoid decisions or actions that may be contrary to WSDOT policy. Should there be any doubts as to the limits of authority, the Project Engineer should consult the Regional Construction Manager.

In many cases, the courts have held that where the Project Engineer has exceeded the authority provided in the plans and specifications or the authority delegated by the Engineer, the actions of the Project Engineer are binding upon WSDOT. Because of this, it is important that the Project Engineer make no instructions, verbally or by written memoranda, that are outside the scope of the plans, specifications, contract provisions, or the authority delegated by the Engineer.

In advance of or during the course of the project, in the interest of economy and efficiency, noncritical items of work may be identified for which the Project Engineer may choose to modify the normal inspection or testing procedures. In taking these actions, the Project Engineer is acting under the professional responsibility inherent in all actions as a representative of the Department and a Licensed Professional Engineer. Full accountability of such incidents is expected. The scope of such actions should not exceed $10,000 for a single bid item, nor exceed $25,000 for an entire project.

The nature of the work to be accepted in this manner will generally be limited to minor and isolated items. Acceptance would typically involve dimensional conformance to the plans and a visual determination that the materials are suitable, however, the Project Engineer may require some testing or other means to support a decision. In such action, the Project Engineer should be guided by the principle of achieving the intent of the contract, attaining reasonable expectations of service life proportional to cost, and protection of public safety. Typically, changes in acceptance procedures will only be made to work outside the vertical limits of the traveled way. Consideration should be given to the consequences of subsequent failure, ease of replacement, whether or not there is a high variability in the quality of similar work, or any other pertinent facts. Actions taken in accepting such materials should be identified in the project records with acknowledgment by signature of the Project Engineer. Materials accepted in accordance with this guidance should be identified in the Project Engineer’s preparation of the Certification of Materials under Chapter 9-1.5 of this manual.

The use of this process is not intended to retroactively justify deficiencies discovered after the completion of work.

**1-2.8B Contractor’s Equipment, Personnel, and Operations**

The Contractor is required to furnish adequate equipment for the intended use. The Contractor’s equipment must also be maintained in good working condition. Prior to the start of work, the Project Engineer should ensure, by inspection, that the Contractor’s plant, equipment, and tools comply with the specifications.
Whenever the specifications contain specific equipment requirements, the Project Engineer should verify that the equipment provided meets these specifications. This should be documented in project records such as the Inspector’s Daily Report. The Contractor is required to furnish, upon request, any manuals, data, or specialized tools necessary to check the equipment.

It is most important that the operation of automatically controlled equipment be checked carefully and that the Contractor be advised immediately whenever the equipment is not performing properly.

The Contractor’s supervisory personnel must be experienced, and able to properly execute the work at hand. If, in the Project Engineer’s opinion, the Contractor’s supervisory personnel are not fully competent, the Project Engineer should immediately notify the Regional Construction Manager of the facts in the matter, seeking assistance and advice.

It is expected that, consistent with WSDOT’s policies and delegated authority, the Project Engineer will assist the Contractor in every possible way to accomplish the work under the contract. However, the Project Engineer must not undertake, in any way, to direct the method or manner of performing the work. Should the Contractor select a method of operation that results in substandard quality of work, non-specification results, a rate of progress insufficient to meet the contract schedule, or that otherwise violates the contract specifications or provisions, the Contractor should be ordered to discontinue that method or make changes in order to comply with the contract requirements. Where cooperation cannot be achieved, the Project Engineer should notify the Regional Construction Manager of the facts in the matter, seeking assistance and advice.

1-2.8C Defective or Unauthorized Materials or Work

Contract Final Acceptance for all work completed on a project is made solely by the Secretary of Transportation. However, the Secretary relies heavily on the actions and professional opinions of others, involved throughout the course of work, in determining acceptability. Because of this, it is expected that the Project Engineer, working with the assistance of the Regional Construction Manager, as well as making full use of the many resources available at both the Regional level and Headquarters, particularly the office of the State Construction Engineer, will ensure that sufficient inspection is conducted in order to determine that the work performed or the materials utilized to construct the project comply with the requirements included in the contract plans and specifications. When inspections or tests are performed that indicate substandard work or materials, the Project Engineer should immediately notify the Contractor, rejecting the unsatisfactory work or material. When a review of the Contractor’s work or materials used indicate questionable acceptability with regard to the specifications, the Contractor should be notified as quickly as possible so that changes in materials or work methods can be made in order to avoid materials or work being rejected.

1-2.8C(1) Defective Materials

The contract plans and specifications for construction of a project require that specific materials and/or work practices be utilized in completing the work. The Project Engineer may reject any materials not conforming to the requirements of the specifications. The rejected materials, whether in place or not, are to be immediately removed from the site of the work unless the following guidelines for acceptance of non-specification materials are followed:

Material Not In Place

1. Nonconforming aggregate materials that are within the defined tolerance limits noted in Chapter 9-5.6 of this manual may be accepted for use on the project in accordance with the guidance in Chapter 9-5.4(B).

2. There may be situations where WSDOT could obtain significant benefit from the use of nonconforming aggregate materials. This requires prior concurrence of the State Construction Engineer and a change order modifying the project specifications.

Except for 1 and 2 above, materials that are known in advance as failing to comply with the Specifications are not to be incorporated into the work.

Material In Place

1. Price adjustments have been developed and are referenced in the contract for acceptance of certain materials whose properties cannot be determined until they are in place. Items this policy applies to include: concrete compressive strength, Portland cement concrete pavement thickness, asphalt concrete gradation, oil content, density, and pavement smoothness.

2. Material incorporated into the work that is subsequently found to be in nonconformance with the specifications and for which price adjustments for acceptance are not included in the contract, must be reviewed to determine acceptability. The determination of acceptability should be made only when, in the Project Engineer’s judgment, there is a possible service or benefit to be obtained from its use. If it is determined that no benefit or service is obtained from the material’s use, the Project Engineer may direct that the material be immediately removed and replaced at no cost to WSDOT.

The Project Engineer may consult the State Materials Laboratory, the State Bridge and Structures Office, or other design organizations for assistance in determining the usefulness of the nonconforming material. If consulted, these offices will offer technical advice to the extent that information is available. It is not intended to enter into extensive research to assess material which could be removed and replaced under the contract terms.
If the material is to be accepted for continued use, a determination of possible reduced service and the resulting credit to be assessed by change order, should be completed by the Project Engineer. This determination must meet with the Region Construction Manager’s approval for execution of the change order. In addition, prior review and concurrence must be obtained from the State Construction Engineer for the intended application of the material and the Materials Engineer for concurrence with issues of material performance. With this determination for acceptance of non-specification material, discussions should be initiated with the Contractor and a final change order completed.

If it is determined that the specification violation will not compromise the performance of the material and the nature of the violation is considered to be more of a technical infraction of the specification, the material may be accepted with a change order, possibly including a price reduction. If there is sufficient data and if the nature of the material makes analysis feasible, the State Materials Laboratory will determine a pay factor using QC/QA methods similar to those described in the Standard Specifications, Section 106.2(2). If QC/QA can not be applied, the Project Engineer may determine an adjustment subjectively, using whatever information is available. This assessment or price adjustment may vary from a portion of the material costs up to the total contract unit bid price for the bid item involved. If it is determined that the violation is serious enough that the material can not be accepted for use on the project, the Project Engineer may direct its complete removal and replacement at no cost to WSDOT.

All change orders for acceptance of nonconforming materials are Contractor proposed and WSDOT is under no obligation to accept or approve any of them.

1-2.8C(2) Defective or Unauthorized Work

The following types of activities will be considered unauthorized work and will be completed solely at the risk and expense of the Contractor:

- Work performed contrary to, or regardless of, the instructions of the Project Engineer.
- Work and materials that do not conform to the contract requirements.
- Work done beyond the lines and grades set by the plans or the Engineer.
- Any deviation made from the plans and specifications without written authority of the Project Engineer.

Until all issues of material acceptance and conformity to the contract plans and specifications can be resolved, unauthorized work will not be measured and paid for by WSDOT. The Project Engineer may direct that all unauthorized or defective work be immediately remedied, removed, replaced, or disposed of. In correcting unauthorized or defective work, the Contractor will be responsible to bear all costs in order to comply with the Engineer’s order.

For additional guidance, see Section 1-05.7 of the Standard Specifications. If the Contractor fails or refuses to carry out the orders of the Engineer or to perform work in accordance with the contract requirements, the Project Engineer should immediately notify the Regional Construction Manager of the facts in the matter, seeking assistance and advice.

1-2.8C(3) Material Acceptance by Manufacturer’s Certificate

All material is to be accepted for use on the project based on satisfactory test results that demonstrate compliance with the contract plans and specifications. All work demonstrating compliance is to be completed prior to the material’s incorporation into the work. In many cases, this testing has already been completed in advance by the manufacturer. A Manufacturer’s Certificate of Compliance is a means to utilize this work in lieu of job testing performed prior to each use of the product. While this provides for a timely use of the material upon arrival to the job site without having delay in waiting for the return of test results, it creates potential difficulties in obtaining and assessing the adequacy of a certificate.

Section 1-06.3 of the Standard Specifications describes the procedures for acceptance of materials based on the Manufacturer’s Certificate of Compliance. Division 9 of the Standard Specifications describes those materials that may be accepted on the basis of these certificates. Since a certificate is a substitute for prior testing, it is intended that all certificates be furnished to the Project Engineer prior to use or installation of the material.

However, there are some circumstances where the Contractor may request, in writing, the Project Engineer’s approval to install materials prior to receipt and submittal of the required certificate. The Project Engineer’s approval of this request must be conditioned upon withholding payment for the entire item of work until an acceptable Manufacturer’s Certificate of Compliance is received. Examples of materials that shall not be approved by the Project Engineer for installation prior to the Contractor’s submittal of an acceptable certificate are: materials encased in concrete (i.e., rebar, bridge drains, etc.); materials under succeeding items where the later work cannot be reasonably removed (i.e., culvert under a ramp to be opened to traffic); etc. The Project Engineer’s approval or denial shall be in writing to the Contractor, stating the circumstances that determined the decision.

At the conclusion of the contract, there may still be some items that are lacking the required certificates. These items must be assessed as to their usefulness for the installation, prior to payment of the Final Estimate and subsequent Materials Certification of the contract. The review of these items may include:

- Comparison with the suitability of other shipments to the project or other current projects.
• If possible, sampling and testing of the items involved
  or residual material from the particular lot or shipment.

• Independent inspection on site of the completed
  installation.

If it is determined that the uncertified material is not
usable or is inappropriate for the completed work that
incorporates the material, the Contractor should be directed
to immediately remove the material, replacing it with other
certified materials. If the material is found to be usable and
is not detrimental to the installation it was incorporated
into, it may be left in place but with a reduction to no pay.
The reduction in pay will be the entire cost of the work (i.e.,
unit contract price, portion of lump sum, etc.) rather than
only the material cost. The Contractor should continue to
have the option of removing and replacing the uncertified
material in order to regain contract payment for the
installation.

1-2.8D Contractor Submittals

Missing submittals is a principal source of delays in closing
out the project and processing the final estimate. As the
project proceeds toward completion, the Project Engineer
and the Contractor should attempt to obtain all submittals
as the need arises. These might include such things as
materials certificates, certified payrolls, extension of time
requests, or any other item or document that might delay
processing the final estimate. Attention is needed to assure
the receipt of these items from subcontractors as they
complete their work.

1-2.8E Statement of Materials and Labor,
Form FHWA-47

This report is required for all projects over $1,000,000 on
the NHS, excluding Force Account, Beautification, and
Railroad Protective Devices. When this report is required,
it is to be prepared in accordance with the requirements and
instructions contained on the form and in the “Required
Contract Provisions Federal-aid Construction Contracts”,
Form 1273, the “pink” sheets that are included in every
federal-aid project.

When this report is a requirement of the contract, the
Project Engineer will obtain it from the Contractor, review
the Contractor’s work for completeness and reasonableness,
complete Section A, and submit it directly to the Office of
the FHWA, Attn: Construction Engineer, at MS: 0943. A
copy of this report shall be submitted with the Final
Estimate to the State Construction Office. If the
Contractor’s submittal is found to be incomplete or to
contain obviously incorrect data, it shall be returned to the
Contractor for correction.

It is mandatory that the materials be reported in the units
shown, i.e., tonnes, meters, etc. Materials not listed on the
report form need not be reported.

1-2.8F Contractor’s Performance Reports

The procedures for completing and submitting the Prime
Contractor Performance Report are included with the
report, Form 421-010, and the Prime Contractors
Performance Report Manual, M 41-40. The requirement for
this report and other direction can also be found in WAC
468-16-150 and WAC 468-16-160.

Should the Contractor’s typical performance on a contract
become below standard, the Project Engineer should
immediately notify the Regional Construction Manager of
the facts in the matter, seeking assistance and advice.

1-3 Estimates and Records

1-3.1 Estimates

1-3.1A General

Payment for work performed by the Contractor and for
materials on hand must be made in accordance with Section
1-09 of the Standard Specifications. To facilitate payments
to the Contractor and ensure proper documentation,
WSDOT utilizes an automated computer system to record
project progress in terms of bid item quantity
accomplishment. This is then used to pay the Contractor
for actual work performed during each designated pay
period or for materials on hand. The automated system that
completes this task is called the Contract Administration
and Payment System (CAPS). CAPS utilizes an electronic
tie between each project office’s computer system and the
mainframe computer. This system provides access to a large
volume of corporate data and facilitates the maintenance of
this data by different groups in different locations. Some of
these different activities include:

• Contract Initiation — A Headquarters action whereby
  new contracts are created and stored in a computer file.
The information consists of the names of the
  Contractor and the Project Engineer, project descriptive
  data, accounting identifier numbers, preliminary
  estimate, proposal date, bid opening date, award date,
  execution date, accounting groups and distributions,
  and an electronic ledger.

• Project Ledger — An updating process by the Project
  Office which keeps track of work performed on the
  contract as it is completed.

• Estimate Payments — A Project Office action whereby
  progress estimates and Regional final estimates are
  processed directly from the Project Office. The
  Headquarters Final Estimate process activates the
  Region Final when all the required paperwork is in
  place. Supplemental final estimates are processed by
  Headquarters only. Complete instructions for use of
  the CAPS computer system are included in the manual
titled Contract Administration and Payment System
  (M 13-01).


1-3.1B Progress Estimates

Progress estimates are normally processed on the 5th of the month for odd numbered contracts and on the 20th of the month for even numbered contracts. Where the Project Engineer deems it appropriate, estimates may also be run on other dates.

Estimates may also be run on other dates if the progress estimate or parts of the progress estimate were withheld to encourage compliance with some provision of the contract and the Contractor resolves the issue that caused the withholding. These estimates should be paid immediately upon resolution by the Contractor.

Within the CAPS system, the basis for making any estimate payment is information from the project ledger. Every entry in the ledger is marked by the computer as either paid, deferred, or eligible for payment. Before an estimate can be paid, a Ledger Pre-Estimate Report (RAKD300C-PE) must be produced. In constructing this report, the CAPS system gathers all the ledger entries that are identified as eligible for payment, prints them on the report summarized by item, and shows the total amount completed to date for that item but not yet paid for by progress estimate. The report also shows any deferred entries or exceptions if they exist and includes a signature block for the Project Engineer’s approval.

If there are errors or omissions in this report, the ledger must be changed to reflect the correct data. After corrections are made, the Ledger Pre-Estimate Report must be run again in order to get the corrections into the report and made available for payment by progress estimate. Once the Ledger Pre-Estimate Report is correct, an actual estimate can be paid. The report containing the Project Engineer’s signature should be retained in the project files.

The estimate process is then accomplished with a few key strokes in option 2, estimate payments, in the CAPS main menu. At this point, the CAPS system will automatically calculate mobilization, retainage, and the sales tax. The warrant will be produced, signed, and sent to the Contractor along with the Contract Estimate Payment Advice Report and two different sales tax summary reports. Copies of these reports will also be sent to the Project Office. When the Project Office receives their copy of the Contract Estimate Payment Advice Report, the total amount paid for contract items should be checked against the Pre-Estimate Report. This helps to verify that the amount paid was what the Project Engineer intended to pay. In addition, the ledger records that produced the estimate will now be marked by the CAPS system as being paid.

Up to the point of actually producing the warrant, the entire process for making a progress estimate payment is initiated and controlled by the Project Office.

Particular attention should be given to the comparison of the plan quantities and the estimate quantities for the various groups on the project as shown on the Ledger Pre-Estimate Report. Overpayments on intermediate progress estimates are sometimes difficult to resolve with the Contractor at the conclusion of the project.

New groups which do not change the termini of the original contract or changes in groups should be accomplished by memorandum from the Region to the State Accounting Services Office.

An additional estimate may be prepared if considerable work has been done between the date of the last progress estimate and the date of physical completion when the Engineer anticipates delays in preparing the final estimate. Should this circumstance occur, the additional estimate should show the work done to date no later than the day before the date of physical completion.

1-3.1B(1) Payment for Material on Hand

Payment for material on hand may only be considered for materials that will be incorporated into the permanent work. Payment amounts for material on hand must not exceed the bid item amount. In processing payment for materials on hand, the CAPS system utilizes the 900 series of item numbers for ledger entries. The requirements for payment of Materials on Hand are noted in Section 1-09.8 of the Standard Specifications. Payments can be made provided that the Contractor submits documentation of the amounts requested, that the materials are found to have met the requirements outlined in the plans and specifications, and the materials are delivered to or stockpiled near the project site or other storage sites that may be approved by the Project Engineer.

All materials, for which requests for payment are made, must be stored under the Contractor’s control. The Contractor must agree that the material will not be diverted to other work. Materials should be segregated, bundled and tagged, or otherwise marked or identified for use on a specific contract or project. All materials paid for as Materials on Hand must be kept in a manner that is readily available for inspection and periodic identification by WSDOT.

Where the items are fabricated and stored in areas outside the Region, then the Region may make arrangements with other Regions or the State Materials Laboratory for inspection deemed necessary prior to paying for the items as Material on Hand.

Payments may also be made for materials stockpiled at a materials fabricator or for completed portions of fabricated items. The Project Engineer may establish the most expedient method of payment for fabricated materials on hand in accordance with the requirements of Section 1-09.8.
Administration

When materials, for which hand-on payments have been made, are incorporated into the work, the MOH payments must be deducted. It is the responsibility of the Project Engineer to devise procedures that assure this is done correctly.

When contracts are estimated to cost more than $2 million and require more than 120 working days to complete, a General Special Provision (GSP) will be included in the contract provisions, providing a different procedure for handling payments and deductions for Material on Hand. When this GSP is included in the contract provisions, the following procedure is used to determine how much of the MOH payment should be deducted from an estimate:

- Each month, no later than the estimate due date, the Contractor will submit a letter to the Project Engineer that clearly states:
  - The amount originally paid on the invoice (or other record of production cost) for the items or Material on Hand,
  - The dollar amount of the previously paid Materials on Hand incorporated into each of the various work items for the month, and
  - The amount that should continue to be retained in material on hand items.

If work is performed on the items and the Contractor does not submit a letter, all of the previous material on hand payment may be deducted on the next available progress estimate.

1-3.1B(2) Payment for Falsework

On those projects which include a lump sum item for bridge superstructure, payment may be made on request by the Contractor for falsework as a prorated percentage of the lump sum item as the work is accomplished. The Project Engineer may require the Contractor to furnish a breakdown of the costs to substantiate falsework costs. For any given payment request, the Contractor may be required to furnish invoices for materials used and substantiation for equipment and labor costs.

1-3.1B(3) Payment for Shoring or Extra Excavation

When Shoring or Extra Excavation Class A is included as a bid item, payment must be made as the work under the bid item is accomplished, the same as for any other lump sum bid item. When Shoring or Extra Excavation Class B is included as a bid item, measurement and payment shall be made in accordance with Sections 2-09.4 and 2-09.5 of the Standard Specifications. RCW 39.04 provides that the costs of trench safety systems shall not be considered as incidental to any other contract item, and any attempt to include the trench safety systems as an incidental cost is prohibited. Accordingly, when no bid item is provided for either Shoring or Extra Excavation Class A or Shoring or Extra Excavation Class B and the Engineer deems that work to be necessary, payment will be made in accordance with Section 1-04.4 of the Standard Specifications.

1-3.1B(4) Payment for Surplus Processed Material

When excess aggregate is produced by the Contractor from a WSDOT furnished source, the Contractor will be reimbursed actual production costs if the excess materials meet the requirements of Section 1-09.10 of the Standard Specifications. If more than one type of aggregate is involved, the provisions of Section 1-09.10 apply to each type.

If WSDOT has a need for the excess aggregate for either maintenance or future construction contracts, the material may be purchased into the appropriate inventory account. The Project Engineer should contact Region Maintenance and Accounting for guidance. If aggregates are to be disposed of as surplus, the Project Engineer should contact the State Administrative Services Office, Purchasing and Inventory Section, for additional assistance.

1-3.1B(5) Liquidated Damages

Liquidated Damages and Direct Engineering, or other related charges, are to be addressed as described in the contract specifications, Section 1-08.9 of the Standard Specifications, and Chapter 1-2.5G of this manual. Direct Engineering charges are a form of Liquidated Damages and must be listed on the monthly progress estimates on the line for Liquidated Damages. Traffic related damages as described in Chapter 1-2.5G(2) of this manual are to be listed under Miscellaneous Deductions. The Project Engineer must evaluate potential Liquidated Damages that have accrued as a result of the expiration of contract time before the damages are withheld from moneys due the Contractor. The work and circumstances that have occurred over the course of the project should be reviewed to determine if there is potential entitlement for granting additional contract time. Liquidated Damages that have accrued should be adjusted for this evaluation. Liquidated Damages deemed chargeable should then be withheld from moneys due the Contractor each monthly progress estimate as Liquidated Damages accrue. While the Project Engineer takes the action to withhold damages as the work progresses, only the State Construction Office may actually assess those damages.

1-3.1B(6) Credits

Dollar amounts may be deducted as a “Below The Line Miscellaneous Deduction” from progress or final estimates when WSDOT is due a credit from the Contractor. Routine credits from the Contractor to WSDOT include, but are not limited to, the following items:

- Engineering labor costs when due to Contractor error or negligence, additional engineering time is required to correct a problem. This includes the costs of any necessary replacement of stakes and marks which are carelessly or willfully destroyed or damaged by the Contractor’s operation.
• Lost and/or damaged construction signs furnished to the Contractor by WSDOT. The Contractor should be given the opportunity to return the signs or replace them in kind prior to making the deductions.

• Assessment to WSDOT from a third party that is the result of the Contractor’s operations causing damage to a third party, for example, damage to a city fire plug. Actual costs will be deducted from the estimate.

• Other work by WSDOT forces or WSDOT materials when the Contractor cannot or will not repair damages that are the responsibility of the Contractor under the contract.

• Liquidated damages not associated with contract time, i.e., ramp closures, lane closures (see Chapter 1-2.5G).

• As provided for in the specifications, specific costs or credits owed WSDOT for unsuccessful contractor challenged samples and testing.

The authority to withhold and assess routine “Below The Line Miscellaneous Deduction” on progress and final estimates has been delegated to the Regional Construction Manager, and may be further subdelegated to the Project Engineer. The Project Engineer must give written documentation to the Contractor describing the deduction and provide sufficient notice of the impending assessment.

Credit items which are specifically provided for by the Standard Specifications or contract provisions, such as non-specification density, non-specification materials, etc. may be taken through the contract items established for those purposes. A change order is required for credit items which are not specifically provided for by the contract provisions.

Occasionally a Contractor will send a check directly to a Project Office for payment of money due WSDOT. (The Project Office should not request payment.) Whenever a Project Office or WSDOT employee receives a check or cash directly from a Contractor, it is very important that the guidance found in Directive 13-80, Control of Cash Receipts, be followed.

1-3.1B(7) Railroad Flagging

All dollar amounts actually incurred by the Railroad Company for railroad flagging, under the terms of the typical railroad agreement, will be paid by WSDOT. The Contractor will incur no costs for railroad flagging unless the flagging is for the Contractor’s benefit and convenience. In this case, the Project Engineer will deduct this cost on monthly progress estimates as a below the line item in the Contract Administration and Payment System.

1-3.1B(8) Payment for Third Party Damages

Section 1-2.4I of this manual details when WSDOT assumes responsibility and pays for third party damages. The Risk Management Manual, M 72 01, provides detailed guidance on procedures, including lines of communication. Payment should be made under the item “Reimbursement for Third Party Damages”. This item is only intended to be used for costs that are the responsibility of the contracting agency. If this item was not included in the contract, it may be added by change order using a separate group for each Control Section in which an incident occurs. On some items such as “Repair Impact Attenuator” there has been a conscious decision by the contracting agency during design to assume a risk which is otherwise the contractor’s. It would not be appropriate to assume this risk for other items of work by adding a similar pay item through a change order.

The next step is for the Project Engineer to determine if an incident warrants an attempt to recover costs based on cost effectiveness. If so, a memo is necessary to provide notice and information to the risk management office. Basically, they need the information necessary to investigate the incident, find the responsible party, determine the amount of the damages and obtain reimbursement for the State. The risk management office needs the following information:

• Contract Number, Project Description
• Names of Witnesses
• Documentation Related to the Damage
  • Change Order Number
  • Field Notes
  • Police Reports
  • Work Order Coding
• Summary of Repair Costs

1-3.1B(9) Withholding of Payments

Withholding payments for work the Contractor has performed and completed in accordance with the contract should not be done casually. There must be clear contract language supporting the action. The authority to withhold progress payments is subdelegated to the Regions. Further delegation to the Project Engineers is at the discretion of each Region.

No Payment for the Work

Standard Specification 1-06.3, “Manufacturer’s Certificate of Compliance” is unique in that this is a situation, specified as part of the contract, where the contractor may assume the risk for no certificate and end up never being paid for the related work.
Progress Payment Deferral

In the following situations the contract specifies that the contracting agency has the authority to defer the entire progress payment:

- The contracting agency may not make any payments for work performed by a Prime/Subcontractor until the contractor performing the work has submitted a Statement of Intent to Pay Prevailing Wages approved by Labor and Industries (RCW 39.12.040).
- The contractor fails to submit a progress schedule that meets the requirements of the contract (Standard Specification 1-08.3).
- Failure to submit the “required reports” by their due dates (Standard Specification 1-07.11(10)B).

Wage Administration in General

The administration of wages and payment for the work are separate issues. Holding a force account payment for certified payrolls is not appropriate. Withholding payments on the contract is suggested as a method to achieve compliance under the Standard Specifications pertaining to wages (1-07.9(1)). This remedy should not be used without review by of the State Construction Office. Routine enforcement of wage requirements should be done on their own merits utilizing the sanctions specified as follows:

State Wage Administration

Labor and Industries is the enforcement agency for state prevailing wage administration. The State (WSDOT) is protected under the contract from wage claims by reserving 5 percent of the moneys earned as retained percentage. This 5 percent is made available for unpaid or underpaid wages liens among other claims. Contract payments should not be deferred due to a contractor’s failure to pay the State minimum prevailing wage.

Federal Wage Administration

FHWA 1273 specifies that the State Highway Administration (SHA) is in the enforcement role for federal prevailing wage administration. Under Section IV “Payment of Predetermined Minimum Wage” subsection 6. “Withholding,” the State Highway Administration (contracting agency) is authorized to withhold an amount deemed necessary to make up any shortfalls in meeting Davis Bacon prevailing wage requirements. It goes on to authorize the deferral of all payments, under certain conditions, until such violations have ceased. This is only for federal wage requirements and the amount “deemed necessary” must be based on the amount of the underpayment.

Application of the Standard Specifications

Under 1-05.1 Authority of the Engineer reads in part as follows: “If the Contractor fails to respond promptly to the requirements of the contract or orders from the Engineer….”

2. The Contracting Agency will not be obligated to pay the Contractor, and ……..”

Under Section 1-09.9 Payments reads in part as follows: “Failure to perform any of the obligations under the contract by the Contractor may be decreed by the Contracting Agency to be adequate reason for withholding any payments until compliance is achieved”.

Sounds good and we can do so, but withholding of payments owed the contractor must not be done on an arbitrary basis. Other than the previously noted exceptions, money is normally withheld because work/work methods are not in accordance with contract specifications. Also, the amount withheld must have a logical basis. We can not penalize the contractor by withholding more than the out of compliance work is worth.

Withholding payments should not be used routinely asa tool for forcing compliance on general contract administration requirements. The State is protected against nonperformance by requiring a performance bond. In the event that lack of contract compliance puts the State at substantial risk monetarily or safety wise, it may be appropriate to inform the contractor of the compliance problem and suspend work under Standard Specification 1-05.1 “Authority of the Engineer” until corrections are made.

When withholding money, remember that delaying the contractor’s cash flow may damage the contractor’s ability to perform work. Before doing so, the State should be able to demonstrate:

- specifically what was not in accordance with the contract and where the requirement is specified in the documents
- that the amount withheld is commensurate with the amount of the unauthorized or defective work
- that the contractor was notified in a timely manner (within 8 days per prompt pay laws) and given a chance to make corrections
- that the State has worked with the contractor to mitigate corrections to non-specification work in order to minimize the cost

The State is required to pay the contractor in a prompt manner within 10 days of the cutoff for a monthly pay estimate for all work performed in accordance with the contract during that period.
1-3.1C Final Estimates — Regions

The final estimate for a project is processed in the same manner as a routine monthly progress estimate. The Work Done To Date entry on a final estimate is the physical completion date. When the Region final estimate is completed and is run in CAPS at the Region, it will not generate a warrant for the Contractor. Instead, the Region final estimate will produce several reports: a final Comparison of Quantities; the Contract Estimate Payment Advice; the Contract Estimate Payment Total; and the Sales Tax Summary.

These reports should be carefully checked to verify the accuracy of items, quantities posted, and the costs that have accumulated through various progress estimates during the life of the contract. Where necessary, corrections can be made to the ledger and the Region final estimate rerun as many times as it takes to make it correct before proceeding with the final estimate process.

If the final estimate shows an overpayment has been made to the Contractor, the estimate should still be processed in the same manner as a normal final estimate. If this occurs, the Contract Estimate Payment Totals report will show a minus amount due the Contractor. When the State Accounting Services Office receives the accepted final estimate package, that office will request any reimbursement due from the Contractor. The Project Engineer should not request reimbursement from the Contractor.

Once the Project Engineer has validated the final estimate amounts, a copy of the Comparison of Quantities Report, the Contract Estimate Payment Advice Report, and the Contract Estimate Payment Totals Report should be forwarded to the Contractor along with the Final Contract Voucher Certification. The Project Engineer might remind the Contractor that the person signing the Final Contract Voucher Certification must be authorized to do so. Authorized signatures are submitted by the contractor at the beginning of each contract.

Once the project has been physically completed, the final estimate package described above should be submitted to the Contractor for signature as soon as is reasonably possible. The final estimate package and request for the Contractor’s signature should be transmitted to the Contractor formally. The effort to prepare the final estimate package will vary in nature and magnitude, depending on the project. In some cases, this work will conflict with field work on other projects. It is expected that final estimate preparation will be scheduled and accomplished during the six month period after physical completion.

Once the signatures and all necessary documents have been obtained, the final estimate package should be assembled by the Region and submitted to the State Construction Office.

If any needed recommendations for assessment of liquidated damages associated with contract time have not already been submitted, this submittal should include them. The State Construction Office must resolve all issues of liquidated damages before the final estimate can be accepted and submitted to the State Accounting Services Office.

1-3.1D Final Estimates — Headquarters

The final estimate package submitted to the State Construction Office consists of the following:

- Project Status Report — The Project Status Report should address contract time and recommendations for liquidated damages related to contract time, amount of railroad flagging used if any, Miscellaneous Deductions identified, etc. In addition, the report should indicate whether or not all Affidavits of Wages Paid have been received for the Contractor, and all subcontractors, agents or lower-tier subcontractors.

- Final Contract Voucher Certification — Form 134-146, original only.

- If an assessment of liquidated damages has been made previously, include a copy of the letter from the State Construction Engineer to the Contractor assessing these.

- If an assessment of miscellaneous damages or liquidated damages resulting from causes other than time, include copies of letters from the Region to the Contractor for assessment of these.

- Contract Estimate Payment Totals — RAKC300F-EA.

- Copy of Form FHWA 47 (NHS Federal-Aid projects over $1 Million).

The final estimate package is reviewed by the State Construction Office and submitted to the State Construction Engineer for acceptance of the contract. The date on which the State Construction Engineer signs the Final Contract Voucher Certification becomes the final acceptance date for the contract itself. The final estimate package is then submitted to the State Accounting Services Office.

1-3.1D(1) Final Estimate Claim Reservations

Should the Contractor indicate a claim reservation on the Final Contract Voucher Certification, it must be accompanied by all of the requirements of Section 1-09.11(2) of the Standard Specifications (provided these have not been met in a previous claim submittal). The Project Engineer must assure that the requirements have been met prior to submitting the final estimate package to the State Construction Office. If the claim package is incomplete, return the voucher to the Contractor with notice of the missing parts.
1-3.1D(2) Unilateral Acceptance of Final Estimates

The Project Engineer cannot establish a completion date for the contract if the Contractor is unwilling or unable to submit one or more of the required documents noted in Section 1-08.5 of Standard Specifications. However, the Region can request that the State Construction Engineer accept the contract by signing the Final Contract Voucher Certification (FCVC) in spite of the missing documents.

If the Contractor has not signed the FCVC, the Region can request that the State Construction Engineer accept the contract without the Contractor’s signature. The Region is responsible for notifying the Contractor before such a request is made. The State Construction Office will generate the certified letter notice mentioned in the Standard Specifications, Section 1-09.9. The date of the State Construction Engineer’s signature of the FCVC becomes both the acceptance date and the completion date of the contract, both established unilaterally.

1-3.1E Supplemental Final Estimates

A Supplemental Final Estimate is a payment adjustment made to a contract after the Final Estimate has been processed and the project has been Accepted by the State Construction Engineer. A Supplemental Final Estimate may be necessary to correct an inadvertent over/under payment or where a claim settlement may require additional payment be made to the Contractor. In order to complete a Supplemental Final Estimate, the Project Engineer should complete and assemble the following items, routing them through the Region to the State Construction Office for review and further processing:

1. Assemble the backup information supporting the necessity and substantiating the cost of the changes to be made.

2. Complete any corrections or additional postings necessary in CAPS, including any postings to change order items added to CAPS for the settlement of a claim. (Please note, where additional CAPS postings are necessary after the Physical Completion date has been established, the “Work Done To” date in CAPS must be entered as the Physical Completion date or prior.)

3. Complete a Pre-Estimate report including the Project Engineer’s signature recommending payment.

4. Complete a supplemental Final Contract Voucher Certification form reflecting the changes made and showing the new total “Final Amount”.

While postings and corrections to CAPS may continue, once the Completion date has been established for a contract, CAPS will no longer allow the Project Engineer or the Region to process further payments to the Contractor. As a result, payment of the Supplemental Final Estimate will need to be completed for the Project Engineer by the State Accounting Services Office.

After review, the Pre-Estimate report will be signed by the State Construction Engineer authorizing payment to proceed. Once the supplemental payment is completed, the signed and executed Pre-Estimate report will be returned to the Project Engineer where it can be maintained as a part of the project payment files and made a part of the Region Temporary Final Records.

While a new Final Contract Voucher Certification is completed as a part of the Supplemental Final Estimate, the Acceptance date will remain the same as established by the State Construction Engineer’s signature on the original Final Contract Voucher Certification.

1-3.1F Retained Percentage

Retained percentage withholding is based upon RCW 60.28, which provides that:

- A sum not to exceed 5 percent of the money earned by the Contractor on estimates be retained by the Contracting Agency.

- The Contractor may submit a bond for all or any portion of the amount of funds retained by WSDOT.

When a contract is awarded, the State Accounting Services Office or the Region Plans Office sends a package of contract documents to the Contractor. This package of contract documents also includes the necessary instructions for the Contractor to make application for a bond to replace all or any portion of the retainage. The bond form will be processed by the State Accounting Services Office without involvement from Project Engineer’s Office.

The Contractor, at any time during the life of the contract, may make a request to the Project Engineer for the release of all or any portion of the amount of funds retained. This request does not need consent of surety since the retainage bond form, for this purpose, requires their consent. The Region must forward this request by transmittal letter to the State Accounting Services Office. The Accounting Office will furnish the appropriate bond form to the Contractor for execution. The Contractor may return the executed bond form directly to the Accounting Office for final approval and signature by WSDOT.

- For projects that include landscaping, the Contractor may request that, 30 days after physical completion of all contract work other than landscaping work, WSDOT release and pay in full the amount of funds retained during the life of the contract for all work except landscaping.
In order to initiate this release of funds, Form 421-009 should be completed by the Contractor and submitted to the Project Engineer. In signing the request, the Project Engineer will confirm that all work, except landscaping work, is in fact physically completed. For any landscaping work that may have been completed, the Project Engineer will designate the amount of landscaping moneys, if any, that have been earned to date by the contractor. In the space designated for remarks the Project Engineer will identify the landscaping or plant establishment work that remains to be completed and its approximate value. Except for landscaping work, the Project Engineer will determine if all Statements of Intent and Affidavit of Wages Paid have been received for the work that has been physically completed. WSDOT will continue to withhold a 5 percent retainage of any moneys earned for landscaping work that may have been completed to date and will continue to retain 5 percent of the moneys that are to be earned for landscaping that is yet to be completed. A bond is not required.

The completed request along with the Project Engineer’s cover memo confirming receipt of Statement of Intent and Affidavit of Wages Paid for the Contractor, subcontractor, and any lower-tier subcontractors who were involved in the completed work, is then forwarded to the State Construction Office for approval. Once approved, the Construction Office will submit the request to the State Accounting Services Office for further processing. If no claims against the retainage for unpaid axes, labor, or materials have been received within the designated 60 day period, the Accounting Office will release the designated retainage to the Contractor.

1-3.2 Final Records for Projects Constructed by Contract

The Project Engineer is responsible for preparing all necessary records in order to document the work performed on the contract. Detailed instructions on the records required and methods of preparing them are covered in Chapter 10 of this manual.

1-3.3 Disputes and Claims

1-3.3A Claims By the Contractor

1-3.3A(1) Disagreement, Dispute, Protest

During the course of a contract, differences of opinion may arise over decisions and plan interpretations that benefit one party at the expense of the other. It is the policy of WSDOT to pursue resolution of these differences at the earliest possible time and to fully recognize all of the contractual rights of the Contractor during the resolution process.

Disagreements, disputes and protests are the responsibility of the Project Engineer until a formal claim is filed in accordance with Section 1-09.11(2). The Project Engineer may employ a variety of techniques and procedures to pursue resolution of these issues. With the high potential for cost impact, it is strongly recommended that all disagreements be identified and tracked.

When a protest occurs during a contract, the Contractor shall pursue resolution through the Project Engineer as outlined in Section 1-04.5 of the Standard Specifications. The Specification contains specific requirements which, if not followed, may result in a waiver of the Contractor’s claim. The Project Engineer should monitor whether the Contractor is meeting these requirements. If all of the requirements have been met, the Project Engineer shall evaluate the merits of the protest and take whatever appropriate action is needed to resolve the issue. If it appears that the Contractor has failed to meet any of the requirements set forth in 1-04.5, the Project Engineer should advise the State Construction Office and request guidance. Pending such guidance, the Project Engineer may continue to discuss the protest with the Contractor with the qualification that no final evaluation of the protest will be made until permission is received from the State Construction Office.

1-3.3A(2) Claims

If the Contractor has pursued and exhausted all the means provided in Section 1-04.5 to resolve a dispute, the Contractor may file a formal claim. A formal claim, filed in accordance with Section 1-09.11(2), is a much more structured device and demands a high level of conformance with the contract requirements. The objective is to utilize the rights that WSDOT has under the contract to identify the issues, obtain a sufficient level of information from the Contractor and limit the discussion to a defined subject matter. To accomplish this, and to maintain the Department’s rights in a situation that may lead to court action and expensive lawsuits, the Project Engineer must insist on rigid conformance with the requirements of the provision. In fact, the first evaluation must not be of the claim’s merit, but rather of the claim’s structure and content. If the package fails the specification requirements in any way, it should be returned to the Contractor immediately with a written explanation. Conversely, if the package meets the contract requirements, then the Project Engineer must comply with the demands for WSDOT actions that are included in the same specification.

The existence of a formal claim does not diminish the responsibility of the Project Engineer to pursue resolution. The only difference is that Headquarters final approval of a proposed settlement is required. The change order settling a formal claim must include waiver language similar to the following:
“The Contractor, (company name), by the signing of this change order agrees and certifies that:

Upon payment of this change order in the amount of $__________, any and all claims set forth in the letter(s) to the Department of Transportation, dated ____________ and signed by ____________ of (company name) in the approximate amount of $__________, have been satisfied in full and the State of Washington is released and discharged from any such claims or extra compensation”.

If the settlement is intended to close out all dispute discussions for the contract, use language similar to:

“The Contractor, (company name), by the signing of this change order agrees and certifies that:

Upon payment of this change order in the amount of $__________, any and all claims in any manner arising out of, or pertaining to, Contract No. ________, (including but not limited to those certain claims set forth in the letter(s) to the Department of Transportation, dated ____________ and signed by ____________ of (company name) in the approximate amount of $__________, have been satisfied in full and the State of Washington is released and discharged from any such claims or extra compensation in any manner arising out of Contract No. ________”.

1-3.3A(3) Legal Filing

Once the Contractor has submitted a formal claim in acceptable form and the State has either denied the claim or failed to respond in the time allowed, the Contractor is free to seek judicial action by filing a lawsuit or, in some cases, demanding binding arbitration. Note that the Contractor must fully comply with the provisions of Section 1-09.11 before it can seek judicial relief. Once any legal action has been started, the Project Engineer may only continue with settlement efforts if the Attorney General’s office has given specific permission to do so. Such permission may be sought through the State Construction Office. Settlements of claims which have resulted in a judicial filing need review and approval by the Attorney General’s office and different waiver language similar to the following:

“The Contractor, (company name), by the signing of this change order agrees and certifies that:

Upon payment of this change order in the amount of $__________, any and all claims in any manner arising out of, or pertaining to, Contract No. ________, (including but not limited to those certain claims set forth in the complaint filed under Thurston County Cause No. ____________

(Contractor’s name) vs. State of Washington, have been satisfied in full and the State of Washington is released and discharged from any such claims or extra compensation in any manner arising out of Contract No. ________”.

1-3.3A(4) Final Contract Voucher Certification

In some cases, of course, the Contractor will not have been so cooperative as to participate in resolution efforts. After a protest has been disallowed, there may have been no formal claim filed and the Project Engineer really doesn’t know if there is a continuing problem. The way to resolve this after the project is physically complete is to assemble the final estimate and send it to the Contractor with a Final Contract Voucher Certification (FCVC). The FCVC is the Contractor’s last chance to formally file a claim. If there is no exception above the Contractor’s signature on the FCVC, there is no claim. The contract will be over as soon as the State Construction Engineer accepts it. If the Contractor does not return the FCVC in a reasonable time, WSDOT may unilaterally set the completion date and process the final estimate without the Contractor’s signature. Proposals to unilaterally accept a contract should be discussed with Region managers before any action is initiated.

1-3.3B Claims Against the Contractor — Damage

The Department has a claims office, now known as the Washington State Department of Transportation Risk Management Office (RMO). All receptionist job descriptions, all Region operations manuals, and all telephone training is set up to refer citizens with damage claims related to construction to the RMO and to provide the toll free number (1-800-737-0615). The RMO will react to the call, issuing claims forms, contacting the contractor, and following up on the actions taken.

The Project Engineer’s role is to appropriately advise the RMO, if needed. There may be confusion about which contract is involved. Field office knowledge about the incident and the surrounding circumstances may be solicited. The contractor’s insurance and the insurance provided by the Contractor for the State may be involved and information about the policy will, most likely, be requested.

If, in spite of the Department process, the claimant contacts the field office directly, the Project Engineer should refer the claimant to the State Risk Management Office (1-800-737-0615).
1-3.3C Claims Against the Contractor — Money

Claims received by the Region for money owed by the Contractor should be referred to the Contractor. A claimant should be advised of the legal right to file a lien against the retained percentage for claims involving labor, equipment, or materials used on the project and be referred to the State Accounting Services Office for obtaining the necessary lien forms.

1-3.3D Claims Against Officials and Employees

The statutes provide that claims may be filed against the State of Washington, State officers and employees, for damages resulting from their conduct and prescribes the manner in which the action must be taken. Whenever this occurs, the state will furnish the legal defense and pay any judgments if the act which caused the alleged damage was within the scope of the person’s duties, was in good faith, and without negligence.

1-3.4 Stewardship

“Stewardship” is a term used in the context of Federal funding. In this context, it means “caretaker duties”. Most of the processes included in this manual are, in one way or another, related to the duties of stewardship. In the simplest terms, being a steward of federal construction funds is the sum total of all the activities that WSDOT performs in construction administration. The fundamental responsibility is “I must see that the taxpayers get what they paid for”. Along with the assignments of stewardship duties goes the responsibility to review and report a summary of the duties that are being or were carried out on the specific project.

Through agreement with FHWA, the responsibility to review and report on federal-aid projects has been assigned as follows:

- FHWA will be responsible for initial, intermediate, and final inspections on new construction and reconstruction projects on the Interstate.
- The State Construction Office will be responsible for interim and final inspections for all other projects with a contract amount over $3.5 million.
- Regions will be responsible for interim and final inspections on all projects with a contract amount less than $3.5 million.

Project inspections are intended to review monitoring and oversight activities of federal-aid projects and to assure FHWA that WSDOT is complying with the contract requirements, established WSDOT procedures, and federal-aid regulations. Final inspections will be performed on all federal-aid projects anytime after 90 percent completion, but no later than 30 days after the Physical Completion date. The scope of inspections is dependent on the size and type of the project. All change orders must be reviewed for compliance with established procedure, delegation of signature authority and federal-aid eligibility, and a statement confirming eligibility must be shown on the inspection report. Other subject areas, at the discretion of the reviewer, might include materials quality, inspection controls, traffic control, training, unusual features, schedule and time status, claims and disputes, etc.

Final Acceptance Reports must be completed on all interstate projects. These reports will be completed by FHWA for new construction and reconstruction projects and by the State Construction Office for all other interstate projects, including those jobs where the Region has performed the inspections. The acceptance report summarizes the findings of inspection reports and adds information regarding materials documentation and materials participation decisions, final costs and the outcome of any actions since the time of the final inspection report.

1-4 Utility and Railroad Relocation

1-4.1 Work Performed Under Utility Agreements

Utility agreement work associated with a contract exists in two categories. The first is work done for a utility by WSDOT that is included in the contract and performed by the WSDOT contractor. The second is work done, either by the utility or the utility’s contractor, that is associated with and done near the WSDOT project.

If the utility work is included in the contract, the plans will show the work and will include pay items exactly as if the work was part of the transportation improvement. The responsibility of the Project Engineer is to treat this work the same way that “normal” work is handled. There will be a necessity for communication with the utility itself, inviting comments and joint reviews and inspection of the work. In many cases, the utility will provide materials or equipment to be incorporated into the work. The utility will also provide certification that provided material meets the requirements of the contract. If problems arise and changes are considered, there are additional paperwork demands. The Project Engineer should consult with the Utility and the Region Utility Engineer.

If the work is associated with the project, or if unrelated work is being done nearby, and the utility or its contractor is performing the work, the Project Engineer should treat the neighboring work in the same manner that adjacent WSDOT work would be treated. (See Standard Specifications, Section 1-05.14 and Section 1-2.2H of this manual.)
1-4.2 Work Performed Under Railroad Agreements

Railroad work associated with a contract exists in three categories. The first is work done for a railroad by WSDOT that is included in the contract and performed by the WSDOT contractor. The second is work done, either by the railroad or the railroad’s contractor, that is associated with and done near the WSDOT project. The third category is railroad protective services. Protective services, such as flagging, are typically provided by the railroad.

If the railroad work is included in the contract, the plans will show the work and will include pay items exactly as if the work was part of the transportation improvement. The responsibility of the Project Engineer is to treat this work the same way that “normal” work is handled. There will be a necessity for communication with the railroad itself, inviting comments and joint reviews and inspection of the work. In many cases, the railroad will provide materials or equipment to be incorporated into the work. The railroad will also provide certification that provided material meets the requirements of the contract. If problems arise and changes are considered, there are additional paperwork demands. The Project Engineer should consult with the Railroad Company and the Region Utility Engineer.

If the work is associated with the project, or if unrelated work is being done nearby, and the railroad or its contractor is performing the work, the Project Engineer should treat the neighboring work in the same manner that adjacent WSDOT work would be treated. (See Standard Specifications, Section 1-05.14 and Section 1-2.2H of this manual.)

Protective services may be called for when the Contractor is performing work on railroad facilities (first category above) or when the Contractor’s work is conflicting or adjacent to a railroad facility that is not being changed. Typically, the railroad will determine the need for service, provide the protective services, and send the bill to WSDOT. There may be an agreement in place, or the railroad’s actions may be unilateral. On all projects including railroad flagging, the Project Engineer will notify the Railroad Company when all work involving the railroad is physically complete.

The addition or revision of agreements with the railroad can be lengthy processes. The Project Engineer should stay alert for possible changes and the need for revisions to the agreement. When these arise, the Railroad Company and the Region Utility Engineer should be contacted early and often.

1-5 Surveying

1-5.1 Site Surveying

1-5.1A Permanent Monuments

Most permanent monuments which are in the construction zone are relocated by the establishing agency. Normally these monuments are relocated prior to beginning of construction, but if monuments are found within the construction zone, they must be preserved until they can be moved. If the urgency of construction does not allow time for the relocation of the monument, it must be properly referenced so it may be reset or relocated at a later time. When a monument is found within the construction area, the proper agency shall be notified promptly and requested to relocate the monument.

1-5.1B Property Corner Monuments and Markers

It is imperative that land plats and property corners be preserved. The 1973 Legislature enacted a Survey Recording Act, RCW 58.09, to provide a method for preserving evidence of land surveys by establishing standards and procedures for monuments and for recording surveys as a public record. When a general land office corner, plat survey corner, or property line corner exists in the construction zone, it is necessary to properly reference it and reset it after the construction work has been done. RCW 58.09.040 requires that, for all monuments that are set or reset, a record of the monument be filed on a Monumentation Map with the County Engineer in the county in which the corner exists and the original sent to the State Right of Way Plans Branch. Headquarters will forward a copy to DNR for their records.

1-5.1C Alignment Monumentation

During construction, alignment monumentation may be altered to fit field conditions. Such changes may include:

- Normally all PCs and PTs are to be monumented. Additional point on tangent (POT) monuments are necessary where line of sight is, or may in the future be obstructed by the horizontal or vertical alignment, buildings, or other barriers.

- When the right of way and the construction alignment do not coincide, the monumentation shall be such that the exact right of way as acquired can be positioned in the field. This will generally require, as a minimum, that the right of way alignment be monumented.

- When safety of the survey crew or survival of the monuments is an issue, monuments may be offset from the true alignment. An extra effort in accuracy must be made when setting offset monuments to ensure an accurate reestablishment of the true alignment. The monumentation, including monument locations, reference distances, stations, and bearings, is to be shown on the as built plans.
1-5.2 Construction Surveying

1-5.2A Surveying Provided by the State

Unless the contract states otherwise, the Project Engineer is responsible for providing all surveying needed to locate and define the contract work. The staking done in construction surveying must assure that the work will conform to the plans and must also conform to the Contractor’s approach to the work. There are numerous survey techniques that will accomplish these objectives. Prior to each phase of the work, the Project Engineer must reach agreement with the Contractor concerning the method, location, and timing of construction staking. Once this agreement is reached, it must be shared with all WSDOT, Contractor, and subcontractor personnel who place or use construction stakes.

1-5.2B Contractor Surveying

If the contract requires the Contractor to provide some or all of the construction surveying, the Project Engineer is required to provide only the primary control points staked, marked, and verified in the field and the coordinate information for the main alignment points in the plans. The plan alignment and the field control points must be referenced to the same grid coordinate system.

The provisions for contractor surveying are intended to provide the stakes needed to inspect the work, as well as the primary function of locating and defining the work. If the survey stakes required by the contract do not provide the reference data needed for inspection, then the Project Engineer will have to provide additional survey work that is needed. As an alternative, a change could be negotiated with the Contractor to perform the added work.

The Contractor’s survey work is a contract item, just like all other contract items. It must be inspected for adequacy and conformance with the contract. Once it is performed and inspected, it must be paid for.

The wise Project Engineer will inspect the survey efforts and check as much of the contractor’s work as is practical. Any errors should be brought to the Contractor’s attention for corrective action. The inclusion of contractor surveying in a project transfers the risk of survey errors to the Contractor. The Project Engineer must assure that the survey work of the Contracting Agency does not relieve the Contractor of that risk.

1-6 Inspection of Course Thicknesses

Tabulated below are the permissible deviations in measured thickness for specified depths of surfacing and paving. While these are the maximum deviations that can be allowed, the Project Engineer may impose tighter requirements for conforming to the plan dimensions where there is a reason to do so.
Grinding depths should be limited to 3/8 inch (9 mm). If the specifications cannot be met with this, the section should be removed. Low areas which grinding cannot feasibly remedy shall be sandblasted, filled with epoxy bonded mortar and textured by grinding. The epoxy bonding agent shall meet Standard Specification Section 9-26.1(1)B for Type II epoxy. Areas which exhibit improperly finished surfaces and would require extensive patching should be removed at the Engineer’s discretion.

5-5.3E Curing

Immediately following final finishing of the concrete, or after free water leaves the surfaces, the curing compound should be applied. The purpose of curing, whatever method is used, is to prevent the loss of moisture required to hydrate the cement so that the concrete will gain its proper strength and durability. It is essential that a complete coverage of curing compound be applied to seal the exposed surface of the pavement.

On most paving work, specifications will call for machine application of the curing compound. It should be seen that the spray nozzle is adequately protected from the wind by shielding so that the compound is not blown off the pavement surface. The Inspector shall check to see that the specified rate of coverage is obtained.

The efficiency of the curing compound in preventing escape of moisture from the concrete is dependent upon the thickness of the membrane. For this reason, it is essential that the compound be evenly applied over the exposed surface at a rate of application not less than that specified.

The curing membrane must be protected from damage by foot traffic or equipment. There is a certain amount of foot traffic required in sawing joints, operating the profiler and other operations. This traffic should be held to a minimum, and if damage from undue scuffing or other causes does occur, the area shall be re-sprayed with the required amount of curing compound. Care must be exercised so that curing compound is not sprayed into saw cuts, as the joint sealing compound will not adhere to the concrete in the joints if the curing compound is present.

When pavement is being constructed in early spring or late fall, the Engineer must be alert to predictions of freezing weather, and see that the Contractor is prepared to protect the fresh concrete from freezing, as required in Section 5-05.3(14) of the Standard Specifications.

When special protection against freezing is required, the protective earth or straw covering must be placed against the sides of steel forms, if used, as well as on the surface of the pavement, since steel offers poor insulation to the change in temperature.

5-5.3F Joints

Contraction Joints

As concrete cures and hardens, a change in volume occurs due to loss of moisture and cooling. This shrinkage results in tensile stresses being set up in the pavement, causing cracks to develop. History has shown that transverse cracks will develop at about 15-foot (4.5-meter) intervals along the length of a slab, and that a slab wider than 15 feet (4.5 meters) may crack longitudinally. Random spacing is specified to break up the harmonics occurring from the wheels rhythmically crossing joints (see the Standard Plans).

The purpose of contraction joints is to control the cracking of the concrete, thereby preventing ragged random cracks that spall and require expensive maintenance. Good construction of these joints is of the utmost importance, and inspection of this work is one of the most important phases of the Engineer’s duties.

Contraction joints are weakened planes that collect the cracking into a controlled joint. These joints are made by sawing and pouring a hot or cold filler into the joint. The purpose is to create a maintainable joint in the slab and cause the crack to form along the plane of the joint.

This type of joint is constructed by sawing a groove in the hardened concrete to create a plane of weakness along which the crack will form. The saw cuts are made with the circular saw blades edged with abrasives or diamonds. On full width construction, a gang sawing machine using several blades simultaneously is generally used to saw the transverse joints. When the gang sawing machine is used, the Inspector must see that the individual blades are properly aligned and set to cut the required depth.

It is necessary to control the time of sawing transverse joints very carefully, so that sawing may be done when concrete has hardened as much as possible without delaying so long as to allow development of random cracks. It is impossible to state a sawing schedule that will be ideal for every job, since curing conditions vary a great deal from job to job. Some generalizations can be made concerning sawing, but the Engineers on each job must determine from experience the most suitable schedule for that job.

It is desirable to delay sawing as long as possible to allow the concrete to gain enough strength to resist raveling adjacent to the saw cut. Sawing green concrete produces excessive wear on the saw blades, and causes washing, raveling, and other structural damages to the concrete near the joint. However, it may be necessary to make some early cuts to control cracking.
In general, a program of sawing control joints should be followed, sawing every fifth joint, not to exceed 64 feet (19.5 meters), as soon as the concrete hardens sufficiently to resist excessive raveling. The time of beginning sawing may vary from about 6 hours on hot, dry days to as long as 18 hours when the weather is cool and the humidity high. The Inspector must use good judgment in controlling the sawing sequence. Sawing of the intermediate joints should follow the sawing of the control joints. It will usually be found possible to delay sawing of the final joints until the day following placement of the concrete (see the Standard Plans).

By observing the frequency of cracking and opening of joints the next day, it will be possible to lay out a sawing schedule that will give best results. If only the control joints are cracked, the sawing of the intermediate joints can be delayed further, given fairly constant weather conditions.

Sawing of the longitudinal joints on full width pavement can be delayed as long as 3 days with no danger of random cracking.

The Engineer should mark off the locations of the transverse joints and should check frequently to see that the specified depth of cut is sawed. Since much of the sawing will be done at night, the Inspector should be equipped with a good flashlight to properly examine the condition of saw cuts and to watch for random cracks.

When paving a lane adjacent to a previously paved slab, an early morning examination of joints in the existing lane will show the joints that are open and working. These locations should be marked for sawing control joints in the second lane. Friction at the construction joint and the tie bars will transmit stresses to the new slab and may cause random cracking to occur. For the same reason, uncontrolled cracks in the first lane should be matched with a control joint in the second. In addition, a bond breaker, such as a small piece of roofing felt, should be over each working joint to prevent uncontrolled migration of the crack into the adjacent slab.

**Construction Joints**

A construction joint shall be made at the end of each day’s paving by placing a header board transversely across the pavement. Uncapped dowel bars should be installed in the joint, seeing that the dowels are parallel with the centerline and profile of the pavement. The ends of the dowels projecting from the header should be protected so that they will not be disturbed or moved from their correct positions.

Upon beginning paving the following day, any broken curing seal on the end of the previous day’s work must be re-sprayed with curing compound. In addition, the exposed dowel bars shall be “greased” to allow for future slab movement.

**5-5.4 Post Paving**

**5-5.4A Sealing Sawed Contraction Joints**

Prior to opening of the pavement to traffic, sawed joints must be sealed with an approved type of filler material. Before application of the filler material, the joints must be thoroughly clean and dry. In most cases, it will be necessary to clean the saw cut with a carborundum blade saw and remove dirt and dust with a jet of compressed air. It is important that the saw cut be completely filled to within 1/8 inch (6 mm) of the top with the filler material. The Inspector can check this by probing the joint after sealing with a stiff wire and watching for sagging of the filler below the top of the joint.

**5-5.4B Thickness**

Section 5-05.5(1) of the Standard Specifications outlines procedures for thickness determinations and provides penalties when prescribed tolerances are exceeded. Before final payment, the thickness tests will have to be made in order to determine the quantities.

**5-5.4C Opening to Traffic**

During the curing period designated for the concrete mix, the pavement must be properly barricaded to close it to all traffic. If necessary, the Contractor may be required to furnish a person to prevent traffic from using the pavement.

When the pavement has developed a compressive strength of 2500 psi (17 megapascals), as determined from cylinders made at the time of placement, it may be opened to traffic. The pavement should be cleaned either by brooming or a pickup sweeper prior to opening.

**5-5.5 Unfinished Cement Concrete Pavement**

**5-5.5A Forms**

Metal side forms, conforming to the requirements of Section 5-05.3(7)B of the Standard Specifications, shall be used for the construction of unfinished cement concrete pavement unless the Contractor requests to use an approved slip form machine.

It is essential that the base of the steel forms have full, equal bearing upon the subgrade throughout their length and width. They should be set true to alignment and grade and firmly staked with steel pins to avoid movement. Steel forms must never be set on blocks or pedestals. After the forms are firmly staked in place, a final inspection of line and grade should be made by sighting along the tops of the forms. Minor adjustments in grade can be accomplished by tamping additional subgrade material under the form base by an approved mechanical form tamper.

If major changes in alignment or grade are required, the forms should be removed and the subgrade reshaped to the proper elevation and recompacted before resetting the forms.
# Chapter 9

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Chapter 9  Materials

9-1  General

9-1.1  Introduction

The quality of material used on the project will be evaluated and accepted in various ways, whether by testing of samples, visual inspection, or certification of compliance. This chapter details the manner in which these materials can be accepted.

9-1.2  Requirements

Requirements for materials are described in Section 1-06 and Division 9 of the Standard Specifications for Road, Bridge and Municipal Construction (M 41-10). Tolerance limits and a procedure for acceptance of certain materials are given in Chapters 9-5.4 and 9-5.6. For inspection of course thickness, the maximum deviations for measured thickness of surfacing and paving see Chapter 1-6 of this manual.

9-1.3  Sample and Test Numbering

A separate series of numbers, starting with No. 1 in each instance, shall be used for acceptance, independent assurance, and verification samples for each type of material for which there is a separate bid item. Verification samples shall be referenced to the corresponding Manufacturer’s Certificate of Compliance.

9-1.3A  Preliminary Samples and Tests

Preliminary samples are intended to show the general character of the materials available or proposed for use. The sample may be taken from a natural deposit, the general stock of a dealer, or elsewhere. The material sampled may require further treatment before it will meet the specification requirements. Preliminary samples are a basis for approving which aggregate site or brand of material will be considered for use. Deliveries cannot be accepted on the basis of preliminary samples unless the samples represent an identified lot of materials.

Unless specified for a particular purpose, preliminary sampling and testing of materials from a potential source are not mandatory functions. It is to be performed when requested by the Project Engineer, or the State Materials Laboratory on the Request for Approval of Material (DOT Form 350-071).

In order to insure consistency in sampling for aggregate sources which will be approved for an extended period of time, the preliminary sample must be witnessed or taken by a designated representative of the Regional Materials Engineer.

Before sampling, check to see whether previous preliminary test reports are available. If preliminary test reports are available and confirm that the material meets the contract documents, additional tests may not be needed. If in doubt the State Materials Laboratory is available to provide assistance.

9-1.3B  Acceptance Samples and Tests

Acceptance samples and tests are defined as those samples tested for determining the quality, acceptability, and workmanship of the materials prior to incorporating the materials into the project. The results of these tests are used to determine conformance to the contract documents. The minimum frequency for sampling and testing of acceptance samples is detailed in Chapter 9-5.7 of this manual.

9-1.3C  Vacant

9-1.3D  Verification Samples and Tests

Verification samples and tests are used for making checks on the reliability of a manufacturers test results when acceptance of the material is based upon a Manufacturer’s Certificate of Compliance.

9-1.4  Form Letters

A number of form letters have been prepared as an aid to the Project Engineer in transmitting information to the laboratory. In order to minimize delays to completion of material testing, transmittal letters should include all the information that is pertinent to the sample in question. In order to assist the laboratory, copies of the transmittal letters should be retained in the Project Engineers Office. The following is a list of the forms that may be used for transmittal of samples and/or information to the materials laboratory:

350-009  Concrete Test Cylinder Transmittal Letter
350-016  Asphalt Sample Label
350-026  Preliminary Sample Transmittal Letter
350-040  Proposed Mix Design
350-056  Sample Transmittal
350-071  Request for Approval of Material
350-074  Field Density Test
350-092  Asphalt Concrete Pavement Compaction Control Report
350-114  Summary Report of Acceptance Sampling and Testing
350-115  Contract Materials Checklist
351-015  Daily Compaction Test Report
410-025  Transmittal of Falsework, Form and Shop Drawings
9-1.5 Project Material Certification

The Project Engineer is responsible for obtaining all required materials documentation or otherwise ensuring that all required materials testing is completed, all with satisfactory results, prior to the materials being incorporated into the project. The Project Engineer is also responsible for maintaining a successful accounting for the materials incorporated into the project in order to support the Region’s Certification of Materials. Management and accounting for materials used in the construction of a project are to be administered in the same manner regardless of its funding source; Federal, State, or a combination of both.

The Region is responsible for periodic reviews of each project’s materials documentation at the Project Engineer’s office. Upon completion of the project the Region will prepare a Region Materials Certification letter listing all variances that were identified and their resolution. On projects that involve Federal participation where material deficiencies are documented, these deficiencies must be resolved with the State Construction Office through the Region before the Region Certification of Materials can be completed. On projects that involve State Funds only, documented deficiencies must be resolved with the Region prior to the Region Certification of Materials. The Regional Administrator or their designee is responsible for signing and distributing the certification letter.

The State Materials Laboratory will also perform compliance reviews on a sampling of completed projects statewide where the materials have been certified.

Definitions

Certification: A Region Materials Certification based on a documented evaluation of the project’s materials inspection, sampling, testing, and other materials acceptance activities for their conformance to the contract documents, Standard Specifications and this manual. The certification reflects the project’s conformance with the Record of Material as adjusted by the Project Engineer for:

1. Actual project quantities utilized,
2. Acceptance practices as provided for in this manual including Chapters 1-2.8 and 9-5.2, and Non-critical items,
3. Adjusted sampling/testing frequencies as provided for in Chapter 9-5.2, and
4. Work added by Change Order.

Variance: An identified difference between the materials acceptance requirements noted in this manual, the contract documents, the Standard Specifications, and a review of the completed projects Record of Materials. All variances must be noted. Such notations will need to include the basis by which the material was accepted and how the requirements for that material were met. Any variance between the recognized acceptance requirements and the Project Engineers use of the material must be resolved with either the Region, State Construction Office, and/or State Materials Laboratory, as appropriate.

Project Material Certification Process

Environmental and Engineering Programs Division (EEPD)

1. State Materials Laboratory (Documentation Section)
   a. Prepare the initial Record of Material for all major items of materials listed in the contract.
   b. Provide technical support, certification guidelines, format, and suggested documents. See Figure 9-1 for Project Materials Checklist (DOT Form 350-115, latest version). See Figure 9-2 for examples of the Region Materials Certification letter and its distribution.
   c. Conduct Compliance Reviews on a sampling of completed projects statewide where the Region has certified the materials.

2. The State Construction Office
   a. Receives variances for federal aid projects identified during the Region’s materials certification review.
   b. Coordinates FHWA and Region to determine funding eligibility for variances.
   c. Prepares response to Region identifying degree of participation (Letter of Resolution).

3. Accounting Office
   a. The federal aid section will make the appropriate transaction as necessary upon receipt of the Letter of Resolution.
   b. Voucher a federal project only after receiving a copy of the Project Materials Certification, the Letter of Resolution and assure that the appropriate credit has been made to FHWA.
   c. Attach a copy of the Letter of Resolution to the Journal Voucher sent to FHWA.

Region

1. Project Engineer
   a. Sets up and maintains a materials documentation system.
   b. Maintains and monitors a current Record of Material ensuring materials certification throughout the course of the project.
# Project Materials Checklist

<table>
<thead>
<tr>
<th>Contract Number</th>
<th>Sign Route</th>
<th>Federal Aid Number(s)</th>
<th>Project Title</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
<td><strong>No</strong></td>
<td><strong>N/A</strong></td>
<td><strong>Item No.(s)</strong></td>
</tr>
<tr>
<td>1</td>
<td>All materials/products used in the construction of this project, including items added by Change Order, have been approved &amp; are listed on the Record of Materials.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>The actual materials/products used along with the actual basis for acceptance of those materials and products has been documented.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>All uses of proprietary items, including those listed in the Special Provisions and/or contractor provided QPL items, are documented.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>When required, change of material/product letters and a revised RAM were initiated by the contractor.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>A Change Order has been completed for all materials accepted and incorporated into the project, but which failed to meet the required specifications when tested.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>An appropriate credit has been received for all non-specification materials used.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Modifications to testing/inspection procedures, including CM 1-2.8A, have been explained and documented by the Project Engineer prior to construction of the item.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Acceptance based on Sampling and Testing for Small Quantities has been documented. CM Chapter 9-5.2C.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Where Manufacturers Certifications were not provided prior to material or product installation, the Project Engineer has provided specific prior approval for the work to continue in accordance with 1-06.3 of the Standard Specifications.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>All required acceptance actions and documentation were completed and satisfactory test results demonstrated before payment was made on each item.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Acceptance sampling &amp; testing frequencies for each item accepted is adequate for the total quantities of those items incorporated into the project.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>All Acceptance Sampling and Testing completed by the Project Engineer utilized Qualified Testers and Verified Testing Equipment in accordance with the Qualified Tester program.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>All Fabrication Inspected items accepted have been documented in accordance with CM 9-1.5C.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>The contractor has submitted all required Manufacturer Certifications and Mill Certifications, the Certifications represent the specification requirements noted in the contract, and quantities represented by the certifications match or exceed the final quantities used.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>All required catalog cuts and/or shop drawings have been approved and are on file.</td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>All required Certificates of Materials Origin have been received and are on file. (Fed Aid projects only)</td>
<td><strong>No</strong></td>
<td></td>
</tr>
</tbody>
</table>

* Checklist items marked “No” constitute a Materials Certification deficiency. Each “No” requires the contract item number for the affected item to be shown along with an attachment to the Materials Checklist detailing the circumstances of use, the method used for acceptance of the material, the Project Engineer’s evaluation of the material, suitability for its application, and determination as to whether or not it may have met the specification in spite of the materials documentation oversight. If the project is Federally funded, the Project Engineer should also include a recommendation for Federal participation in light of the use of undocumented materials.

** These specific materials deficiencies on Federal Aid projects must be resolved through OSC Construction and may result in the loss of Federal participation.

---

<table>
<thead>
<tr>
<th>Project Engineer</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region Construction Engineer/Operations Engineer/Area Engineering Manager</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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*Figure 9-1*

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*Construction Manual*

*January 2003*
Kevin J. Dayton P.E.
State Construction Engineer
P.O. Box 47354
Olympia, WA 98504 - 7354
MS: 47354

Cont. No: SR-
F.A. No.:
Section:

Date Completed:

Dear Sir:

This is to certify that:

The results of acceptance sampling and testing completed for the project referenced above, confirm that the materials incorporated into the construction of the project were found to have met the requirements as outlined in the contract plans, provisions, and Standard Specifications.

There were no exceptions.

OR:

This is to certify that:

The results of the tests on acceptance samples indicate that the material incorporated in the construction operations controlled by sampling and testing were in conformance with the approved plans and specifications.

Exceptions to the plan and specifications are explained on the attached sheet.

Very truly yours,

Regional Administrator
RGF
Attachment

cc: FHWA, 40943
State Materials Engineer, 47365
Accounting Chief, 47420
Regional Oper./Const. Engineer
Project Engineer
c. Identify, document, and justify all materials variances including determination and acceptance of noncritical items in accordance with Chapter 1-2.8 of this manual. Justification may be any of the following:

1. Follow requirements of Section 1-2.8C(3) if the deficiency is a lack of manufacturer’s certification.
2. Satisfy the deficiency through additional testing or documentation.
3. Demonstration that the existing documentation is adequate (for example, 19 out of 20 test were taken).
4. Demonstration that the cost of obtaining the missing documentation will not be justified by the benefits received.

d. Identify and document the determination and acceptance of all non-critical items in accordance with Section 1-2.8A of this Manual.

e. Prepares the Region Materials Certification package, which includes the Region Materials Certification letter, identified variances, Letters of Resolution for all identified variances on federal aid projects and resolution actions taken. This package also includes a completed Contract Materials Checklist (DOT Form 350-115). The certification package is submitted to the Region Construction Manager for review. The certification letter is to be addressed to the State Construction Engineer.

2. Regional Operations/Construction Office
   a. The Region shall review projects according to Chapter 10-5 of this manual for documentation requirements including materials.
   b. Resolve materials variances identified by the Project Engineer and the Region’s review of materials documentation at the Region level for State funds only projects. Resolve materials variances on Federal aid projects through contact with the State Construction Office.
   c. Review certification package for completeness.
   d. Submit certification letter to Regional Administrator for signature.
   e. Distribute signed Region Materials Certification letter. The original is submitted to the State Construction Engineer, with copies sent to FHWA, State Materials Engineer, State and Accounting Chief. A copy of the Letter of Resolution shall be attached if there are any variances.

3. Regional Administrator, or designee
   a. Signs the certification letter.

4. State Administration and Support Accounting Office
   a. Completes the necessary paperwork.

Compliance Review for Materials Certification Process

Compliance reviews will be performed by the State Materials Laboratory to document how well project records conform to materials certification standards. Upon receipt of a completed Region Materials Certification letter from the Regional Operations/Construction Office, the State Materials Laboratory will notify the Region within 60 days of intent to perform a compliance review on that project. If the project is selected for a compliance review, it will be scheduled within 180 days of notification to the Project Office.

The compliance review will normally be conducted at the project office unless arrangements are made for it to be conducted elsewhere.

The goal is to perform a compliance review on at least one project per project office every two years. Compliance reviews may be conducted more frequently as appropriate. Projects will be selected with consideration given to project size and complexity.

The records maintained and developed by the Project Engineer for acceptance of the materials and the identification of variances will be reviewed.

Upon completion of the review, the findings will be discussed with the Project Engineer and/or his representative. A report of the findings will be prepared and sent to the Project Engineer within 60 days after the review. A copy will be sent to the Regional Documentation Engineer, Construction Manager, State Construction Office, and the FHWA Division Office.

If the Compliance Review shows a discrepancy of a serious nature, the Construction Manager will correct any such discrepancy in the process.

The following items of documentation are required to develop the Material Certification and must be made available for review:

1. Record of Materials, as revised and amended by the Project Engineer (ref. 9-1.5A)
2. Request for Approval of Material (ref. 9-1.5B)
3. Comparison of Quantities (Region Final)
4. List of Change Orders
5. Reduced Frequency Testing Approval
6. Test Results
   a. Acceptance Test Reports
   b. Assurance Test Reports (where applicable)
c. Independent Assurance Test Reports (where applicable)
d. Verification Test Reports (Cement and Liquid Asphalt)

7. Manufacturer’s Certificate of Compliance (ref. 9-1.5E)
   a. Concrete Pipe Acceptance Report (ref. 9-1.5F)
   b. Lumber Grading Certificate
   c. Certification of Cement Shipment
   d. Notice of Asphalt Shipment or Certified Bill of Lading
   e. Any other certificate required by the contract documents

8. Inspected Items Acceptance (ref. 9-1.5D)
9. Catalog Cuts (Product Data Sheet)
10. Small Quantity Acceptance Documentation
11. Proprietary or Qualified Products List (QPL) Item Acceptance Documentation (ref. 9-1.5B)
12. Sign Acceptance Report (ref. 9-1.5G)
13. Field Acceptance Reports, Field Note Records, and/or Inspectors Daily Reports
14. Follow-up actions for excessive variations between the Acceptance Sample and the Independent Insurance Sample Test Results (when applicable)

9-1.5A Record of Materials (ROM)

A listing of all major construction items for each project is provided by the State Materials Laboratory, establishing a Record of Materials (ROM) specific for that project. For these major construction items, the ROM identifies the kinds and quantities for all materials deemed to require quality control testing. It further identifies the minimum number of acceptance and verification samples that would be required for acceptance of those materials. The minimum number of acceptance tests is based on the planned quantities for the project and should be adjusted for the actual quantities used. Also listed are those materials requiring other actions, such as fabrication inspection, Manufacturer’s Certificate of Compliance, shop drawings, or catalog cuts.

The acceptance action and/or numbers of samples listed are the minimum requirements for the Project Engineer’s acceptance of those materials and the minimum requirements necessary for the Region’s certification for the materials used on that project. The State Materials Laboratory will forward the Record of Materials electronically to the Regional Materials Engineer, and Project Engineer shortly after the contract is awarded. The copy submitted to the Project Engineer is intended as a tool to assist the project office in tracking the samples approved, samples tested, Manufacturer’s Certificate of Compliance, shop drawings, catalog cuts received, and other pertinent data necessary for the Project Engineers and the Regions certification of materials.

The acceptance requirements shown on the Record of Material may be modified by the Contractors specific Requests for Approval of Material. In addition the ROM is based on the State Material Laboratory’s review of the major items of construction identified by the contract Summary of Quantities. Reviewing the contract plans and provisions may also identify additional materials documentation requirements as well as major construction items that require additional materials not accounted for in the State Material Laboratory’s initial review of the project. These additional materials documentation requirements should be added to the ROM and tracked for completion throughout the course of the project work.

The accuracy of the ROM and Certification of Materials is largely the responsibility of the Project Engineer.

Where the ROM is not clear or there appears to be opportunities to adjust the acceptance requirements that have been identified, the Project Engineer is encouraged to contact the Region Materials Engineer or the State Materials Laboratory for assistance.

In order to ensure clarity upon completion of the work and to allow for easy certification of the project by both the Project Engineer and the Region, it is important that the project ROM be accurate and actively maintained throughout the course of the project. Any changes to the acceptance requirements, additional materials used, or any additional materials added to the project by change order should be accurately documented and tracked in the project Record of Materials.

9-1.5B Approval of Materials

To fulfill the requirements of Standard Specifications Section 1-06.1, the Contractor must notify the Engineer of all proposed materials prior to use. This may be accomplished by a Qualified Product List (QPL) submittal or by submitting a Request for Approval of Material (RAM) (DOT Form 350-071). Approval of the material does not necessarily constitute acceptance of materials for incorporating into the work. Additional acceptance actions, as noted by the code on the RAM or QPL must be completed prior to the material being used in the work.

Where the Contract Documents list products by specific name and model, and for which no additional requirements are stated (proprietary products), the Contractor needs only to complete the RAM indicating to the Engineer the intended choice. The Engineer shall approve the RAM, noting the page number where it is listed as a proprietary product in the Contract Documents.
**Qualified Products List — Submittals**

Products listed in the QPL have been found capable of meeting the requirements of the Standard Specification or General Special Provision under which they are listed and, therefore, have been “Approved.” These may be “Accepted” by fulfilling the requirements of the Acceptance Code and any notes that apply to the product. Instructions are given in the QPL for processing QPL submittals. The Engineer shall review the submittal of the material for consistency with the Bid Item and shall promptly notify the Contractor of any concerns, working toward resolving these with the Contractor. QPL submittals inconsistent with the intended use for the Bid Item should be marked “unacceptable for intended use” and returned to the Contractor.

**Request for Approval of Material — Submittals**

Requests for materials not included in the QPL shall be submitted using the RAM form. Aggregate Sources will be approved by consulting the Aggregate Source Approval database for the use intended. Fabrication Facilities, Nurseries, and Concrete Batch Plant approvals will be determined by the use of other reference databases.

The Engineer may use the QPL as a reference source for coding products submitted on a RAM. The specific product listed on the RAM must be identified by make, model, batch, color, size, part no., etc. and correspond exactly to the approved QPL product. The product must also be listed in the QPL under the appropriate Standard Specification for the intended use as indicated by the Bid Item and Specification Reference shown on the RAM. The RAM should be coded with the 4 digit QPL code and any notes and/or restrictions restated as “Remarks” on the RAM.

When unable to approve a RAM as outlined above, the Engineer will code the items with a “7” and forward it to the State Materials Laboratory Documentation Section. A copy should also be returned to the Contractor at this point to inform him that the RAM has been sent to the State Materials Laboratory for approval. Attach any additional documentation, along with appropriate transmittals, that may assist the RAM Engineer in approving the proposed material; such as Catalog Cuts, Manufacturer’s Certificate of Compliance, etc. Including the page number of the Special Provision or Plan Sheet will also aid in expediting the Approval process.

All RAMs shall be signed and dated by the Engineer. Copies shall be distributed as indicated at the bottom of the form. Acceptance requirements should be noted on the maintained ROM or Materials Tracking Program. When additional material documentation such as Manufacturer’s Certificate of Compliance or Catalog Cuts are available, copies may be made to assist the Inspector in the acceptance/verification process.

All RAMs shall be signed and dated by the Engineer. Copies shall be distributed as indicated at the bottom of the form. Acceptance requirements should be noted on the maintained ROM or Materials Tracking system. When noted on the State approved RAM, copies of requested material documentation (i.e., Manufacturer’s Certificate of Compliance, Mill Test Reports, Catalog Cuts, etc.) should be sent to the State Materials Laboratory, QPL Engineer, for possible inclusion on the QPL.

**Low Risk Materials**

There are low risk, low cost materials that may be used in the project with neither contractor identification per Section 1-06 of the Standard Specifications nor any other documentation. These materials include:

- Nails
- Pea gravel for decorative purposes
- PVC glue
- Polypropylene rope for induction loop
- Centralizers and spacers for rebar columns
- Friction tape
- Moisture proof varnish for friction tape
- Duct tape for bridge approach slab anchors
- Grout for cosmetic purposes
- Electrical tape
- Straw bales not used as mulch

Other items can be considered for addition to this list. We encourage anyone with suggestions to contact the Construction Office or the State Materials Laboratory.

**9-1.5C Vacant**

**9-1.5D Materials Fabrication Inspection Office — Inspected Items Acceptance**

Items that are inspected and found to meet contract documents by the Materials Fabrication Inspection Office are identified by a tag or stamp. This type of inspection is generally performed at the manufacturing or fabrication plants. There are various types of stamps or tags used for acceptance of inspected items, which attest that the item was in full conformance with the specifications at the time of inspection. The inspected items along with the type of stamp designation is covered under Section 9-1.5D(1) of this manual.

The following is the process for the acceptance of inspected items.

1. The manufacturing or fabrication plant must be approved via the “Request for Approval of Material,” (RAM) or the Qualified Products List (QPL)
2. The Materials Fabrication Inspection Office Inspector, who will obtain the necessary mill tests or other documentation from the manufacturer and reference them to the stamp or tag shown in Figures 9-3 through 9-7, must inspect the item of work. This number can be used for tracking of the item.
Materials

3. Once the fabricated item arrives on the job, check for approval stamp or tag.
   a. If there is an approval stamp or tag, record the type of tag or stamp along with the ID number when applicable, quantity, and brief description of the item for project records. The Project Engineer’s representative should note in a report that the material was in satisfactory visual condition when installed and forward all information to the project office. In case of questions concerning an inspected item, contact the appropriate Materials Fabrication Inspection Office. The offices are:

   State Materials Laboratory, Tumwater,
   Mail Stop 47365

   Seattle Inspection Office, Mail Stop NB-82,
   Northwest, MS-501

   Spokane Inspection Office, Mail Stop Eastern,
   Materials Lab

   Vancouver Inspection Office, Mail Stop
   Southwest S-15, Materials Lab

   b. If there are no stamps or tags, inform the Contractor that the item may not be acceptable, and contact the Materials Fabrication Inspection Office to determine the status of the inspection. Items lacking tags or stamps or damaged during shipping should be rejected and tagged or marked appropriately.

9-1.5D(1) Inspected Items, Stamps and Tagging Identification
The following are examples of the types of stamps and tags used by the Materials Fabrication Inspection Office. The letter on the stamp or tag represents the inspector who performed the inspection.

<table>
<thead>
<tr>
<th>M</th>
<th>W.S.D.O.T.</th>
<th>M</th>
<th>W.S.D.O.T.</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>INSPECTED</td>
<td>M</td>
<td>INSPECTED</td>
<td>M</td>
</tr>
</tbody>
</table>

Stamps
Figure 9-3

All Documentation associated with these stamps in Figure 9-3 will be reviewed and approved by the Materials Fabrication Inspection Office and kept at the point of Manufacture, with the exception that they will not track the quantities of foreign materials used on the project.

APPROVED FOR SHIPMENT
WASH. DEPT. TRANSP.
N001234
Stamp
Figure 9-4

APPROVED FOR SHIPMENT

Tag
Figure 9-5

The stamp shown in Figure 9-4 or tag shown in Figure 9-5 identifies inspection and the inspector of the following items:

1. Concrete Wall Panels — Stamped or tagged
2. Three Sided Structures — Stamped or tagged
3. Prestressed Concrete Products — Stamped or tagged
4. Steel for Bridges — Stamped or tagged
5. Signal, Luminaire and Strain Poles — Stamped or tagged
6. Miscellaneous Welded Shop Items (see RAM or QPL for special items) — Stamped or tagged
7. Sign Structures — Stamped or tagged
8. Anchor Bolts for Luminaires, Signal Poles and Sign Structures

The stamps shown in Figure 9-3 identifies inspection and the inspector of the following items:

1. Precast Concrete Barrier
2. Precast Concrete Catch Basins, Manholes and Inlets. This includes all sections and risers 6 inch and above.
3. Concrete Utility Vaults
4. Concrete Junction Boxes
5. Galvanized Steel
9. Epoxy Coated Reinforcing Steel Bars for Concrete — Bundles of rebar shall be randomly tagged per shipment to the project
10. Metal Bridge Rail — Each bundle of rail shall be tagged
11. Raised Pavement Markers, Type 1 (thermo-resin type only) — Each box of markers shall be stamped.
12. Concrete Culvert, Sewer Pipe (30 inches (750 mm) and above) — Stamped

All Documentation associated with the stamp in Figure 9-4 or the tag in Figure 9-5 will be reviewed and approved by the Materials Fabrication Inspection Office and kept at the point of Manufacture, with the exception that they will not track the quantities of foreign materials used on the project.

Tag
Figure 9-6

The tag in Figure 9-6 identifies inspection and inspector of Treated Timber, Piling and Poles

1. Bundles of treated timber may be randomly tagged “Approved for Shipment” referencing the inspector’s identification number.
2. Treated Piling and Poles shall be individually tagged “Approved for Shipment” referencing the inspector’s identification number.

All Documentation associated with the tag in Figure 9-6 will be reviewed and approved by the Materials Fabrication Inspection Office and kept at the Materials Fabrication Inspection Office.

WSDOT-A

Stamp
Figure 9-7

The stamp shown in Figure 9-7 identifies inspection and inspector of the following items:

(This stamp is impressed on the casting and will be circled with spray paint for ease of visibility of the stamp.)

1. Gray-Iron Castings, Steel Castings, Ductile-Iron Castings — Stamped
2. Standard Plan B-2a and B-2b Frames and Grates — Each set shall be stamped aligning the adjacent mating surfaces to each other. This alignment is critical as the leveling pads are ground to prevent rocking of the grates in the frames.

All Documentation associated with the stamp in Figure 9-7 will be reviewed and approved by the Materials Fabrication Inspection Office and kept at the Materials Fabrication Inspection Office, with the exception that they will not track the quantities of foreign materials used on the project.

9-1.5E Manufacturer’s Certificate of Compliance

As designated by the specifications and contract special provisions, certain materials may be accepted on the basis of a Manufacturer’s Certificate of Compliance. This acceptance is an alternate to job site sampling and testing. The Record of Material should indicate the required sampling and testing and provide a guide to the items for which a compliance certification is an acceptable basis of acceptance. The Manufacturer’s Certificate of Compliance is required prior to installation of the material. See Section 1-2.8C(3) of this manual for guidance on allowing material to be placed without certification.

Acceptance by Manufacturer’s Certificate of Compliance will be permitted where designated by the contract documents. The Record of Material will provide a summary of requirements combining the special as well as general requirements of the contract.

The form of the Manufacturer’s Certificate of Compliance will vary considerably based on both the material and the origin and may take the form of standard state certificate forms, individual letters from manufacturers, or overstamps on bills of lading. Certain information is required and is designated by the specifications. This information includes the identity of the manufacturer, the type and quantity of material being certified, the applicable specifications being affirmed, and the signature of a responsible representative of the manufacturer. Supporting mill tests or documents may also be required. A Manufacturer’s Certificate of Compliance is required for each delivery of material to the project and the lot number of material being certified shall be identified.

Upon receipt of the Manufacturer’s Certificate of Compliance at the project office, it shall be reviewed for compliance with the specifications requirements using the preceding guidelines and the checklist for Transmittal of Manufacturer’s Certificate of Compliance Form 350-572. The manufacturer of the material must make the certification. A supplier certificate is not acceptable except
as evidence for lot number and quantity shipped and can only be accepted when accompanied by a certificate from the manufacturer, which meets the requirements of Section 1-06.3 of the Standard Specifications.

9-1.5F Concrete Pipe Acceptance Report
Fabrication inspection is periodically performed at approved sources of concrete pipe. During this inspection, samples of each type, size, and class of pipe are inspected and tested to verify compliance with the **Standard Specifications**. For a 90-day period of manufacture from the date of inspection, concrete pipe less than 30 inches (750 mm) diameter may be shipped and accepted based on “Concrete Pipe Acceptance Reports.” This report is prepared by the Fabrication Inspector and copies are thereafter supplied by the fabricator to accompany each shipment of pipe.

The Acceptance Report will indicate the date and original test results as performed by the Fabrication Inspector and will bear appropriate certification from the fabricator. Verify the conformance of the shipment with the contract requirements and examine the manufacture and shipping dates of the pipe for conformance with specifications and with the Acceptance Report.

9-1.5G Sign Acceptance Report
The Sign Fabricator Inspector is to verify that signs for an individual contract were inspected and approved for shipment to the project by having a “**FABRICATION APPROVED**” decal, see Figure 9-8.

![Figure 9-8](image)

Pre-approval of the Sign Fabricator is required by Traffic Operations and/or the Materials Fabrication Office. The Sign Fabricator is approved via the Request for Approval of Material (DOT Form 350-071).

**Sign Fabrication Inspectors**
Seattle, Yakima, Tacoma, and other Western Washington area — Contact the State Materials Lab- Seattle Inspection Office, Mail Stop NB82-501, (206) 464-7770.

Vancouver-Portland area — Contact the State Materials Lab Vancouver Inspection Office, Mail Stop S33, (360) 905-2236.

Spokane-Eastern Washington area — Contact the Eastern Region Materials Lab, Spokane, (509) 324-6169

Sign Inspection documentation requirements:

1. Sign blanks or panels: Manufacturer’s Certificate of Compliance with accompanying mill certifications will be kept at the Sign Fabrication facility.

2. Reflective Sheeting and Cutout Legend: Manufacturer’s Certificate of Compliance, this certificate will verify that the product(s) meets all the requirements of Standard Specification 9-28.12. The Manufacturer’s Certificate of Compliance will be kept at the Sign Fabrication facility.

3. The Project Engineer Representative will accept for installation and payment only those signs which have a “**FABRICATION APPROVED**” decal affixed. In the event there is no “**FABRICATION APPROVED**” decals on the signs, they may be rejected. Contact the appropriate Sign Fabricator Inspector for status, or have the Contractor ship the signs back to Sign Fabricator, if this does not delay the project.

Double-faced signs, which do not receive decals, will be approved on visual inspection at the fabricator’s facility and in the field.

A list/invoice of all inspected and accepted signs will be kept in the Sign Fabricator Inspector’s files.

9-1.6 Control of Materials
The succeeding parts of this chapter on materials outline the detailed method to be used in the control of materials. The expenditure made for materials is a large item in construction costs. If faulty materials are permitted to be incorporated into the project, the cost of replacement may exceed the original cost.

Chapter 9-4, Specific Requirements for each type of material, includes the following information:

1. Approval of Material
2. Preliminary Samples
3. Acceptance Samples
4. Field Inspection
5. Specification Requirements
Chapter 9-5, Guidelines for Job Site Control of Materials, provides the Engineer with additional information to assist in determination of the point of acceptance for materials from WSDOT and Contractor sources, the basis of acceptance, verification sampling and testing, tolerance limits, and the sampling and testing frequency guide.

Chapter 9-6, Radioactive Testing Devices, explains policy on the administration of radioactive testing devices.

Chapter 9-8, WSDOT Test Methods/Field Operating Procedures, are the testing procedures that are used in the field.

9-2 Vacant

9-3 Vacant

9-4 Specific Requirements for Each Material

<table>
<thead>
<tr>
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9-4.1 Portland Cement or Blended Hydraulic Cement

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: Preliminary samples will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance/Verification
   a. Acceptance
      (1) Bulk Cement: Bulk cement will be accepted upon receipt of a Manufacturer’s Mill Test Report Number, which shall be reported on each certified concrete delivery ticket.
      (2) Bagged Cement: If the quantity of bagged cement exceeds 400 bags, then it will be accepted by “SATISFACTORY” test reports from the State Materials Laboratory. If a sample is needed, acquire a 10-pound (5-kilogram) sample from one of every 400 bags and ship to the State Materials Laboratory for testing. Allow a minimum of 14 days from receipt of the sample at the Laboratory for testing. DO NOT permit the use of bagged cement until a “SATISFACTORY” test report has been received from the State Materials Laboratory.
      b. Verification: Manufacturing mills will provide samples directly to the State Materials Laboratory on a quarterly basis to compare with the manufacturing mill test report. The Engineer may take samples for testing as described in Standard Specifications Section 9-01.3.

4. Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc., as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


9-4.2 Bituminous Materials

1. Approval of Material: Approval of the materials are required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071). A preliminary sample consists of two (2) one-liter (1-quart) cans.

3. Acceptance/Verification
   a. Acceptance: Bituminous materials may be used after receipt by the Engineer of Asphalt Supplier’s Certification of Compliance incorporated in their Bill of Lading with the information required by the Standard Specifications 9-02. Examine these certificates to make sure the material is of the grade required and that it comes from the approved supplier and point of shipment.
   b. Verification: Samples for verification conformance will be taken based on the frequencies as stated in Section 9.5-7 of this manual. Because the entire sample may be used in testing, it is necessary to take a backup for each sample. The samples shall be taken and labeled in duplicate by the Engineer with both samples forwarded promptly to the State Materials Laboratory. Paving asphalt’s (PG, AR, PBA, AC, and RA grades) shall be taken at a frequency corresponding to every
other ACP mix acceptance sample. The first, third, fifth, and every fifth sample thereafter will be tested. Emulsions and cutbacks (such as MC and RC grades), shall be sampled from every other shipment. Emulsion used exclusively for tack coat (such as STE-1 and CSS-1), do not require sampling.

Consult the FOP for AASHTO T40 for detailed sampling procedures. Samples shall be taken as close as possible to the point where the material is to be used; i.e., pug mill, distributor, etc. In the case of cutback asphalt’s, sampling may be from the distributor itself, by opening a valve or one of the nozzles. If a hand nozzle is available, the sample may be drawn off there. Paving asphalt for use in a plant should be sampled by drawing from either the supply line between the storage tank and the mixer or the storage tank. Specifications require the Contractor to install a valve for this purpose.

If samples cannot be taken from the distributor, as outlined above, they may be taken from the storage tank. Samples taken directly from storage tanks must be taken with a “thief,” so that they do not include surface material and are from near the middle of the asphalt in storage. They may be taken by the grab method — that is, the full amount of the sample will be taken at one time or at one spot in the car.

Samples of emulsified asphalt shall be taken as close as possible to the location the materials are used, but they must be taken before any dilution of the material takes place.

The containers for all liquid asphalt products except emulsions will be approximately 1 quart (1 liter) cans with 1 1/4-inch (44-mm) screw caps. Containers for emulsions shall be 1 quart (1 liter) plastic. Always use new, clean containers that are free of rust, dents, or other weaknesses that may cause leaking or contamination. Containers previously used for any other purpose will not be satisfactory regardless of how well cleaned they are considered to be. The outside of the containers must not be cleaned by immersion in kerosene or other solvent because of the danger of contaminating the sample. Containers must not be cooled by immersion in water or other liquid as contraction may draw contaminants into sample. Enter complete data on gummed label DOT Form 350-016 and attach to each of the two cans. Complete a Sample Transmittal (DOT Form 350-056) and attach it, in its envelope, to the container. If tape is used to attach envelope to container, or the containers together, be sure the tape is not contacting the label(s).

4. Field Inspection: Check the “Bill of Lading” that the liquid asphalt delivered complies with the requirements of the approved mix design. Check temperature to which material is heated to make sure specified limits are not exceeded, see Standard Specification 9-02.3.


**9-4.3 HotMelt Traffic Button Adhesive**

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071). Submit Manufacturers Certificate of Compliance meeting the requirements of Standard Specifications Section 1-06.3, including supporting tests reports to State Materials Laboratory for evaluation.

3. Acceptance/Verification
   a. Acceptance: Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).
   b. Verification: Submit a sample of each lot of material to the State Materials Laboratory for testing.

4. Field Inspection: Verify correct heating of product per manufacturers recommendations.


**9-4.4 Concrete Aggregates**

1. Approval of Material: Consult the Aggregate Sources Approval (ASA) database for approval of material for each source prior to use.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on the Request for Approval of Material (DOT Form 350-071) or if the ASA database indicated that the aggregate source has expired. Contact the Regional Materials Office if preliminary samples are required. Preliminary samples for Concrete Aggregate shall be made up of 50-100 pounds (25-50 kilograms) of clean, washed coarse aggregate and 20-25 pounds (10-13 kilograms) of clean washed fine aggregate. The sample is to be shipped in increments, using satisfactory containers, not exceeding 30 pounds (15 kilograms).
Materials

3. Acceptance: After the source has been approved, concrete aggregates may be accepted upon satisfactory field tests for grading, cleanliness and free from excessive organic matter, silt, and soft or foreign pieces. Acceptance samples shall be obtained, tested, and recorded in accordance with the Standard Specifications Section 9-03.1, the contract special provisions, and Chapters 9-5.7, and 10-3.14A of this manual.


9-4.6 Aggregates for Asphalt Concrete and Asphalt Treated Base

1. Approval of Material: Consult the Aggregate Sources Approval (ASA) database for approval of material for each source prior to use.

2. Preliminary Samples
   a. Preliminary Samples: A preliminary sample of the material will be required only if requested on the Request for Approval of Material (DOT Form 350-071) or if the ASA database indicated that the aggregate source has expired. Contact the Regional Materials Office if preliminary samples are required. Preliminary samples for the aggregate shall be made up of 80-120 pounds (35-55 kilograms) as required to perform the quality tests. The sample is to be shipped in increments, using satisfactory containers, not exceeding 30 pounds (15 kilograms).

   b. Preliminary Mix Design Samples: These samples are used to determine if the aggregate source is capable of meeting the mix design specification requirements. Preliminary samples shall be made up of 200 pounds (100 kilograms) of rock or pit run gravel and 25 pounds (10 kilograms) of blend sand if utilized. Contact the Regional Materials Office if preliminary samples are required. Give full details of type of construction proposed. The sample is to be shipped in increments, using satisfactory containers, not exceeding 30 pounds (15 kilograms).

3. Acceptance: After the source has been approved, the aggregates may be accepted upon satisfactory field tests. Acceptance samples shall be obtained, tested, and recorded in accordance with the Standard Specifications, the contract special provisions, and Chapters 9-5.7, 9-8 and 10-3.14A of this manual. Aggregates produced for use on the current contract shall be sampled and tested for fracture and sand equivalent as the material is placed into stockpile. When material is used from a stockpile that has not been tested as provided above, the requirements for fracture and sand equivalent shall apply at the time of its introduction to the cold feed of the mixing plant. Acceptance of the aggregate for gradation shall be based on samples taken from the Hot Mix Asphalt.

   If the aggregates are being produced for use on a future contract, they shall be sampled and tested for gradation as well as fracture and sand equivalent at the time the material is placed in stockpile.

5. Specification Requirements: See Standard Specifications Sections 3-02, 9-03.6 and 9-03.8. Review contract documents to determine if supplemental specifications apply.

9-4.7 Asphalt Concrete and Asphalt Treated Base

1. Approval of Material: Approval of the materials for asphalt concrete and asphalt treated base are required prior to use.

A current approved mix design is required for each contract. An approved mix design is only valid for a single construction season.

a. Job Mix Design: Send 200 pounds (100 kilograms) of aggregate from each coarse stockpile (No. 4 (4.75 mm) and larger), 100 pounds (50 kilograms) of aggregate from each fine stockpile (smaller than No. 4 (4.75 mm)), and 50 pounds (25 kilograms) of blend sand if utilized to the State Materials Laboratory for testing. The sample is to be shipped in increments, using satisfactory containers, not exceeding 30 pounds (15 kilograms).

The aggregate samples must be accompanied by completed sample transmittals from the Project Engineer and the contractor’s proposal containing the following data: individual stockpile average gradations, proposed combining ratios of aggregate stockpiles, which when calculated will reflect the proposed gradation of the completed mix. Also include the asphalt supplier(s) and grade of the asphalt cement.

b. Reference Mix Design: A reference mix design can be used if there is a current valid mix design previously developed using the same materials and JMF as the one proposed. Contact the State Materials Laboratory, Bituminous Section for availability.

2. Preliminary Samples: Not required.

3. Acceptance: After the sources have been approved, the aggregates may be accepted upon satisfactory field tests, for gradation and asphalt content. Acceptance samples shall be obtained, tested, and recorded in accordance with the Standard Specifications, the contract special provisions, and Chapters 9-5.7, 9-8 and 10-3.14A of this manual. The sampling will be on a random basis using the procedures shown in WSDOT Test Method 716. The sampling and testing frequency for each lot is indicated in Chapter 9-5.7.

4. Field Inspection: The Engineer should perform a plant inspection prior to production. Contact the Regional Materials Office for assistance with this inspection. See Chapters 9-8 for Sampling Methods and Testing Procedures. Discuss test results with the Contractor’s representative.


9-4.8 Mineral Filler

1. Approval of Material: Approval of the materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Sample: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071). Ship 3 pounds (1.5 kilograms) in polyethylene bag.

3. Acceptance: Acceptance of mineral filler (commercial stone dust) shall be based on “SATISFACTORY” laboratory tests only for each lot of 50 tons (tonnes) or less. Portland cement may be accepted without test if it is furnished in original factory sacks and is not lumpy.

4. Field Inspection: Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071). See that the mineral filler does not contain foreign material or lumps.


9-4.9 Gravel Base and Bank Run Gravel for Trench Backfill

1. Approval of Material: Consult the Aggregate Sources Approval (ASA) database for approval of material for each source prior to use.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on the Request for Approval of Material (DOT Form 350-071) or if the ASA database indicated that the aggregate source has expired. Contact the Regional Materials Office if preliminary samples are required. Preliminary samples for the aggregate shall be made up of 50-100 pounds (25-50 kilograms) are required to perform the quality tests. The sample is to be shipped in increments, using satisfactory containers, not exceeding 30 pounds (15 kilograms).
3. Acceptance: After the source has been approved, the aggregates may be accepted upon satisfactory field tests. Acceptance samples shall be obtained, tested, and recorded in accordance with the Standard Specifications, the contract special provisions, and Chapters 9-5.7, 9-8 and 10-3.14A of this manual.


9-4-10 Pit Run Aggregates (Gravel Backfill for Foundation CL, B, Walls, Pipe Zone Bedding, Drains and Drywells; Backfill for Sand Drains, Sand Drainage Blanket, Bedding Material for Rigid Pipe, Thermoplastic Pipe; Foundation Material Class A, B, and C, Gravel Borrow, Common Borrow, Select Borrow)

1. Approval of Material: Consult the Aggregate Sources Approval (ASA) database for approval of material for each source prior to use. For Borrow sources, approval of source can be performed in the field by conforming that the gradation and SE meets the requirements as defined in Section 9-03 of the Stand Specifications.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on the Request for Approval of Material (DOT Form 350-071) or if the ASA database indicated that the aggregate source has expired. Contact the Regional Materials Office if preliminary samples are required. Preliminary samples for the aggregate shall be made up of 80-120 pounds 0 (33-55 kilograms) are required to perform the quality tests. The sample is to be shipped in increments, using satisfactory containers, not exceeding 30 pounds (15 kilograms).

3. Acceptance: After the source has been approved, and prior to use, the gradation and SE tests shall be performed to determine if the material does in fact meet specifications for intended use. The aggregates may be accepted upon satisfactory field tests. Acceptance samples shall be obtained, tested, and recorded in accordance with the Standard Specifications, the contract special provisions, and Chapters 9-5.7, 9-8 and 10-3.14A of this manual.


9-4.11 Vacant

9-4.12 Premolded Joint Filler

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: If a preliminary sample is required, it shall consist of a 1 square foot (300 mm²) section from each lot of material used. Submit sample to the State Materials laboratory for testing. If the lot can be identified and proven to have prior satisfactory acceptance test results, it may be used without testing on current projects.

3. Acceptance: Materials shall be accepted on receipt of “SATISFACTORY” test reports from the State Materials Laboratory. If the lot can be identified and proven to have prior satisfactory acceptance test results, it may be used without testing on current projects.

4. Field Inspection: Check for accuracy in cutting, stapling, and care in handling. Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


9-4.13 Elastomeric Compression Seals

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: If a preliminary sample is required, it shall consist of a 2 feet (0.6 meters) section from each lot of material used. Submit sample to the State Materials laboratory for testing. If the lot can be identified and proven to have prior satisfactory acceptance test results, it may be used without testing on current projects.
3. Acceptance: The material/product may be accepted on a “SATISFACTORY” test report from the State Materials Laboratory. If the lot can be identified and proven to have prior satisfactory acceptance test results, it may be used without testing on current projects.

4. Field Inspection: Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


9-4.14 Two Component Poured Rubber Joint Sealer

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: If a preliminary sample is required, it shall consist of an unopened container of each component from each lot of material used unless specifically exempted by the State Materials Laboratory. Submit sample to the State Materials Laboratory for testing. If the lot can be identified and proven to have prior satisfactory acceptance test results, it may be used without testing on current projects.

3. Acceptance: Material shall be accepted on “SATISFACTORY” test report or lot approval by the State Materials Laboratory.

4. Field Inspection: Make certain that application is in accordance with requirements of Standard Specifications and manufacturer’s written recommendations. In order to obtain satisfactory adhesion of the sealer, joints must be thoroughly cleaned before the sealer is applied. Verify the material received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


9-4.15 Hot Poured Joint Sealant

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification, and a “SATISFACTORY” test report from the State Materials Laboratory prior to use.

2. Preliminary Samples: If a preliminary sample is required, submit one box sample to the State Materials Laboratory for testing.

3. Acceptance: The material/product shall be accepted on a “SATISFACTORY” test report from the State Materials Laboratory. If the lot can be identified and proven to have prior satisfactory acceptance test results, it may be used without testing on current projects.

4. Field Inspection: Ensure that application is in accordance with requirements of the Standard Specifications Section 5-04.3(5C), 5-05.3(8)B and the manufacturer’s recommendation. Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


9-4.16 Concrete Culvert, Sewer, Drain, and Underdrain Pipe

1. Approval of Material: Approval of manufacturer is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). Notify Materials Fabrication Inspection Office of need to approve fabricator and provide Inspection Services. If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).
3. **Acceptance:**
   a. Concrete pipe less than 30 inches (750 millimeters) in diameter will be accepted based on “Concrete Pipe Acceptance Reports” which shall accompany the pipe to the job. Individual pipes are not stamped.
   
   b. Concrete pipe 30 inches (750 millimeters) in diameter and larger are individually inspected at the plant prior to shipment. Accepted pipe will be stamped “APPROVED FOR SHIPMENT” with ID number (Figure 9-5) on each piece of pipe, numbers repeated per inspection visit, number will differ for different diameters.

4. **Field Inspection:**
   
   a. Concrete pipe less than 30 inches (750 millimeters) in diameter:
      1. Verify that the “Concrete Pipe Acceptance Report” is current and covers the diameter quantity and class of pipe delivered.
      2. Inspect the manufacture date marked in each pipe to verify that it was made within the period covered by the Inspection Report. Also verify that shipment was made after the required retention time. **Standard Specifications** require 28 days for pipe using Type II cement and seven days for pipe using Type III cement. If tested and accepted at an earlier age these requirements may be modified.
      3. Verify that the pipe is free from damage from handling and shipping.
      4. Concrete sewer pipe requires testing after installation in conformance with the **Standard Specifications** Section 7-04.3.
      5. Complete the upper portion of the “Concrete Pipe Acceptance Report” and forward to the contract files.

   b. Concrete pipe 30 inches (750 millimeters) in diameter and larger:
      1. Verify that each pipe in the shipment is stamped “APPROVED FOR SHIPMENT.” Only properly stamped pipe may be accepted.
      2. Verify that pipe is free from damage from shipping and handling. Concrete sewer pipe requires testing after installation in conformance with the **Standard Specifications** Section 7-04.

5. **Specification Requirements:** See **Standard Specifications** Section 9-05. Review contract documents to determine if supplemental specifications apply.

### 9-4.17 Galvanized Steel, Pipe Arch, Aluminized Steel and Aluminum Corrugated Metal Culvert, Drain Pipe and Perforated Underdrain Pipe

1. **Approval of Material:** Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification. Notify Materials Fabrication Inspection Office of the need to provide Inspection Services for a fabrication facility not listed on the QPL. Approval of the fabrication facility as well as the base metal must be obtained.

2. **Preliminary Samples:** A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. **Acceptance:**
   
   a. QPL Acceptance: Untreated metal culvert and drainpipe may be accepted at the job site from pipe provided by a manufacturer listed in the QPL. If the pipe shipment does not identify the pipe manufacturer, shipping Bill of Lading should be requested prior to accepting or installing the pipe. Pipe delivered without the appropriate AASHTO specification for the steel sheet, gauge thickness, and heat number stamped on the pipe shall not be installed. Record heat numbers for each pipe installation. Any pipe, which is damaged in any way from shipping or handling, should not be accepted.

   b. Non-QPL Acceptance:
      1. The Materials Fabrication Inspection Office will inspect treated metal culvert pipe at the point of fabrication. A representative number of pipes in each shipment will display “WSDOT INSPECTED” stamp. See Figure 9-3. If none of the pipe bears the “WSDOT INSPECTED” stamp, contact the Fabrication Inspection Office to arrange for an on site inspection prior to installation.
      
      2. In addition to verifying material has in fact been approved for use, acceptance shall consist of obtaining a Manufacturer’s Certificate of Compliance with supporting Mill Test Reports prior to use.
4. Field Inspection: Check each delivery for fabrication details and quality of workmanship. Check for shipping damage and ensure that the spelter coating is intact. Check treated pipe for damage to coating. Obtain documentation for all pipes not accepted under provisions established in the QPL. Contact the Materials Fabrication Inspection Office for assistance.


9-4.18 Perforated Underdrain Pipe

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: Not required unless requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Pipe may be accepted on Manufacturer’s Certificate of Compliance and field inspection.

4. Field Inspection: Check for compliance with specifications, particularly the size and spacing of holes, and for shipment and handling damage.


9-4.19 Structural Plate Pipes and Arches

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Acceptance may be on the basis of Manufacturer’s Certificate of Compliance, with accompanying mill test reports. The certification must accompany the shipment and must contain the information which is listed hereinafter:

   a. Chemical analysis of the base metal of each heat number in the shipment

   b. The mass of zinc coating for each heat number in the shipment

4. Field Inspection: Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071). Check for breaks in the spelter and coating and for damage from shipment. Material in the shipment must be properly identified as to heat number.


9-4.20 Gray-Iron Castings, Steel Castings, Ductile-Iron Castings (Catch Basin Frames and Grates, Manhole Rings and Covers, Monument Case and Cover, etc.)

1. Approval of Material: Approval of fabricator is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). An inspection to qualify a manufacturer will be required only if requested on Request for Approval Material (DOT Form 350-071). The Materials Fabrication Inspection Office will perform an on-site inspection of the manufacturing facilities prior to approval. Notify the Materials Fabrication Inspection Office of need to provide Inspection Services.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Acceptance will be based on Inspected Items Stamp (Figure 9-7). All castings will be the stamping by the Materials Fabrication Inspection Office Inspector.

   For Standard Plan B-2a and B-2b the frame and grate will each be stamped. Align the two stamps adjacent to each other. This alignment is critical as the leveling pads are ground to prevent rocking of the grates in the frames.

4. Field Inspection: Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071). Check for defects listed in the Standard Specifications. Check for the Inspector’s approved stamp (Figure 9-7) and document it.

9-4.21 Sanitary Sewers
1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification. An inspection to qualify a manufacturer of concrete pipe will be required only if requested on Request for Approval of Material (DOT Form 350-071). The Materials Fabrication Inspection Office will perform an on-site inspection of the manufacturing facilities prior to approval.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance:
   a. QPL Acceptance:
      If using the QPL, be sure to verify appropriate means of acceptance, see applicable Acceptance Code within the QPL.
   b. Non-QPL Acceptance:
      Material may be accepted in lieu of sampling upon receipt of an “Approved” document as shown below:

      (1) Ductile Iron Sewer Pipe — Manufacturer’s Certificate of Compliance
      (2) Plain Concrete Storm Sewer Pipe — Concrete Pipe Acceptance Report *
      (3) Reinforced Concrete Storm Sewer Pipe — Concrete Pipe Acceptance Report *
      (4) Vitrified Clay Sewer Pipe — Manufacturer’s Certificate of Compliance.
      (5) PVC Sewer Pipe — Manufacturer’s Certificate of Compliance.
      (6) Ductile Iron Sewer Pipe — Manufacturer’s Certificate of Compliance.
      (7) ABS Composite Sewer Pipe — Manufacturer’s Certificate of Compliance.

   *For concrete pipe 30 inches (750 millimeters) in diameter and larger, accepted pipe will be stamped “APPROVED FOR SHIPMENT” with ID number (Figure 9-5) on each piece of pipe.

4. Field Inspection: Check material delivered to the project for damage, and conformance to the contract documents.


9-4.22 Steel for Bridges
1. Approval of Material: Approval of the fabricator as well as the manufacturer of the steel is required prior to use. Upon receipt of the “Request for Approval of Material,” the Materials Fabrication Inspection Office will inspect the fabrication shop to ensure it meets all contract requirements. A copy of the Request for Approval of Material will be sent to the Materials Fabrication Inspection Office.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Materials and fabrication will be accepted on Approved for Shipment stamps or tags (Figure 9-4 or 9-5) except in the case of minor parts. As soon as the fabricator receives the materials, the Materials Fabrication Inspection Office Inspector will check the accompanying mill test certificates to ensure the materials meet contract requirements. The Materials Fabrication Inspection Office Inspector will also provide weekly written shop inspection reports to the Project Engineer while major steel structures are being fabricated.

4. Field Inspection: Check for “APPROVED FOR SHIPMENT” tags or stamps (Figure 9-4 or 9-5) and shipping and handling damage.


9-4.23 Unfinished Bolts (Ordinary Machine Bolts), Nuts, and Washers
1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).
3. **Acceptance:** Unfinished bolts, nuts, and washers may be accepted on receipt of Manufacturer’s Certificate of Compliance. If using the QPL, be sure to verify appropriate means of acceptance, see applicable Acceptance Code within the QPL.

4. **Field Inspection:** Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).

    Check each lot of material delivered to the project for damage, and that accompanying Manufacturer’s Certificate of Compliance is present.

5. **Specification Requirements:** See *Standard Specifications* Section 9-06.5(1). Review contract documents to determine if supplemental specifications apply.

### 9-4.24 High Strength Bolts, Nuts and Washers

1. **Approval of Material:** Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. **Preliminary Samples:** A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. **Acceptance:** Materials may be accepted on receipt of “SATISFACTORY” test reports from the State Materials Laboratory. When the materials are received on the job site, sample each shipment of the bolts, nuts, and washers in accordance with the table in Section 9-06.5(3) of the *Standard Specifications*. A separate transmittal and materials certification shall accompany each sample of bolts, each sample of washers, and each sample of nuts.

4. **Field Inspection:** Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071). Make certain that material being used is from a lot represented by “SATISFACTORY” test report.

5. **Specification Requirements:** See *Standard Specifications* Section 9-06.5(3). Review contract documents to determine if supplemental specifications apply.

### 9-4.25 Anchor Bolts

1. **Approval of Material:** Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification. Notify the Materials Fabrication Inspection Office of need to provide Inspection Services.

2. **Preliminary Samples:** A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. **Acceptance:** Acceptance may be based on “APPROVED FOR SHIPMENT” tags and/or stamp (Figure 9-4 or 9-5).

4. **Field Inspection:** Check for “APPROVED FOR SHIPMENT” tags and/or stamp (Figure 9-4 or 9-5). Check for damage due to shipping and handling.

5. **Specification Requirements:** See *Standard Specifications* Section 9-06.5(4). Review contract documents to determine if supplemental specifications apply.

### 9-4.26 Reinforcing Bars for Concrete

1. **Approval of Material:** Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071).

2. **Preliminary Samples:** May be required if requested on Request for Approval of Material (DOT Form 350-071).

3. **Acceptance:** Acceptance will be by the Fabricators Certification of Compliance and Certified Mill Test Reports that will accompany each shipment.

**Note:** If Mill Test reports are not available, do not incorporate steel into the project and contact the State Materials Laboratory, General Materials Engineer for guidance.

Representative of the Materials Fabrication Inspection Office may take random samples at the point of fabrication.

4. **Field Inspection:** Check for Certification of Compliance and Certified Mill Test Reports for sizes and heats of rebar. Remove excess rust and mill scale before using. Check steel fabrication and bends for compliance with contract documents.

5. **Specification Requirements:** See *Standard Specifications* Section 9-07. Review contract documents to determine if supplemental specifications apply.
9-4.27 **Epoxy Coated Reinforcing Steel Bars for Concrete**

1. Approval of Material: Approval of materials is required for both materials and coating applicator prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-0712). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071). Notify Materials Fabrication Inspection Office of need to provide Inspection Services.

3. Acceptance: Material may be accepted on “APPROVED FOR SHIPMENT” stamp or tag (Figure 9-4 or 9-5).

   **Note:** If bar is not tagged “APPROVED FOR SHIPMENT” do not incorporate steel into the project and contact the Materials Fabrication Inspection Office for guidance.

Representatives of the Materials Fabrication Inspection Office may take random samples at the point of fabrication and at the coating facility. The Fabricator shall provide the Mill Certificates to the Materials Fabrication Inspection Office Inspector.

4. Field Inspection: Check shipment for “APPROVED FOR SHIPMENT” stamp or tag (Figure 9-4 or 9-5). Check coating for shipping damage, check steel fabrication and bends for compliance with contract documents.


9-4.28 **Mechanical Splices**

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Sample: A preliminary sample for qualifying the rebar coupling system, will be required only if requested on Request for Approval of Material (DOT Form 350-071). The sample to include a made up splice for each size bar to be used and include the manufacturers product information. The overall length of spliced rebars should be approximately 5 to 6 feet (2 meters).

3. Acceptance: Material may be accepted on receipt of a “Satisfactory” Test Report from the State Materials Laboratory from contractors assembled samples (see Note) taken from the project. A Manufacturer’s Certificate of Compliance and other technical data MUST be submitted with the samples. The overall length of spliced rebars should be at least 5 feet (2 meters).

   **Note:** This is a test of the Contractors ability to properly assemble the splice as much as it is a test of the quality of the materials. For this reason the spliced bars must be assembled by the contractors personnel, witnessed by the inspector and transmitted intact to the State Material Lab for testing.

4. Field Inspection: Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071), and having “Satisfactory” test results.

5. Specification Requirements: See **Standard Specifications** Section 6-02.3(24)F and G. Review contract documents to determine if supplemental specifications apply.

9-4.29 **Rebar Chairs, Dobies, and Spacers**

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Sample: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance:

   a. Dobie Blocks: Material may be accepted on receipt of Manufacturer’s Certificate of Compliance with supporting test reports. See **Standard Specifications** Section 6-02.3(24)C.

   b. Rebar Chairs and Spacers: May be accepted based upon inclusion in the QPL as an “Approved” product.

4. Field Inspection: Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).

5. Specification Requirements: See **Standard Specifications** Section 6-02.3(24)C. Review contract documents to determine if supplemental specifications apply.
9-4.30 Dowels and Tiebars for Concrete Pavement, incl. Epoxy Coated

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Sample: A preliminary sample of two dowels will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Acceptance may be on Manufacturer’s Certificate of Compliance with accompanying Mill Test Reports for both steel and coating process.

4. Field Inspection: Check for dimensional conformance and if proper mill test certificates have been provided. Check epoxy coating for damage and uniformity.


9-4.31 Wire Reinforcement for Concrete

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: May be required if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Acceptance will be by the Manufacturer’s Certificate of Compliance and Certified Mill Test Reports that accompany each shipment.

4. Field Inspection: Check for excessive rust on wire, and check the spacing of the wires and weight per square yard (meter).


9-4.32 Bridge Approach Slab Anchors

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Sample: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance:
   a. Anchors Type A: These anchors may be accepted on a Manufacturers Certificate of Compliance for the Steel Rod and Plate.
   b. Anchors Type B: These anchors may be accepted on a Manufacturers Certificate of Compliance for the Threaded Steel Rod and Steel Plate and Manufacturers Product Information on inch stop coupling.
   c. Other Anchor Rod materials: Such as plastic pipe, polystyrene, and duct tape may be accepted on visual inspection.

4. Field Inspection: Check material delivered to the project for conformance with the contract plan and specifications.


9-4.33 Prestressing/PostTensioning Reinforcement—Strand

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Sample: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Acceptance will be on “SATISFACTORY” laboratory test report only. Submit one sample (minimum of 5 feet (2 meters) in length) from each reel or pack. A copy of a Manufacturer’s Certificate of Compliance with supporting test report and stress/strain curve MUST accompany each sample submitted for testing.

4. Field Inspection: Check the strand for dirt, grease or rust. Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc., a approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).

9-4.34 Prestressing/Post Tensioning Reinforcement—Bar

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Acceptance will be on “Satisfactory” laboratory test report only. Send two samples from each heat. If supplemental requirements apply, send additional samples of two bars from each heat. See contract documents. The samples must be a minimum of 5 feet (2 meters) in length. A copy of the Manufacturer’s Certificate of Compliance shall accompany each heat of reinforcing bar.

4. Field Inspection: Check material delivered to the project for damage. Verify the materials received on the job site, is in fact the same make, lot, batch, size, etc., as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


9-4.35 Paints for Structures

1. Approval of Material: Approval of source is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: Preliminary Samples will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Paint will be sampled at the point of production and tested by the State Materials Laboratory prior to its receipt on the project. The lot number on the containers must be checked against the Laboratory test reports. Except as indicated, paint which has not been tested and accepted by the Laboratory will not be used.

When less than 20 gallons (80 liters) of one kind of paint are involved, its use without laboratory tests may be approved upon the Manufacturer’s Certificate of Compliance that the material meets the specification. The certificate shall include a list of materials and the quantities used. One copy of the certificate shall be submitted to the State Materials Laboratory for approval.

4. Field Inspection: No field samples are required. Material shall be accepted on satisfactory test report or lot approval by the State Materials Laboratory. Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).

See that paint is not caked in the container, that it is free from skins and is well stirred before withdrawing portions for use.

After application the paint should dry to a uniform film without running, streaking or sagging.


9-4.36 Structural Timber and Lumber—Untreated

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance:

   a. Permanent structures require a Manufacturer’s Certificate of Compliance (i.e., Grading Certificate) conforming to the requirements of the Standard Specifications. The Grading Certificate will be issued by the grading bureau whose authorized stamp is being used, or by the mill grading the timber or lumber under the supervision of one of the following lumber grading agencies: West Coast Lumber Inspection Bureau (WCLIB), Western Wood Products Association (WWPA), or the Pacific Lumber Inspection Bureau (PLIB). A typical lumber grade stamp as used by the various inspection agencies are shown in the QPL, Appendix B:
b. Sign posts, mileposts, sawed fence posts, and mailbox posts will be accepted by visual determination in the field that materials delivered to the job site bears the appropriate lumber grading stamp. The PLIB graded lumber will be graded under the grading rules of one of the other two listed agencies and will be grade stamped accordingly. All timber and lumber is subject to re-inspection upon delivery to the project.

4. Field Inspection: Check that all lumber and timber has the proper lumber grade stamps.


9-4.37 Treated Timber and Piling

1. Approval of Material: Approval of materials and treating facility are required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance:
   a. Permanent structures, sign posts 6 inches x 6 inches (150 mm x 150 mm) and larger. Check for “APPROVED FOR SHIPMENT” tag (Figure 9-6). Approved for shipment tags will be stapled to the ends of the pilings or timber. All piling will be stamped or tagged on the butt end. Only about one-third of the approved timber pieces will be stamped or tagged for acceptance.
   b. Sign posts less than 6 inches x 6 inches (150 mm x 150 mm), mileposts, sawed fence posts, and mailbox posts shall be accepted as listed under 9-4.36.

4. Field Inspection: Check primarily for damage caused by handling. Check pieces for “APPROVED FOR SHIPMENT” stamp or tag (Figure 9-6).


9-4.38 Piling—Untreated

1. Approval of Material: Approval of material is not required prior to use for temporary structures.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Field inspection for compliance with contract requirements.

4. Field Inspection: Check for compliance with specifications.


9-4.39 Steel H-Piling

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: Samples are not required unless requested on Request for Approval of Material (DOT Form 350-071). Submit a 1-foot (300-mm) section of the piling if requested.

3. Acceptance: Material may be accepted on satisfactory Manufacturer’s Certificate of Compliance including mill certificates showing heat number, physical properties and chemical composition.

4. Field Inspection: Check material in each shipment against heat numbers shown on Mill Test Certificates. Check for damage due to shipping and handling.


9-4.40 Hollow Steel Piling and Jack Casing

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Sample: Samples are not required unless requested on Request for Approval of Material (DOT Form 350-071). Submit a 1-square foot (300 mm²) section of the piling if requested.
Materials

3. Acceptance: Material may be accepted on satisfactory Manufacturer’s Certificate of Compliance showing heat number, physical properties, and chemical composition.

4. Field Inspection: Check material in each shipment against heat numbers shown on Mill Test Certificates. Check for damage due to shipping and handling.


9-4.41 Precast Concrete Catch Basins, Manholes, and Inlets

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Acceptance will be based on “WSDOT Inspected” stamp (Figure 9-3) provided by the Materials Fabrication Inspection Office Inspector.

4. Field Inspection: Check for shipping and handling damage and “WSDOT Inspected” stamp (Figure 9-3).


9-4.42 Riprap, Quarry Spalls, Slope Protection, and Rock Wall

1. Approval of Material: Consult the Aggregate Sources Approval (ASA) database for approval of material for each source prior to use.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on the Request for Approval of Material (DOT Form 350-071) or if the ASA database indicated that the aggregate source has expired. Contact the Regional Materials Office if preliminary samples are required. Preliminary samples for the aggregate shall be made up of 50-80 pounds (25-35 kilograms) are required to perform the quality tests. The sample is to be shipped in increments, using satisfactory containers, not exceeding 30 pounds (15 kilograms).

3. Acceptance:
   a. When project quantities are less than 130 cubic yards (100 cubic meters) 250 tons (tonnes), the Project Engineer may accept the material by visual inspection.

   b. When project quantities exceed 130 cubic yards (100 cubic meters) 250 tons (tonnes), the Project Engineer shall determine that the grading is in conformance with the Standard Specifications Section 9-13, or that the Gabion Stone is in conformance with Section 9-27.

4. Field Inspection: See that the gradation remains constant.


9-4.43 Semi-Open Slope Protection

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Material may be accepted on receipt of Manufacturer’s Certificate of Compliance.

4. Field Inspection: Check material delivered to the project for conformance with the contract plan and specifications. Also check for shipping damage.


9-4.44 Plant Material

1. Approval of Material: Approval of material is required prior to use. This approval will be submitted to the field office by listing the nursery to supply the plant material on a Request for Approval of Material (DOT Form 350-071).

2. Preliminary Site Inspection, when requested on the RAM, will be performed by the Region Landscape Architect or the State Horticulturist.

3. Acceptance: After the approval of the material, the plants will be accepted based on field inspection on the job site. Sample lots as provided in (4), Field Inspection will be the inspection of samples delivered to the site. Acceptable samples will be incorporated into the project.

4. Field Inspection: Check for uniformity of plants within each lot and for representative sample lot based on the following:
(N = total number of plants in lot)
(n = number of plants in sample lot)

<table>
<thead>
<tr>
<th>Total Number of Plants (N)</th>
<th>Minimum No. of Plants Required to Make Sample Lot (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 500</td>
<td>All plants</td>
</tr>
<tr>
<td>501 - 1,000</td>
<td>500</td>
</tr>
<tr>
<td>1,001 - 5,000</td>
<td>600</td>
</tr>
<tr>
<td>5,001 - 30,000</td>
<td>850</td>
</tr>
<tr>
<td>Over 30,000</td>
<td>1000</td>
</tr>
</tbody>
</table>

Should 5 percent or less of the sample lot fail, the entire lot may be accepted. Should over 5 percent of the acceptance sample lot fail to meet nominal specification requirements, the entire lot shall be rejected and removed from the job. The Engineer may accept the plants if there is a large percentage of plants that appears to be exceptionally hearty and vigorous after sorting by the Contractor. If done immediately, the Contractor shall be allowed to sort and remove the substandard portion of the plants.

After the contractor has completed sorting, a new sample lot based on the above schedule of the remaining stock will again be selected and inspected. Should 5 percent or less of this sample lot fail, the sorted lot may be accepted.


9-4.45 Topsoil Type A

1. Approval of Material: Approval of Topsoil Type A prior to use is required by a Request for Approval of Material (DOT Form 350-071).

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071). Samples of (5-10 pounds (3-5 kilograms) are required to perform the qualifying tests.

3. Acceptance: Material may be accepted upon receipt of a Manufacturer’s Certificate of Compliance with accompanying test reports verifying conformance with the Contract Specifications.

4. Field Inspection: The material shall be inspected for roots, weeds, subsoil, rocks, and other debris.


9-4.46 Seed

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualiﬁed Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualiﬁed for its intended use, product is listed under appropriate speciﬁcation. If there is a question on the intended use of the seed, contact the State Horticulturist.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Material may be accepted on analysis shown on the label. If using the QPL, be sure to verify appropriate means of acceptance, see applicable Acceptance Code within the QPL.

4. Field Inspection: Each individual sack of seed must contain a label (tag) as to the contents and be unopened prior to use on the project. At least one label should be retained in the project records in the event that subsequent questions or claims may arise. Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


9-4.47 Fertilizer

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualiﬁed Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualiﬁed for its intended use, product is listed under appropriate speciﬁcation. If there is a question on the intended use of the fertilizer, contact the State Horticulturist.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance:

a. Fertilizer for General Use. Fertilizer may be accepted based on approval of material and chemical content shown on container labels meeting contract requirement. No fertilizer shall be used from unidentified or unlabeled containers.

b. Fertilizer for Erosion Control. For Erosion Control on projects with total quantities less than 5 acres (2 hectares) of Compliance, acceptance of fertilizer may be made by verification of the components based on stamped or printed bag analysis. Projects involving 5 acres (2 hectares) or more shall require a certified analysis of each component furnished meeting the requirements of a Manufacturer’s Certificate.
Materials

c. Fertilizer for Landscaping.
Fertilizer for landscaping projects may be accepted on the basis of examination of the labeled contents for conformance to the project specifications.

4. Field Inspection: Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071). Each individual sack must be labeled as to its contents, which must meet the requirements specified in the special provisions. All bags must be unopened prior to use on the project. Most fertilizers specified contain ureaform (38-0-0) which is blue-green in color, which makes that component’s presence easy to identify. Retain label showing analysis for contract records.


9-4.48 Mulch

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification. If approval action is being requested via the RAM process, attach Catalog Cuts or other appropriate documents, using proper transmittal, to assist RAM Engineer in the approval process.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Material may be accepted as described below for the different types of mulch:

a. Straw — Visual inspection

b. Wood Cellulose Fiber — Manufacturer’s Certificate of Compliance

c. Bark — Field gradation test (WSDOT Test Method 123)

d. Sawdust — Visual inspection

e. Tackifier — Manufacturer’s Certification of Compliance

f. Compost — Waste handling permit, etc. see contract provisions. To purchase Solvita Compost Maturity Test Kits for field office use contact: Woods End Research Laboratory, Inc. Box 297, Mount Vernon, Maine 04352 207-293-2457 E-mail: info@woodsend.org

4. Field Inspection: Verify the material received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071). A visual inspection shall be made to ensure uniformity of the mulch. Also check for detrimental contamination.


9-4.49 Irrigation System

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of the QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification. If approval action is being requested via the RAM process, attach Catalog Cuts or other appropriate documents, using proper transmittal, to assist RAM Engineer in the approval process.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: The irrigation system material, when approved as noted above, may be accepted in the field by verifying that the materials placed on the job are the same make model, lot, batch, size, color, blend, etc. that was, in fact, approved. In addition the following materials will need appropriate documentation and transmittals as noted below:

a. PVC Water Pipe - Manufacturer’s Certificate of Compliance

b. Polyethylene Pipe – Manufacturer’s Certificate of Compliance

c. Galvanized Iron Pipe – Manufacturer’s Certificate of Compliance

4. Field Inspection: Check for damage to the galvanized coatings in shipping and handling. See that damaged areas and field cut threads are protected with an approved galvanized repair paint formula, standard formula A-9-73. Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


9-4.50 Fencing

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.
2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Material may be accepted on receipt of “SATISFACTORY” test report from the State or Regional Materials Laboratory. Send acceptance samples as follows:
   a. Chain Link Fabric — One sample consisting of three wires across full width of fabric from one roll for each 50 rolls.
   b. Wire Mesh — One 12-inch (300-mm) sample across full width of roll, from one roll for each 50 rolls.
   c. Tension and Barbed Wire — One 3-foot (1-meter) piece from one roll for each 50 spools.
   d. Rails and Class 1 Posts for Chain Link Fence — Sample to consist of one post and rail, where applicable, for each 500 post or rails or fraction thereof.
   e. Class 2 Posts for Chain Link Fence — Posts may only be used East of Cascades. Manufacturer’s Certificate of Compliance must identify min. yield strength and both interior and exterior zinc coating thickness; otherwise, post must be sampled as above and tested to Class 1 specifications.
   f. Wire Fence Line Posts — One complete post with plate for each 500 posts or fraction thereof.
   g. Corner Posts or brace posts — One complete post assembly per 10 corner or brace posts.
   h. Misc. Fence Hardware — These materials includes such items as tie wire, hog rings, galvanized bolts and nuts, fence clips, stays, post caps, tension band and bars, rail end caps, etc. The Engineer shall visually inspect and approve for use.

Above samples are to be taken from properly identified lots of material stored at job site. Be sure samples are numbered and properly identified as to Lot, if applicable, when sent to the Laboratory. If first sample fails, two additional samples are to be submitted from same lot. Resamples are to be properly identified as to Lot and referenced to previous Lab No. for first sample.

4. Field Inspection: Check for damage to zinc or other coating on posts, rails, hardware, etc. Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


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9-4.51 Beam Guardrail, Guardrail Anchors, and Glare Screen

1. Approval of Material: Approval of Material is required prior to use. This approval may either be by virtue of the inclusion of this materials/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Materials listed on the Qualified Products List may be accepted as outlined on the QPL or by Manufacturers Certificate of Compliance meeting the requirements of Standard Specifications Section 1-06.3 including supporting test reports.

4. Field Inspection: Check material delivered to the project for damage to galvanizing.


9-4.52 Guardrail Posts and Blocks

1. Approval of Material: Approval of material and treating facility is required prior to use. This Approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on the Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Materials listed on the Qualified Products List may be accepted as outlined on the QPL. Materials not listed on the QPL will be accepted by receipt of an acceptable certificate of treatment and by visual determination in the field that materials delivered to the job site bears the appropriate lumber grading stamp.

4. Field Inspection: Check material delivered to the project for conformance with the contract plan and specifications.

9-4.53 *Miscellaneous Precast Concrete Products (Block Traffic Curb, Precast Traffic Curb)*

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: In general, the Materials Fabrication Inspection Office will not, undertake inspection of these products. When large quantities are involved, the Regional Administrator should arrange for inspection during manufacturer, including the sampling of materials and the making of test cylinders.
   a. Precast Traffic Curb — Acceptance on field inspection. Unless the curb sections have been inspected prior to shipping they are to be carefully inspected upon arrival on the project site. Check for surface color and damage, such as cracks, broken corner or edges, contour and alignment. Surface color and texture should match advanced sample provide by the manufacturer. See Standard Plans for details.
   b. Block Traffic Curb — Acceptance on visual inspection. Check exposed faces of curb sections for damage such as chips, cracks, and air holes. See *Standard Specifications* Section 9-18.3 for details. Compressive strength may be determined in accordance with the FOP for ASTM C 805.

4. Field Inspection: Check for damage due to shipping and handling.


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9-4.54 *Prestressed Concrete Products*

1. Approval of Material: Approval of fabricator and materials are required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). Notify Materials Fabrication Inspection Office of need to provide Inspection Services, or to verify that the prestress plants annual review and approval is current.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Acceptance will be based on “APPROVED FOR SHIPMENT” stamp or tags (Figure 9-4 or 9-5) from Materials Fabrication Inspection Office inspection and on field inspection for damage due to shipping and handling.

4. Field Inspection: Check for damage due to shipping and handling. Check and record “APPROVED FOR SHIPMENT” stamp or tag (Figure 9-4 or 9-5).

5. Specification Requirements: See *Standard Specifications* Section 6-02.3(25), 6-02.3(26), 6-02.3(28), and Section 9-19. Review contract documents to determine if supplemental specifications apply.

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9-4.55 *Raised Pavement Markers, Types 1, 2, and 3*

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance:
   a. Type 1 Markers.
   b. Plastic Markers: Shall be from tested and approved lots identified with an “APPROVED FOR SHIPMENT” stamp (Figure 9-4). After use, all emptied, marked boxes shall be destroyed.
   c. Thermoplastic Markers: Markers listed on the QPL may be accepted based on visual inspection as to brand and model listed. Verification samples of Type 1 thermoplastic markers are required for each lot used on a project. A sample shall consist of three markers per job lot (from different boxes) for each color.
   d. Type 2 Markers: Only markers listed on the QPL may be accepted, visually inspect markers as to brand and model listed.
   e. Type 3 Markers: Only markers listed on the QPL may be accepted, visually inspect markers as to brand and model listed.

4. Field Inspection: A visual inspection shall be made to ensure that cracked or damaged lane markers are not incorporated in the work.

9-4.56 **Signing Materials**

1. Approval of Material: Approval of the sign fabricator as well as the manufacturer of the sign blanks, panels and the reflective sheeting is required prior to use. The approval of the sign fabricator will be by the Request for Approval of Material (DOT Form 350-071). The approval of the sign blanks, panels and the reflective sheeting may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use; product is listed under appropriate specification. The fabrication facility will notify Sign Fabrication Inspector of need to provide Inspection Services.

2. Preliminary Samples: A preliminary sample of the material may be requested on the Request for Approval of Material (DOT Form 350-071), or as requested by the Sign Fabricator Inspector.

3. Acceptance: Materials and fabrication will be accepted on “FABRICATION APPROVED” decal (Figure 9-8).
   a. Sign Blanks: As soon as the fabricator receives the materials, the Sign Fabricator Inspector will check the accompanying mill test certificates to ensure the materials meet contract requirements. These documents will be kept at the fabrication facility.
   b. Reflective Sheeting: The Sign Fabricator Inspector will check the Manufacturer’s Certificate of Compliance for the reflective sheeting and the cutout legend to ensure the materials meet contract requirements. These will be kept at the sign fabrication facility.

4. Field Inspection: Check for a “FABRICATION APPROVED” decal (Figure 9-8) on the back of the sign and document Inspector’s Daily Report. Check for damage due to shipping, handling, and installation.


9-4.57 **Concrete Curing Compounds**

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use; product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Submit 1 quart (1 liter) for each lot of curing compound delivered to each project. Material will be accepted based on “SATISFACTORY” test results from the State Materials Laboratory on samples taken from the project. No curing compound shall be used on WSDOT work prior to testing of each lot. Samples must be submitted for testing 14 days prior to use of curing compound.

4. Field Inspection: Check different lots for similarity in appearance and working properties. Check that the lots being used have “Satisfactory” test reports from the State Materials Laboratory.


9-4.58 **Admixtures for Concrete**

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use; product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Acceptance will be on the basis of Certified Concrete Delivery Ticket, *Standard Specifications* Section 6-02.3(5)B, indicating the brand/product and dosage of the admixture as shown on the concrete mix design.

4. Field Inspection: Check Concrete Delivery Ticket for proper admixture usage. Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


9-4.59 **Plastic Waterstop**

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use; product is listed under appropriate specification.
2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Material may be accepted on basis of Manufacturer’s Certificate of Compliance.

4. Field Inspection: Check for uniformity of product in lot, and for damage in shipment or handling. Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


9-4.60 Epoxy Systems

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance/Verification
   a. Acceptance: Material may be accepted for use on receipt of a passing test report from the State Materials Laboratory. For epoxy bonding agents, submit mix ratios, intended use and a representative sample of each component for each batch or lot number. A representative sample may consist of 1 pint of each component for bulk lots or a prepackaged kit. Containers shall be identified as “Component A” (contains the Epoxy Resin) and “Component B” (contains the Curing Agent) and shall be marked with the name of the manufacturer, the date of manufacture and the lot number. If the material is to be used as an epoxy grout, mortar or concrete, include a 5-pound representative sample of aggregate. Samples shall be submitted to the State Materials Laboratory. Epoxy Adhesive for Lane Markers does not require field sampling, but does require a Manufacturer’s Certificate of Compliance. A period of 15 working days should be allowed for testing.

   b. Verification: Proper proportioning of Epoxy Adhesive for Lane Markers can be verified at the State Materials Laboratory if desired. Submit a 1 pint sample of the field mixed epoxy in question and a 1 pint sample of each component as is detailed under “Acceptance” above.

4. Field Inspection: Check for uniformity of color and conformance to required mix proportions. Streaking is an indication of inadequate mixing. Check for set and hardness with your thumbnail. You should not be able to dent the properly mixed and cured material. Epoxies shall be mixed and applied in conformance to manufacturer’s written instructions unless otherwise modified in writing by the manufacturer’s agent. Verify the materials received on the job site, is in fact the same type, grade, and class, etc., as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


9-4.61 Resin Bonded Anchors

1. Approval of Material Prior to Use: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance:
   a. Qualified Product Listed Product: If Product is listed on QPL, the acceptance of the resin adhesive shall be by field acceptance procedures documenting that brand and model of the resin system. Threaded rod, nut and washer or other inserts shall be accepted on the basis of a Manufacturer’s Certificate of Compliance with supporting Mill Test Reports indicating they meet the contract requirements.

   b. Non-qualified Product Listed Product: Submit independent test lab data indicating resin system meets specifications when tested in accordance with ASTM E 488, and threaded rod, nut and washer or other inserts shall be accepted on the basis of a Manufacturer’s Certificate of Compliance with supporting Mill Test Reports indicating they meet the contract requirements.

4. Field Inspection: Check for proper embedment depths, check that holes are properly cleaned. Check that the installation is in accordance with the manufacturers written instructions.

5. Specification Requirements: Review contract documents to determine if supplemental specifications apply.
9-4.62 **Gabion Baskets**

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071). The sample shall consist of the following:
   a. One square yard (meter) of mesh including selvage and body wire.
   b. Three feet (1 meter) of tie wire.
   c. Three feet (1 meter) of lacing wire.
   d. Six each wire clips, fasteners.

3. Acceptance: Acceptance is based on receipt of a Manufacturer’s Certificate of Compliance with accompanying Mill Test Report.

4. Field Inspection: Check for damage.


9-4.63 **Sign Structures**

1. Approval of Material: Approval of material: Approval of the fabricator as well as the manufacturer of the steel is required prior to use. Upon receipt of the “Request for Approval of Material,” the Materials Fabrication Inspection Office will inspect the fabrication shop to ensure it meets all contract requirements. A copy of the Request for Approval of Material will be sent to the Materials Fabrication Inspection Office.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: The fabricated sign structure will be accepted on the basis of an “APPROVED FOR SHIPMENT” stamp (Figure 9-8). When the structures are fabricated out-of-state and are shipped directly to the job site, arrangements must be made with the Materials Fabrication Inspection Office to have the structures inspected prior to erection.

4. Field Inspection: Check for “APPROVED FOR SHIPMENT” stamp (Figure 9-8) and damage due to shipping, handling and erection.


9-4.64 **Conduit**

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: If using the QPL, be sure to verify appropriate means of acceptance, see applicable Acceptance Code within the QPL.
   a. Galvanized conduit shall be accepted on receipt of “SATISFACTORY” test reports from State Materials Laboratory for each size and shipment. Each sample requires two 12-inch (300-mm) sections, one from each end of a standard length of conduit. Re-sampling, when directed, requires twice the number of pieces specified. Be sure that matching end pieces are identified.

   The Project Engineer may accept galvanized conduit based on nondestructive testing according to the FOP for ASTM D 1186.
   b. Fiber reinforced plastic, flexible, and plastic conduit shall be accepted on Manufacturer’s Certificate of Compliance or on catalog cuts.

4. Field Inspection: Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071). Check for Underwriters approval labels. Check for damage to coatings in shipping and handling, and see that damaged areas and field cut threads are protected with an approved coating.


9-4.65 **Electrical Conductors**

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of
Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071). A sample shall consist of 15 feet (5 meters).

3. Acceptance: Conductors shall be accepted upon receipt of “Satisfactory” Test Report from State Materials Laboratory.
   a. Single Conductors: If using the QPL, be sure to verify appropriate means of acceptance, see applicable Acceptance Code within the QPL. For wire manufacturers not listed in the QPL, submit a sample. A sample shall be a length of wire that shall include the complete printed/stamped designation: manufacturer, size, and insulation type.
   b. Multiple Conductors: If using the QPL, be sure to verify appropriate means of acceptance, see applicable Acceptance Code within the QPL. For wire/cable manufacturers not listed in the QPL, submit a sample. A sample shall be a length of wire that shall include the complete printed/stamped designation: manufacturer, size, and insulation type.
   c. Fiber Optic Cable. A sample of the Fiber Optic cables shall be a minimum 2 feet (600 mm) long.

4. Field Inspection: Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071). A visual inspection shall be made to ensure that no conductors with damaged insulation are incorporated into the project.


9-4.66 Signal, Luminaire, and Strain Poles

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification. Notify Materials Fabrication Inspection Office of need to provide Inspection Services.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: If poles were inspected prior to shipment to job site, they will be stamped “APPROVED FOR SHIPMENT” (Figure 9-4). If not, poles must be inspected and approved at the job site by the Materials Fabrication Inspection Office prior to installation. Acceptance will be based on approved shop drawings per Chapter 8-20.2B of this manual, Mill Test Certificates supplied by the manufacturer.

4. Field Inspection: Check for “APPROVED FOR SHIPMENT” stamp (Figure 9-4) and damage due to shipping, handling and erection. Arrange for inspection if not tagged.


9-4.67 Anchor Bolts for Luminaire, Signal Poles, and Sign Structures

1. Approval of Material: Approval of materials and fabricator are required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification. Notify Materials Fabrication Inspection Office of need to provide Inspection Services.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071)

3. Acceptance: Acceptance may be based on “APPROVED FOR SHIPMENT” tag and/or stamp (Figure 9-4 or 9-5).

The ID number on the tags that is attached to the bundles of anchor bolts will be stamped on a representative number of anchor bolts.

4. Field Inspection: Check and record the “APPROVED FOR SHIPMENT” tag and/or stamp (Figure 9-4 or 9-5). Check for damage due to shipping and handling.

Note: Special attention shall be placed on the proper installation of bolts. No adjustments (bending) of bolts will be allowed after placement in concrete.

9-4.68 Luminaires and Lamps

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: Preliminary samples will be required only if requested on Request for Approval of Material (DOT Form 350-071). Submit Manufacturer’s Certificate of Compliance and catalog cut to the State Materials Laboratory for evaluation if requested.

3. Acceptance: Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).

4. Field Inspection:
   a. Luminaires: A visual inspection shall be made to ensure damaged equipment is not installed and that luminaires are mounted level. Confirm the socket position is the same as that noted on the catalog cut.
   b. Lamps for Luminaires and Signal Heads: Check that all lamps are of the proper wattage, see contract documents.


9-4.69 Water Distribution System

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of the QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification. If approval action is being requested via the RAM process, attach Catalog Cuts or other appropriate documents, using proper transmittal, to assist RAM Engineer in the approval process.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: The water distribution material, when approved as noted above, may be accepted in the field by verifying that the materials placed on the job are the same make model, lot, batch, size, color, blend, etc. that was, in fact, approved. In addition, the following: materials will need appropriate documentation and transmittals as noted below.

4. Field Inspection: Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071). Check material delivered to the project for damage to the galvanized coatings in shipping and handling and conformance to the contract documents. See that damaged areas and field cut threads are protected with an approved galvanized repair paint formula, standard formula A-9-73. Water distribution pipe requires testing after installation in conformance with the Standard Specifications Section 7-11.3.


9-4.70 Elastomeric Bearing Pads

1. Approval of Material: Approval of material is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071).

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Material may be accepted on a Manufacturer’s Certificate of Compliance accompanied by a certified test report identifying the specific batch of material and conforming to AASHTO M251.

4. Field Inspection: Make certain that material to be used is from the certified batch.

9-4.71 Fabric Bearings Pad

1. Approval of Material: Approval is required for the fabricator and all material components of the bearings prior to the start of fabrication. For approved plants in Washington State, or the need for inspection, contact the Materials Fabrication Inspection Office.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: All Fabric Bearing Pads need to be inspected prior to installation. If the fabricator is within Washington State, than the bearing pad will be inspected at the fabrication plant and stamped “Approved for Shipment”, see Figure 9-4. If the Fabric Bearing Pads are fabricated outside of Washington State, than the bearing pad will need to be inspected on site by the Materials Fabrication Inspection Office.

   The Project Engineer shall collect all of the documentation and Test Reports for the various material items used in the Manufacturing of the Fabric Pad Bearing as listed below. Copies of these documents and test reports shall be sent to the Materials Fabrication Inspection Office prior to inspection.


   b. Steel Plates and shapes including stainless steel — Manufacturer’s Certificate of Compliance.

   c. TFE and stainless steel coefficient of friction requirements — Certified Test Reports from independent testing laboratory.

   d. Sample of preformed fabric pad — “SATISFACTORY” Test Report from the State Materials Laboratory.

4. Field Inspection: Check for damage caused by shipping and handling.

5. Specification Requirements: Review the contract documents to determine the specification requirements.

9-4.72 Precast Concrete Barrier and Wall Panels

1. Approval of Material: Approval of fabricator is required prior to the start of fabrication. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). Notify Fabrication Office of need to provide Inspection Services, or to verify that the precast plants annual review and approval is current for wall panels only.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Accept only barrier sections that are stamped “WSDOT INSPECTED” (Figure 9-3). Accept only wall panels, which are stamped “APPROVED FOR SHIPMENT” (Figure 9-4).

4. Field Inspection: Check for shipping and handling damage and “APPROVED FOR SHIPMENT” stamp or “WSDOT INSPECTED” stamp.

5. Specification Requirements: See Standard Specifications Section 6-10, 6-02.3(25), and 6-02.3(28). Review contract documents to determine if supplemental specifications apply.

9-4.73 Safety Bars, Cattle Guards, Sign Mounting Brackets, Steel and Special Guardrail Posts, Steel Sign Posts

1. Approval of Material: Approval of fabricator is required prior to the start of fabrication. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If fabrication or welding of the item is needed, contact the Materials Fabrication Inspection Office for disposition and possible inspection.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Materials may be accepted on receipt of Manufacturer’s Certificate of Compliance for the base metal including Mill Test Certificates.

4. Field Inspection: Check each lot of material delivered to the project for damage, and that accompanying Manufacturer’s Certificate of Compliance is present. Check galvanizing using procedures stated in FOP for ASTM D 1186. Identify lots with test reports. Check for handling or shipping damage.


9-4.74 Metal Bridge Rail

1. Approval of Material: Approval of fabricator is required prior to the start of fabrication. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). Notify Fabrication Office of need to provide Inspection Services.
2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: If rails were inspected prior to shipment to job site, they will be stamped or tagged “APPROVED FOR SHIPMENT” (Figure 9-4 or 9-5). If not, rails must be inspected on job site by the Materials Fabrication Inspection Office prior to installation. Acceptance will be based on approved shop drawings per Chapter 8-20.2B of this manual, Mill Test Certificates supplied by the manufacturer.

4. Field Inspection: Check for “APPROVED FOR SHIPMENT” tags or stamp. Check for damage caused by shipping and handling. Unless aluminum parts have been adequately wrapped, there may be damage to anodic and lacquer coating. Damaged parts shall be rejected.

5. Specification Requirements: See Standard Specifications Section 6-06.3(2). Review contract documents to determine if supplemental specifications apply.

**9-4.75 Construction Geotextiles**

1. Approval of Material: Approval of materials is required prior to use. This approval may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance:
   a. Satisfactory test reports from the State Materials Laboratory when quantities exceed the limits stated in Standard Specification Section 9-33.4(4). Sample per WSDOT Test Method 914. A Manufacturer’s Certificate of Compliance MUST accompany all samples submitted for testing.
   b. Acceptance may be on Manufacturer’s Certificate of Compliance when quantities are within the limits stated in Standard Specification Section 9-33.4(4).

4. Field Inspection: Check each roll of geotextile fabric for proper identification as shown on either the Manufacturer’s Certificate of Compliance or on the State Materials Laboratory test report. Verify the materials received on the job site, is in fact the same make, model, lot, batch, size, color, blend, etc. as approved for use, be it by QPL or via the Request for Approval of Material (DOT Form 350-071).


**9-4.76 Concrete**

1. Approval of Material: Approval of all materials is required prior to use.
   - Cement — see Section 9-4.1
   - Fine Aggregate (sand) — see Section 9-4.4
   - Coarse Aggregate — see Section 9-4.4
   - Admixtures for Concrete — see Section 9-4.58
   - Water — see Section 9-4.77

Contractor must submit a concrete mix design on DOT Form 350-040. All concrete except commercial and Lean Concrete must come from a pre-qualified Batch Plant. Contact the Regional Materials Engineer to determine if plant is pre-qualified.

For mix designs proposed for cement concrete pavement the contractor is required to submit flexural and compressive strength test results in accordance with Section 5-05 of the Standard Specifications as part of the concrete mix design.

**Note:** If the Aggregate Sources Tackling System requires Alkali Silica Reaction (ASR) mitigation the concrete mix design submittal may include the use of either a low alkali cement per section 9-01.3(3), or fly ash per 9-23.9, as approved by the Engineer. The contractor shall provide test results for ASTM C 1260 or AASHTO T 303 showing the mitigating measures are effective (see Section 9-03 of the Standard Specifications). If Fly Ash is proposed for use for the contractor must also provide test results for ASTM C 441 showing that the Fly Ash does not make the ASR worse. Contact the General Materials Engineer of the State Materials Laboratory or the State Bridge Construction Engineer if the contractor is proposing to use other mitigating measures.

2. Preliminary Samples: Not Required

3. Acceptance:
   a. Commercial and Lean Concrete: Is accepted based on a Certificate of Compliance to be provided by the supplier as described in Section 6-02.3(5) B of the Standard Specifications.
   b. Cement Concrete Pavement: Is accepted based on satisfactory field tests for air content and compressive strength (see Section 9-5 of this manual for testing frequency).
   c. Structural Concrete: Is accepted based on tests for Slump, Air Content, Compressive Strength, and Temperature (see Standard Specifications Section 6-02.3(5)G for testing frequency).
4. Field Inspection: The concrete mix provided shall match the mix the contractor submitted for review. The Mix design submittal shall include the Aggregate Correction Factor to be used in determining the Air Content, if the contractor fails to provide this information on DOT form 350-040 do not apply an aggregate correction factor.

5. Specification Requirements: See Standard Specifications Section 9-03.1, 5-05 and 6-02.

**9-4.77 Water for Concrete**

1. Approval of Material: Not required.

2. Preliminary Samples: Not required.

3. Acceptance: Is based on test results provided by the contractor. If the Contractor is using potable water that is clear and apparently clean, then no testing is required.
   a. Physical Requirements: conducted on a weekly interval for the first four weeks and thereafter on monthly interval.
   b. Chemical Requirements: conducted on a monthly interval.

4. Field Inspection: See Section 9-4.75 concrete.


**9-4.78 Expansion Joints**

1. Approval of Material: Approval is required for the fabricator and all material components of the expansion joints prior to the start of fabrication. For approved plants in Washington State, or the need for inspection, contact the Materials Fabrication Inspection Office.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: All expansion joints need to be inspected prior to installation. If the fabricator is within Washington State, than the expansion joints will be inspected at the fabrication plant and stamped “Approved for Shipment”, see Figure 9-4. If the expansion joints are fabricated outside of Washington State, than the expansion joints will need to be inspected on site by the Materials Fabrication Inspection Office.

The Project Engineer shall collect all of the documentation from the out of state fabricator for the various material items used in the Manufacturing of the expansion joints as listed below. Copies of these documents shall be sent to the Materials Fabrication Inspection Office prior to inspection.

4. Elastomeric expansion joint strip — Manufacturer’s Certificate of Compliance

5. Steel Plates and shapes including — Manufacturer’s Certificate of Compliance

6. Coatings for steel parts — Manufacturer’s Certificate of Compliance

4. Field Inspection: Check for damage caused by shipping and handling.

5. Specification Requirements: Review contract documents to determine if supplemental specifications apply.

**9-4.79 Controller Cabinet Assembly**

1. Approval of Material: Approval of all components in the Controller Cabinet Assembly are required. This approval is conditional and may either be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of Material (DOT Form 350-071). If approval is by means of QPL, be certain to verify that product is in fact qualified for its intended use, product is listed under appropriate specification.

2. Preliminary Samples: A preliminary sample of the individual components will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Final acceptance is based on a satisfactory test report. A satisfactory test report is defined as acceptable performance in the following tests:
   - WSDOT Test Method 421, Traffic Controller Inspection and Test Procedure
   - WSDOT Test Method 422, Transient Voltage Test (Spike Test) Procedure
   - WSDOT Test Method 423, Conflict Monitor Testing
   - WSDOT Test Method 424, Power Interruption Test Procedure
   - WSDOT Test Method 425, Environmental Chamber Test

4. Field Inspection: Verify the controller cabinet assembly received on the job site, has satisfactory test reports if required. Check for damage due to shipping and handling.

9-4.80 Miscellaneous Temporary Erosion and Sediment Control Items

1. Approval of Material: Approval of all materials is required prior to use. The approval may be by virtue of the inclusion of this material/product on the Qualified Products List or by approval of a Request for Approval of material (DOT Form 350-071). If approval is by means of QPL, be certain to verify the product is, in fact, qualified for it’s intended use and the product is listed under the appropriate specification.

2. Preliminary Samples: A preliminary sample of the material will be required only if requested on Request for Approval of Material (DOT Form 350-071).

3. Acceptance: Material will be accepted by visual inspection. The exception to this will be Geotextile for Silt Fence, which will be accepted on basis of Manufacturer’s Certificate of Compliance.

4. Field Inspection: Verify that the product used is, in fact, the approved product and document in writing.


9-5 Guidelines for Job Site Control of Materials

9-5.1 General

When in doubt as to sampling requirements, refer to Record of Materials, (ROM), Request for Approval of Material, (RAM), and Chapter 9-4 of this manual. All items for acceptance, except for sampling and testing PCC cores, testing concrete cylinder and cement and as shown in Chapter 9-5.7 of this manual will be sampled and tested by the Project Engineers representative.

In some instances, certain items usually sampled by Project Engineers representative may be sampled and tested by representatives of the State Materials Laboratory or other representatives. Such items as shown in Chapter 9-1 of this manual, when properly identified with an “Approved for Shipment” tag, may be accepted for use by the Project Engineer without any further sampling or testing.

9-5.2 Sampling and Testing Schedule

9-5.2A General

The intent of sampling and testing is to ensure that the material provided to the project conforms to the specifications. The frequency schedule in Chapter 9-5.7 of this manual covers the minimum requirements for sampling and testing at the project level. The Project Engineer is responsible for obtaining the number of samples necessary to ensure adequate control of the material being produced under the circumstances and conditions involved with the particular project. In some instances, good construction practice will necessitate more frequent tests to ensure adequate control of the quality of production. This will be the case where production is just getting under way, where source material is variable or marginal in quality. Also operations from commercial sources when small lots of material are being sampled (as for barge loads of aggregate) or when stockpiles are built and depleted may require more frequent sampling and testing.

The instructions listed in Chapter 9-5.7 of this manual, will be followed in the production of those surfacing materials covered therein. A minimum of one acceptance test is required except for small quantities as shown in Chapter 9-5.2C of this manual.

9-5.2B Reducing Frequency of Testing

In instances of uniform production where the material is running well within specification limits, the Project Engineer may initiate deviations from the schedule. Deviations exceeding a 10 percent reduction will require approval from the Construction Materials Engineer at the State Materials Laboratory and must be documented in the project records, and fully explained by the Project Engineer. Lack of personnel, equipment, and facilities will not be considered sufficient reasons for such deviation.

Authority for approval of frequency reduction may be delegated to the Regional Materials Engineer upon request. This authority may permit overall reduction of sampling frequency or selective relief of selected test properties. Examples of selective relief would be reduction/elimination of fracture determinations for production from quarry sources or reduction of frequency for sand equivalent determination. As a general principle, frequency reduction may be considered whenever five consecutive samples taken at the normal frequency indicate full conformance with the specifications.

9-5.2C Sampling and Testing for Small Quantities of Materials

The Project Engineer may elect to accept small quantities of materials without meeting minimum sampling and testing frequencies using the following criteria.

An item can be accepted as a small quantity if the proposed quantity for a specific material is less than the minimum required frequency. For mainline paving, less than one-half the required frequency as defined in Chapter 9-5.7 of this manual.

Materials that will not be considered under the small quantity definition are:

- Structural Concrete
Some issues that the Project Engineer may consider prior to use of small quantity acceptance are:

- Has the material been previously approved?
- Is the material certified?
- Do we have a mix design or reference design?
- Has it been recently tested with satisfactory results?
- Is the material structurally significant?

Small quantity acceptance could be visual, by certification, or other methods. Acceptance of small quantities of materials by these methods must be documented. Documentation of materials under these methods must be provided by the Project Engineer or representative accepting the material. For visual documentation, an entry should be made in the project records as to the basis of acceptance of the material, and the approximate quantity involved.

The small quantity acceptance may be used for any quantity of the following uses:

- Curbs and Sidewalks
- Driveways
- Road approaches
- Paved ditches and slopes

9-5.3 **Point of Acceptance**

State Owned Source: Material produced from State owned source may be accepted either as it is placed into stockpile or as it is placed in hauling vehicles for delivery to the roadway. The sampling and testing frequency during stockpiling shall be in conformance with Chapter 9-5.7 of this manual.

In the event sample testing during stockpiling shows the material to be marginal (i.e., within tolerance limits) in any specification requirement, acceptance at this point shall be conditional and dependent on adherence to specifications at the time of removal from stockpile.

Contractor’s Source: If stockpiled material is set aside exclusively for use on WSDOT projects it may be accepted the same as that for a state-owned source. If stockpiles are constructed for general use, then materials for WSDOT projects shall be tested for acceptance from samples taken by the Project Engineer representative in accordance with WSDOT FOP for AASHTO T 2. The Engineer will determine the exact point of acceptance. If an existing stockpile was built without acceptance testing during material production, and later set aside exclusively for use on state projects, the material may be accepted with appropriate test results from samples taken by the Project Engineer representative in accordance with WSDOT FOP for AASHTO T 2. The sampling and testing frequency shall conform to Chapter 9-5.7 of this manual.

9-5.4 **Basis for Acceptance**

The basis of acceptance of Hot Mix Asphalt and aggregates may be either by statistical evaluation or non-statistical evaluation methods. The method to be used is specified in Standard Specifications or Contract Documents.

The testing tolerances shown in Chapter 9-5.6 of this manual apply exclusively to the appropriate specifications as listed in the Standard Specifications. These tolerances do not apply to those “special” materials having requirements differing from those listed in the Standard Specifications.

For these “special”, materials usually described in the contract documents, tolerances will be provided by the State Materials Laboratory upon request from the Regional Construction Manager.

Material that has been produced prior to rejection (i.e., ACP in storage silo, crushed materials hauled to the job site) may be incorporated into the project provided the Contractor is made fully aware that the material may be subject to a price adjustment or, in extreme cases, to total removal. Every effort shall be made to place this material in structurally noncritical areas such as shoulders or gore areas.

All material produced between the time of rejection and the time an acceptable material is produced, as defined by WSDOT adopted testing procedures, shall not be incorporated in the work in any manner until it meets specifications.

9-5.4A **Basis for Acceptance — Statistical Evaluation**

For materials being accepted using statistical evaluation procedures, random samples will be evaluated to determine quality level within a defined tolerance band. Acceptance, bonus, and disincetive procedures are defined in the contract documents.

Test results with acknowledged errors or equipment deficiencies are to be immediately discarded without recourse and another sample run.

Test results for Hot Mix Asphalt may be challenged by the Contractor, as defined in the Standard Specifications Section 5-04.3(8)A3C. These specifications allow the Contractor to challenge results of any individual acceptance sample test in writing and within 5 days from receipt of the specified test results.

When the Contractor challenges a test, a split of the original field sample must be tested by different equipment and a different qualified tester. It therefore is necessary that a split of every field sample (i.e., opposite quarter from acceptance test) be saved in a secure area, accurately marked, and be available for challenge sample testing. The specifications require that the challenge sample testing be done in the Regional Materials Laboratory or the State Materials Laboratory.

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Materials Laboratory. When the Contractor makes a challenge it is expected that the split sample be sent and tested as quickly as possible. This will require that testing of these samples be prioritized. By expediting the challenge sample testing, problems that may exist in testing or with the material being produced can be identified and corrected lessening the impact to both the Contractor and WSDOT.

9-5.4B Basis for Acceptance — Non-Statistical Evaluation

If statistical acceptance procedures are not specified nonstatistical acceptance method will be used.

Individual samples taken for acceptance by this method may be subject to certain tolerances allowed outside the established value stated in the Standard Specifications. The tolerance acceptance procedures shall be followed in these cases. Test results with acknowledged errors or equipment deficiencies are to be immediately discarded without recourse and another sample run.

When the test results for Hot Mix Asphalt fall outside the broad band specification limits the material will be evaluated according to the Standard Specifications Section 5-04.5(1)A.

The basis for acceptance of paving asphalt is compliance with existing specifications as modified to include the tolerance as follows:

1. If a sample fails to meet the required specifications, the samples prior and subsequent to the failed sample will be tested. Samples of paving asphalt will continue to be tested until samples taken both prior and subsequent to the failing samples meet the specifications. The quantity of out of specification ACP is determined from the tons of ACP represented by each of the paving asphalt samples that failed to meet the specifications.

2. If a sample does not meet the specifications but is not more than 10 percent outside the specification limits and the sample prior and subsequent to the out of specification made both meet the specifications, there will be no price adjustment.

3. If the sample is more than 10 percent out of specification or if the sample is less than 10 percent out of specification and either the sample prior or subsequent to does not meet the specifications, the ACP will be rejected.

The basis for acceptance of other materials is compliance with existing specifications as modified to include tolerances Established in Chapter 9-5.6 of this manual. The application of these tolerances shall be as follows:

1. Take the following actions any time a sample falls outside the specification limits, but within tolerance bands:
   a. Immediately take two separate additional samples representing current production in accordance with Chapter 9-4 of this manual. The contractor has the option of making plant adjustments prior to taking these samples.
   b. Production will be accepted until the second sample is checked for properties that were out of specification in the first sample.
   c. Do not accept any additional material if the second sample is also out of specification.
   d. If the second sample is within specification, immediately check the third sample. Do not accept any additional material if the third sample is out of specification.
   e. No further material will be accepted after the time of rejection until corrections are made in the operations. This will be confirmed by new tests within specification limits.
   f. Basis for acceptance after this correction will be in conformity with the procedure outlined above. All tests of material outside the specification limits must be listed and justified on the materials certification as required by Chapter 9-1.5 of this manual.

2. The acceptance of material shall cease with one or more of the following conditions:
   a. When a sample falls outside of the applicable tolerance bands.
   b. When any two out of three consecutive samples are within tolerance bands, but outside specification limits.
   c. When any sample has a gradation that falls within both the high and low tolerance bands.
   d. Any sample where the material is outside the specification limits, but within the tolerance bands, in any two of the following properties:

   Gradation
   Fracture
   Sand Equivalent

9-5.5 Testing Staff Qualifications and Independent Assurance Program

9-5.5A Testing Staff Qualification

9-5.5A(1) General

WSDOT personnel assigned with testing construction materials will be enrolled in the Construction Tester Qualification Program. The details of this program are contained in this section. This program establishes uniform testing procedures, insures that testing staff is qualified in
performing the testing procedures, and provides a regular review. The review process, through inspection by the Region Independent Assurance Inspector (IAI) evaluates the performance of all testing staff, recognizes proficient performance, and improves substandard performance by recommending corrective action. The qualification program extends the State Materials Laboratory accreditation principles. This includes the assignment, management, and review of project level testing using elements of the State Materials Laboratory accreditation program to accommodate an interface with region and, project level materials testing operations and the use and understanding of national standard test procedures such as AASHTO and ASTM, and other test procedures such as WAQTC and WSDOT.

9-5.5A(2) Construction Tester Qualification Rules

1. Responsibility: The construction tester qualification program requires detailed and specific attention to be paid to the testing procedures involved: The State Materials Engineer will address and resolve policy issues related to the qualification program.

2. Qualification Modules: The construction tester qualification modules have been set up in 5 areas of testing that represent most of the acceptance tests performed. The project acceptance testers will be evaluated for their proficiency in one or more of the construction tester qualification modules. Each module has a defined list of test procedures in which proficiency is evaluated, see Section 9-8 of this manual. The modules are listed as follows:
   - Aggregates
   - Hot-Mix Asphalt
   - Structural Concrete
   - Embankment and Base Density
   - Asphalt Pavement Density

3. Qualification Categories: The tester can be qualified in one or more of three categories. The qualification categories are:
   a. Module Qualified Tester: Fully proficient in a testing module, normally works independently with only general supervision and is responsible for determining material compliance.
   b. Individual Method Qualified Tester: Has proficiency in one or more test procedures which may partially encompass methods in the qualification modules, but also extends to other infrequent acceptance procedures performed at the project level, and includes tests performed at the Regional or State Materials Laboratories.
   c. Interim Qualified Tester: Basically proficient in one or more tests but, limited to an interim period of in training work. Works under the close supervision of a module or individual method qualified tester, refer to Paragraph 5 below.

Testing personnel at the Region may be either Module Qualified, Individual Method Qualified, or Interim Qualified Testers. Per the AASHTO accreditation, the State Materials Laboratory personnel are Individual Method Qualified Testers.

4. Attaining Qualification:
   a. Module Qualified Testers: To become a Module Qualified Tester the tester shall satisfactorily complete the required written tests and proficiency evaluations by the IAI, the Region Construction Trainer, or materials staff under the direction of the Materials Engineer in a field or region laboratory for one or more modules in the construction tester qualification program.
   b. Individual Method Qualified Testers: To become a Individual Method Qualified Tester the tester shall satisfactorily complete the proficiency evaluation by the IAI, the Region Construction Trainer, or materials staff under the direction of the Materials Engineer. This can be accomplished in a field or region laboratory or State Materials Laboratory. Their qualification records reflect proficiency in the specific individual test methods.
   c. Interim Qualified Testers: To become an Interim Qualified Tester, the following conditions have to be met:

      (1) Individual study of the written test method(s) for a complete module,
      (2) Test demonstration by a proficient tester,
      (3) Allowance for practice or trial tests,
      (4) Successful completion conforming to testing checklist(s) without coaching, and
      (5) The Interim Qualified Tester works under close supervision by a Module or Individual Method Qualified Tester who is qualified in the same tests.

The conditions as described above, leading to interim qualification, may be conducted by another tester currently qualified in the module or test concerned. Based on evaluation of prior experience by the supervisor, with concurrence of the region IAI or Region Construction Trainer, a non-qualified tester may be considered to have
the equivalent of conditions 1 through 3 above. An individual will be considered an interim qualified tester when successful testing performance conforming to the checklists has been completed in the presence of another qualified tester.

5. Supervision of Interim Qualified Testers: An Interim Qualified Tester works under the close supervision of a Module or Individual Method Qualified Tester that is qualified in the same test or module containing the test. Close supervision means that the Module or Individual Method Qualified Tester is physically present when the Interim Tester performs the test. The Module or Individual Method Qualified Tester must review and endorse all test results and determinations of material conformance.

6. Criteria for Evaluating Performance: Satisfactory performance constitutes performance conforming to the method checklist or with limited deviations corrected on the spot. Unsatisfactory performance consists of repeated infractions from previous evaluations, or incorrect performance of individual critical items, or of more than one-third of the items on an individual method checklist. Unsatisfactory evaluations shall be subject to region review.

7. Qualification of Evaluating Staff: Staff participating in evaluation of testers for qualification operate under the professional responsibility of the Regional Materials Engineer, and are not themselves required to be qualified testers.

8. Frequency of Equipment Verification: Regional laboratory and field laboratory test equipment will be verified annually, usually during the first quarter of the year, utilizing State Materials Laboratory equipment verification criteria. A tag bearing the year the verification expires will identify verified equipment.

9. Test procedures that are not included in the testing modules, shall be considered infrequently performed test procedures and shall be individual method qualified. For those procedures the Regional Material’s Engineer, or his designated representative, will insure that the following process is employed in carrying out the procedure:

   a. The employee responsible for performing the test will study the test method, after first determining that the procedure is the applicable current version.

   b. The necessary test equipment will be assembled and confirmed as to its suitability and verification if required.

   c. The employee will review how to conduct of the test with the supervisor and clarify any questions.

   d. The test procedure will be performed in duplicate, using split portions of the test sample if possible. If not, a blank of other similar material will be run in duplicate prior to testing.

   e. The results of the duplicate determination will be compared with the expected precision and bias determinations, if any, from the test procedure.

   f. Lacking any defined basis of comparison, the results will be reported as the average of the two determinations with both the individual values and the average shown on the test report.

9-5.5A(3) Personnel Qualification Policy

1. All personnel performing acceptance testing will be either Module Qualified, Individual Method Qualified, or Interim Qualified Testers.

2. Module or Individual Method Qualified Tester designated as responsible for the performance of an Interim Qualified Tester must be in close contact, which means that the Module or Individual Method Qualified Tester is physically present when the Interim Tester performs the test. The Module or Individual Method Qualified Tester must review and endorse all test results and determinations of material conformance.

3. The Tester Qualification Tracking System will identify each tester, their specialty, level of qualification, and the results of ongoing evaluations. The IAI shall be the responsible person within the region for the accuracy of the information contained in the Tester Qualification Tracking System.

4. On-the-job performance will be evaluated by the IAI, the Region Construction Trainer, or materials staff under the direction of the Materials Engineer using the qualification checklists. Noted deficiencies will be reported in writing to the tester and his/her supervisor.

5. Supervisor action is required for notations of unsatisfactory performance.

6. The region tester performance review Chapter 9-5.5A(9) will consider continued qualification of individuals noted as deficient in performance. The supervisor shall submit to the Regional Materials Engineer the corrective action taken for unsatisfactory performance.

9-5.5A(4) Laboratory Qualifications Policy

A region or other subordinate laboratory to be considered qualified shall meet the following conditions:

1. Identify all test methods performed on a regular basis. Methods must conform to those established by WSDOT for materials acceptance.

2. Annually, verify laboratory and field test equipment, using State Materials Laboratory equipment verification criteria. An attached tag will identify the verified equipment.

3. Maintain staff qualification for all methods performed in the laboratory. Qualification shall be either by Module Qualified Tester or Individual Method Qualified tester.
4. Respond to the findings of the review program by the State Materials Laboratory staff, modeled on AASHTO Materials Reference Laboratory (AMRL) inspection program. Such reviews shall be conducted at least biennially.

5. With approval of the State Materials Engineer, a non-WSDOT contracting laboratories having an equipment calibration/verification policy, and a technician training and evaluation process meeting the requirements of AASHTO R-18 may be used to conduct acceptance testing. Documentation of equipment calibration/verification and tester qualification shall be maintained and available for review by the Contracting Agency upon request. The Contracting Agency may conduct an on site review of the laboratory facilities, witness the tester performing the tests, verify the testing equipment, and review records when deemed necessary.

9-5.5A(5) Construction Tester Qualification Program

1. Qualifications:
   a. Module Qualified Tester: Qualification in a module will require satisfactory completion of a written exam, followed by hands-on performance of testing procedures. Written examinations require an overall score of 70 percent, with not less than 60 percent on each module for satisfactory completion. Performance examination requires satisfactory performance in the presence of the independent Assurance Inspectors, the Construction Trainers, or materials staff of all checklist steps, in sequential order, in each required method.
   
   b. Individual Method Qualified Tester: Qualification in an individual method requires satisfactory completion of hands on performance of the testing procedures in the presence of the Independent Assurance Inspectors, the Construction Trainers, or materials staff. Performance examination requires satisfactory performance of all checklist steps, in sequential order.
   
   c. Interim Qualified Tester: Qualification as an Interim Qualified Tester requires satisfactory completion of hands-on performance of the testing procedures in the presence of a qualified tester that is qualified in the same test or module containing the test. Performance examination requires satisfactory performance of all checklist steps, in sequential order.

2. Equivalent programs, i.e., American Concrete Institute (ACI) Certification, may be accepted for qualification where feasible. The State Materials Engineer will determine acceptance of alternate programs.

3. Qualification examinations will be administered by Region IAI supported by Regional Construction Trainers and Regional laboratory supervisors.

4. Performance qualification will be determined from correct performance of all steps, in sequence, based on testing checklists derived from WSDOT adopted test methods as listed in the Materials Manual.

5. Failure of a qualification examination will allow for reexamination after a 3 day minimum period of preparation for retest.

6. Repeated failures will be referred to the candidate’s supervisor for regional performance review.

7. Tester will continue to be qualified under the following conditions:
   
   a. All unsatisfactory evaluations are resolved within 30 days.
   
   b. The IAI evaluates the Tester any time during the next calendar year (January to December).
   
   c. Testers that missed an annual demonstration of proficiency, may be allowed to do acceptance testing for a 30-day period, if requested by the Project Engineer and approved by the IAI. An evaluation and checklist review by the IAI, the Region Construction Trainer, or materials staff under the direction of the Materials Engineer must be conducted within this 30-day period.
   
   d. Any tester missing two consecutive yearly annual evaluations, will be required to retake the written test and achieved a satisfactory IAI performance evaluations.

9-5.5A(6) Regional Materials Laboratory Responsibilities

The Regional Materials laboratories will:

1. Examine and qualify testers using the Independent Assurance Inspectors, the Region Construction Trainers, or regional materials staff as a primary resource.

2. Annually, verify regional laboratory and field laboratory test equipment, using State Materials Laboratory equipment verification criteria. A tag will identify the verified equipment.

3. Maintain staff qualification for all methods performed in the Regional Materials Laboratory. Qualification shall be either by Module Qualified or Individual Method Qualified

4. Insure that the IAI will be the responsible person within the region for the accuracy of the information contained in the Tester Qualification Tracking System.

5. Respond to the findings of the review program by the State Materials Laboratory Staff.
6. Perform testing of independent assurance samples and comparison samples using qualified staff and verified equipment, if the region has a qualified laboratory.

7. Support the Construction Tester Training Program for their region or in cooperation with other regions by providing training facilities.

8. Support of construction program testing including: density cores, nuclear gauge correlation and management, concrete 28-day cylinders (acceptance), density standards (Proctor and maximum density), and as needed, asphalt concrete ignition furnace calibration.

**9-5.5A(7) Project Engineer Responsibilities**

The Project Engineer will:

1. Ensure that all personnel assigned the responsibility for testing materials are Module Qualified Testers, Individual Method Qualified Tester, or Interim Qualified Testers who work under close supervision of a Qualified Tester.

2. Provide an opportunity for on-the-job training, and/or mentoring of Interim Qualified Testers prior to assigning testing responsibilities.

3. Take corrective actions for unsatisfactory evaluations of Qualified Testers.

4. Advise the Regional Independent Assurance Inspector of changes in assigned testers, new testers needing qualification testing, and of follow up corrective actions.

**9-5.5A(8) The State Materials Laboratory Responsibilities**

The State Materials Laboratory will:

1. Attain and maintain AASHTO Accreditation of the Materials Quality System responding to the AASHTO Accreditation Program. The Materials Quality System shall include all test methods performed at the State Materials Laboratory.

2. Assist the Regional Materials Laboratories by providing standards and procedures derived from the Materials Quality System Manual for direct application to corresponding procedures in the Regional Laboratories.

3. Maintain testing standards and procedures in conformance with WSDOT, AASHTO, ASTM, and WAQTC.

4. As the departmental laboratory qualification authority, periodically review the performance and records of region and other subordinate laboratories for consistent practices in testing, equipment verification, and staff qualification.

5. Maintain examinations and checklists used to qualify all WSDOT testing personnel.

6. Provide oversight and coordination for establishment and revision of the qualification programs. Creation and revision of qualification program modules will be by a cross functional work group.

7. Maintain Tester Qualification Tracking System computer program.


**9-5.5A(9) Tester Performance Review**

1. The IAI, the Region Construction Trainer, or materials staff under the direction of the Materials Engineer reviews performance of all Module qualified, Individual Method Qualified, and interim qualified testers as provided under the IA process.

2. Such reviews are documented in the form of checklists reflecting the degree of conformance to the test procedure. Copies of the review are provided to the tester and to the tester’s supervisor (normally the Project Engineer) at the conclusion of the review.

3. Remarks may be included to reflect commendable performance, attention to detail, cooperative attitude, or other performance beyond the expected norm. Satisfactory reports affirm tester proficiency, attest to proper operation of the materials acceptance process.

4. Expected satisfactory performance is that all steps of the checklist be performed correctly. However, incidences of single to several errors as isolated, first-time occurrences, which are acknowledged and corrected by on the spot, discussion with the IAI, also constitute satisfactory performance. (Note: Some procedures may have single steps of such criticality that their omission reflects unsatisfactory performance.)

5. Unsatisfactory performance constitutes repeated occurrences of previous on-the-spot corrections, incorrect performance of critical steps, or incorrect performance of over one-third of the checklist task steps. IAI’s may also assign unsatisfactory performance based on observed falsification of test reports, violations of safety, hazardous materials or nuclear materials security standards, or failure to provide proper care of equipment. The Regional Materials Engineer shall promptly review all unsatisfactory performance reports.

6. Reports alleging improper performance of test procedures, may be originated by other parties to a construction contract such as contractors, subcontractors or suppliers. Such allegations must be submitted in writing to the Project Engineer for review. Allegations must identify the specific test procedure and alleged omissions or commissions and contain the name and signature of the individual making the allegation. These reports will be investigated.
9-5.5A(10) Review Actions for Unsatisfactory Performance

1. The tester’s supervisor is expected to review and act on all unsatisfactory performance reports.

2. For unsatisfactory performance, the Regional Materials Engineer will work with the Project Engineer for proposed corrective action. Mutual agreement on corrective action shall be documented by attachment to the performance report.

3. Unresolved reports shall be referred to the Regional Construction Manager.

4. Review of substandard performance shall afford the tester involved the opportunity for a personal appearance. In the case of written allegations of misconduct, the individual making the allegation shall also have the opportunity to appear. The Regional Construction Manager shall review recommendation for corrective action. All findings related to allegations of misconduct shall be made in writing by the Regional Construction Manager.

9-5.5B Independent Assurance (IA) Program

9-5.5B(1) General

The IA Program, through a combination of sampling and observation, is intended to determine the conformance of sampling and testing to the defined procedures. The Independent Assurance process is intended to verify procedures, confirm equipment verification, and, in some instances, obtain split samples (Independent Assurance Samples) for independent testing. These samples do not reflect on the specification conformance of the materials involved. IA evaluation will be on a system basis, focused on individuals testing activity rather than being project based on a sample frequency and materials quantity basis.

9-5.5B(2) Independent Assurance Inspector (IAI)

The Regional Construction Manager should assign a sufficient number of persons in each region to handle the program for independent assurance sampling, testing, and annual tester evaluation reviews. These IAI’s should be under the direction of the Regional Materials Engineer and should be well trained and experienced in all phases of the work.

It will be the duty of the IAI to conduct the IA Program in accordance with the requirements of WSDOT. The IA program requires the evaluation of all materials testers, observation of the techniques used to run the field tests, determination of the verification status and condition of testing equipment in use, and procurement of appropriate Independent Assurance Samples. The IAI’s should exercise tact and good judgment in securing maximum cooperation on the part of the testers and other project personnel. IAI’s will conduct the examination process under the Construction Tester Qualification Program.

The Tester Qualification Tracking System will identify each tester, their specialty, level of qualification, and the results of ongoing evaluations. The IAI shall be the responsible person within the region for the accuracy of the information contained in the Tester Qualification Tracking System.

The IAI may normally have other materials related functions to perform in addition to the IA functions. Typically, these may include:

1. Conducting initial training to establish interim qualification.
2. Mentoring interim or newly qualified testers to enhance efficiency and confidence.
3. Assisting in or conducting testing and inspection training in concert with the Regional Construction Trainer.
4. Reviewing materials, test-related records, and forms.
5. Radiation Safety Officer
6. Inspection and Certification of Asphalt and Concrete production facilities.

9-5.5B(3) Independent Assurance Evaluations

It is essential that the IAI evaluate all project and region materials testers, observe the techniques of running the field tests, ascertain the verification status of testing equipment in use, and obtain the appropriate Independent Assurance Samples.

The frequency of Independent Assurance Inspections is managed by the IAI’s. On-site evaluation by the IAI will be conducted at least once per calendar year, per module or test. The on-site evaluation will accrue the calendar year following qualification or requalification. The on-site evaluation shall include evaluation in all test methods in the applicable qualification module, or the individual method qualified tests. Tests included in a module but not evaluated on a project may be evaluated off-site, such as at the region laboratory. Additional visits are recommended based on the activity level of the individual tester. Further, additional evaluations may be required for follow up of deficient performance or for monitoring activities of Interim Qualified Testers.

Observations of performance and split sampling will be performed for hot mix asphalt and aggregate testing. Only observations of performance are required for testing of Portland cement concrete and for density testing.

Independent Assurance observations and evaluations will follow the Tester Qualification Checklists for the procedures involved. A copy of these checklists and observations will be provided to the Project Engineer. Each observation will be cataloged to the tester that is observed, to maintain an ongoing account of his/her performance. A complete record should be made of the evaluation and sampling performed during this inspection, the personnel
contacted, the testing equipment observed, and the suggestions or on-the-spot corrections that were left with job personnel. Observations other than test performance related to checklists are not normally considered in the evaluation of the individual tester, but may require action by management involved.

At the time of the Independent Assurance Inspection, where samples are required, the IAI will observe the initial sampling and participate in the sample splitting activity to ensure that an accurate split is obtained. The field split will then be tested, under observation. The split portion will be returned to the Regional Materials Laboratory and tested for comparison of results.

Additional separate comparison samples may be split by the field tester and forwarded to the Regional Materials Laboratory as initiated by the field tester or when directed by the IAI as follow up for observed deficient performance. This sample will be carefully split, identified as “Comparison Sample,” show the tester’s identity, and be forwarded to the Regional Materials Laboratory accompanied by the field test results.

All testing equipment involved will be examined for the presence of the required Region verification tags current for the present calendar year. In addition, evaluation of the condition of the equipment items is advised for determination of in service wear or damage.

9-5.5B(4) Evaluation of Independent Assurance Samples Testing

The companion tests of Independent Assurance Samples will be performed employing another qualified operator and set of verified testing equipment than that used for the field (acceptance) test results. When acceptance testing is performed at the Regional Materials Laboratory, the operators should be under the same degree of Independent Assurance oversight as for acceptance sampling performed in the field.

9-5.5B(5) Comparison of Independent Assurance and Acceptance Test Results

Independent Assurance results or comparison results will be compared with the acceptance results. Reports of the comparison of results will be provided to the Project Engineer and the Region IAI. Comments reflecting the degree of conformance will be entered in the remarks section of the report by the Regional Materials Engineer. The degree of conformance will be determined according to the deviation ranges noted below. Gradation test results will be compared only on specification screens.

<table>
<thead>
<tr>
<th>Test</th>
<th>Normal Range of Deviation</th>
<th>Maximum Range of Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand Equivalent Fracture</td>
<td>± 8points</td>
<td>± 15points</td>
</tr>
<tr>
<td>Asphalt Content</td>
<td>± 5percent</td>
<td>± 10percent</td>
</tr>
<tr>
<td>(ACP&amp;ATB) Sieve Analysis — All Items: No. 4 (4.75 mm) sieve and larger</td>
<td>± 0.3 percent</td>
<td>± 0.6 percent</td>
</tr>
<tr>
<td>No. 6 (3.35 mm) sieve to No. 80 (0.180 mm) sieve</td>
<td>± 5 percent</td>
<td>± 8 percent</td>
</tr>
<tr>
<td>No. 100 (0.150 mm) sieve to No. 200 (0.075 mm) sieve</td>
<td>± 3 percent</td>
<td>± 6 percent</td>
</tr>
<tr>
<td></td>
<td>± 2percent</td>
<td>± 4 percent</td>
</tr>
</tbody>
</table>

In the table above, “Normal Range” indicates an acceptable range of variation between test results and no action is required. Test results that fall in this category will be so indicated by the wording “normal deviation” on the independent assurance test reports.

Test results falling outside of the “Normal Range” but within the “Maximum Range,” will be indicated by the wording “questionable deviation” on the independent assurance test reports. For deviations falling into this category, the Project Engineer or a representative shall review the original test report form, advise the responsible test operator of the deviation, and review the test procedure at the next opportunity. The IAI will take the same actions relative to the test operator in the region laboratory.

Test results exceeding the maximum range will be indicated by the wording “excessive deviation.” For deviations falling in the excessive category, the Project Engineer or a representative will notify the IAI and/or Region Construction Trainer for their services in corrective action. Corrective action involving both the field tester and the region laboratory tester will include review of sampling procedures, sample splitting procedures, testing procedures, and testing equipment.

The Project Engineer will document actions and results of these investigations by a notation or attachment to the independent assurance sample test report. The Independent Assurance Inspector shall document the actions and results of these investigations on the individual’s checklist evaluation with notations as to his/her findings in reviewing region lab procedures. Lacking any other actions, these results shall be considered in scheduling repeat evaluations of a tester and entered into the individual’s qualification record. These may include comments or findings by the Region Construction Trainer.

The focus of Independent Assurance sampling is based on individual tester’s activity and is not intended to provide independent assurance sample reports on all projects or on all materials on any particular project.
**Materials**

**9-5.6 Tolerance Limits**

### Crushed Coverstone

<table>
<thead>
<tr>
<th>Specification</th>
<th>Metric</th>
<th>Tolerance Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Passing (\frac{3}{4})(^\uparrow)</td>
<td>% Passing 19.0 mm</td>
<td>100 - 95-100</td>
</tr>
<tr>
<td>% Passing (\frac{5}{8})(^\uparrow)</td>
<td>% Passing 16.0 mm</td>
<td>95-100 - 90-100</td>
</tr>
<tr>
<td>% Passing No. 4</td>
<td>% Passing 4.75 mm</td>
<td>20-45 - 16-49</td>
</tr>
<tr>
<td>% Passing No. 200</td>
<td>% Passing 0.075 mm</td>
<td>0-7.5 - 0-9.0</td>
</tr>
<tr>
<td>Sand Equivalent</td>
<td>Sand Equivalent</td>
<td>32 Min. - 27 Min.</td>
</tr>
<tr>
<td>Fracture</td>
<td>Fracture</td>
<td>75% Min. - 70% Min.</td>
</tr>
</tbody>
</table>

** Crushed Screenings \(\frac{3}{4}\)\(^\uparrow\) — \(\frac{1}{2}\)\(^\uparrow\) (19.0 mm — 12.5 mm) for B.S.T.**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Metric</th>
<th>Tolerance Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Passing 1(^\uparrow)</td>
<td>% Passing 25.0 mm</td>
<td>100 - 95-100</td>
</tr>
<tr>
<td>% Passing (\frac{3}{4})(^\uparrow)</td>
<td>% Passing 19.0 mm</td>
<td>95-100 - 90-100</td>
</tr>
<tr>
<td>% Passing (\frac{1}{2})(^\uparrow)</td>
<td>% Passing 12.5 mm</td>
<td>0-20 - 0-25</td>
</tr>
<tr>
<td>% Passing (\frac{5}{8})(^\uparrow)</td>
<td>% Passing 9.50 mm</td>
<td>0-5 - 0-10</td>
</tr>
<tr>
<td>% Passing No. 200</td>
<td>% Passing 0.075 mm</td>
<td>0-1.0 - 0-2.0</td>
</tr>
<tr>
<td>Fracture</td>
<td>Fracture</td>
<td>75% Min. - 70% Min.</td>
</tr>
</tbody>
</table>

** Crushed Screenings \(\frac{5}{8}\)\(^\uparrow\) — No. 4 (16.0 mm — 4.75 mm) or B.S.T.**

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<td>% Passing 19.0 mm</td>
<td>100 - 95-100</td>
</tr>
<tr>
<td>% Passing (\frac{5}{8})(^\uparrow)</td>
<td>% Passing 16.0 mm</td>
<td>95-100 - 90-100</td>
</tr>
<tr>
<td>% Passing No. 4</td>
<td>% Passing 4.75 mm</td>
<td>0-10 - 0-15</td>
</tr>
<tr>
<td>% Passing No. 10</td>
<td>% Passing 2.00 mm</td>
<td>0-3 - 0-7</td>
</tr>
<tr>
<td>% Passing No. 200</td>
<td>% Passing 0.075 mm</td>
<td>0-1.0 - 0-2.0</td>
</tr>
<tr>
<td>Fracture</td>
<td>Fracture</td>
<td>75% Min. - 70% Min.</td>
</tr>
</tbody>
</table>

** Crushed Screenings \(\frac{1}{2}\)\(^\uparrow\) — No. 4 (12.5 mm — 4.75 mm) or B.S.T.**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Metric</th>
<th>Tolerance Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Passing (\frac{5}{8})(^\uparrow)</td>
<td>% Passing 16.0 mm</td>
<td>100 - 95-100</td>
</tr>
<tr>
<td>% Passing (\frac{1}{2})(^\uparrow)</td>
<td>% Passing 12.5 mm</td>
<td>95-100 - 90-100</td>
</tr>
<tr>
<td>% Passing No. 4</td>
<td>% Passing 4.75 mm</td>
<td>0-15 - 0-20</td>
</tr>
<tr>
<td>% Passing No. 10</td>
<td>% Passing 2.00 mm</td>
<td>0-3 - 0-7</td>
</tr>
<tr>
<td>% Passing No. 200</td>
<td>% Passing 0.075 mm</td>
<td>0-1.0 - 0-2.0</td>
</tr>
<tr>
<td>Fracture</td>
<td>Fracture</td>
<td>75% Min. - 70% Min.</td>
</tr>
</tbody>
</table>

** Crushed Screening \(\frac{1}{8}\)\(^\uparrow\) — No. 10 (9.50 mm — 2.00 mm)**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Metric</th>
<th>Tolerance Limits</th>
</tr>
</thead>
<tbody>
<tr>
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<td>% Passing 12.5 mm</td>
<td>100 - 95-100</td>
</tr>
<tr>
<td>% Passing (\frac{1}{8})(^\uparrow)</td>
<td>% Passing 9.50 mm</td>
<td>90-100 - 85-100</td>
</tr>
<tr>
<td>% Passing No. 4</td>
<td>% Passing 4.75</td>
<td>30-56 - 25-61</td>
</tr>
<tr>
<td>% Passing No. 10</td>
<td>% Passing 2.00 mm</td>
<td>0-10 - 0-12</td>
</tr>
<tr>
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<td>0-1.0 - 0-2.0</td>
</tr>
<tr>
<td>Fracture</td>
<td>Fracture</td>
<td>75% Min. - 70% Min.</td>
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** Crushed Screenings No. 4 — 0” (4.75 mm — 0 mm) for B.S.T.**

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<tr>
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<td>75% Min. - 70% Min.</td>
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### Ballast

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<td>60-100</td>
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<td>% Passing 1½</td>
<td>% Passing 25.0 mm</td>
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<td>45-90</td>
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<td>26-44</td>
<td>21-49</td>
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<td>10.0 Max.</td>
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<td>22 Min.</td>
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### Shoulder Ballast

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<td>35-85</td>
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### Crushed Surfacing Base Course

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<td>75-100</td>
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<td>% Passing ½</td>
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<td>45-85</td>
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<td>27 Min.</td>
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<td>70% Min.</td>
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### Crushed Surfacing Top Course

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<td>46-66</td>
<td>41-71</td>
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<td>11.0 Max.</td>
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<td>Sand Equivalent</td>
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<td>27 Min.</td>
</tr>
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<td>70% Min.</td>
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### Maintenance Rock

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<td>8.0 Max.</td>
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<tr>
<td>Sand Equivalent</td>
<td>Sand Equivalent</td>
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<td>27 Min.</td>
</tr>
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<td>70% Min.</td>
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## Materials

### Gravel Base

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<td>% Passing 2”</td>
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<td>11.0 Max.</td>
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<td>22 Min.</td>
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### Gravel Backfill for Walls

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<tbody>
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<td>% Passing 2” ↑</td>
<td>% Passing 50.0 mm</td>
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<td>70-100</td>
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<tr>
<td>% Passing No. 4</td>
<td>% Passing 4.75 mm</td>
<td>22-66</td>
<td>17-71</td>
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<tr>
<td>% Passing No. 200</td>
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<td>6.0 Max.</td>
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<tr>
<td>Sand Equivalent</td>
<td>Sand Equivalent</td>
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<td>47 Min.</td>
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<td>Dust Ratio</td>
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### Gravel Backfill for Pipe Zone Bedding

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<tbody>
<tr>
<td>% Passing 1½↑</td>
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<td>100</td>
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<tr>
<td>% Passing 1↑</td>
<td>% Passing 25.0 mm</td>
<td>75-100</td>
<td>70-100</td>
</tr>
<tr>
<td>% Passing 7/8↑</td>
<td>% Passing 19.0 mm</td>
<td>80-100</td>
<td>75-100</td>
</tr>
<tr>
<td>% Passing 0.4</td>
<td>% Passing 4.75 mm</td>
<td>20-80</td>
<td>15-85</td>
</tr>
<tr>
<td>% Passing No. 40</td>
<td>% Passing 0.425 mm</td>
<td>3-24</td>
<td>2-29</td>
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<td>Sand Equivalent</td>
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<td>22 Min.</td>
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### Gravel Backfill for Drains

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<tr>
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<td>100</td>
<td>95-100</td>
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<tr>
<td>% Passing 7/8↑</td>
<td>% Passing 19.0 mm</td>
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<td>75-100</td>
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<td>% Passing 4.75 mm</td>
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### Gravel Backfill for Drywells

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<td>% Passing 1½↑</td>
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<td>100</td>
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<tr>
<td>% Passing 1↑</td>
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<td>% Passing 7/8↑</td>
<td>% Passing 19.0 mm</td>
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<td>0-25</td>
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<td>% Passing 4.75 mm</td>
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<td>0-3</td>
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### Backfill for Sand Drains

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## Sand Drainage Blanket

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## Gravel Borrow

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## Select Borrow

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## Foundation Material Class A

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## Foundation Material Class B

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## Asphalt Materials — Paving Asphalt

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### 9-5.7 Acceptance Sampling and Testing Frequency Guide

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<th>Test</th>
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<th>Metric Acceptance Sample</th>
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<td>Grading &amp; SE</td>
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<td>4000 Tonnes</td>
</tr>
<tr>
<td>Select Borrow</td>
<td>Grading &amp; SE</td>
<td>1 – 4000 Ton</td>
<td>4000 Tonnes</td>
</tr>
<tr>
<td>Sand Drainage Blanket</td>
<td>Grading</td>
<td>1 – 4000 Ton</td>
<td>4000 Tonnes</td>
</tr>
<tr>
<td>Gravel Base</td>
<td>Grading, SE &amp; Dust Ratio</td>
<td>1 – 4000 Ton</td>
<td>4000 Tonnes</td>
</tr>
<tr>
<td>CSBC</td>
<td>Grading, SE &amp; Fracture</td>
<td>1 – 2000 Ton</td>
<td>2000 Tonnes</td>
</tr>
<tr>
<td>Maintenance Rock</td>
<td>Grading, SE &amp; Fracture</td>
<td>1 – 2000 Ton</td>
<td>2000 Tonnes</td>
</tr>
<tr>
<td>Ballast</td>
<td>Grading, SE &amp; Dust Ratio</td>
<td>1 – 2000 Ton</td>
<td>2000 Tonnes</td>
</tr>
<tr>
<td>Shoulder Ballast</td>
<td>Grading &amp; Fracture</td>
<td>1 – 2000 Ton</td>
<td>2000 Tonnes</td>
</tr>
<tr>
<td>Backfill for Sand Drains</td>
<td>Grading</td>
<td>1 – 2000 Ton</td>
<td>2000 Tonnes</td>
</tr>
<tr>
<td>Crushed Covers e</td>
<td>Grading, SE &amp; Fracture</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>Crushed Screening 1/8 – No. 4 (16.0 – 4.75 mm)</td>
<td>Grading &amp; Fracture</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>1/2 – No. 4 (12.0 – 4.75 mm)</td>
<td>Grading &amp; Fracture</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>No. 4 – 0 (4.75 – 0 mm)</td>
<td>Grading &amp; Fracture</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>Gravel Backfill For Foundations</td>
<td>Grading &amp; SE</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>Walls</td>
<td>Grading, SE &amp; Dust Ratio</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>Pipe Zone Bedding</td>
<td>Grading &amp; SE</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>Drains</td>
<td>Grading</td>
<td>1 – 100 Ton</td>
<td>100 Tonnes</td>
</tr>
<tr>
<td>PCC Paving</td>
<td>Grading</td>
<td>1 – 2000 Ton</td>
<td>2000 Tonnes</td>
</tr>
<tr>
<td>Coarse Aggregate</td>
<td>Air</td>
<td>1 – 500 CY</td>
<td>400 m³</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>Compressive Strength</td>
<td>1 – 500 CY</td>
<td>400 m³</td>
</tr>
<tr>
<td>Air Content</td>
<td>Density</td>
<td>1 – 500 CY</td>
<td>400 m³</td>
</tr>
<tr>
<td>Cylinders (28-day)</td>
<td>Thickness</td>
<td>1 – 500 CY</td>
<td>400 m³</td>
</tr>
<tr>
<td>Core</td>
<td>Chemical &amp; Physical Certification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement</td>
<td>See Note 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCC Structures</td>
<td>Grading</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>Coarse Aggregate</td>
<td>Air</td>
<td>1 – 500 CY</td>
<td>40 m³</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>Compressive Strength</td>
<td>1 – 500 CY</td>
<td>40 m³</td>
</tr>
<tr>
<td>Consistency</td>
<td>Air</td>
<td>1 – 500 CY</td>
<td>40 m³</td>
</tr>
<tr>
<td>Air Content</td>
<td>Cement</td>
<td>See Note 5</td>
<td></td>
</tr>
<tr>
<td>Cylinders (28-day)</td>
<td>Chemical &amp; Physical Certification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asphalt Concrete Pavement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed Mix, See Note 3 and 4</td>
<td>Grading &amp; Asphalt Content</td>
<td>1 – 800 Ton</td>
<td>800 Tonnes</td>
</tr>
<tr>
<td></td>
<td>Compaction</td>
<td>5 – 400 Ton</td>
<td>400 Tonnes</td>
</tr>
<tr>
<td>Open Graded, See Note 3 Class D and D Mod.</td>
<td>Grading (Agg. from cold feed)</td>
<td>1 – 800 Ton</td>
<td>800 Tonnes</td>
</tr>
<tr>
<td>Item</td>
<td>Test</td>
<td>English Acceptance Sample</td>
<td>Metric Acceptance Sample</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-----------------------------</td>
<td>---------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Asphalt Concrete Aggregate Aggregate (from cold feed)</td>
<td>SE &amp; Fracture, See Note 3</td>
<td>1 – 1600 Ton</td>
<td>1600 Tonnes</td>
</tr>
<tr>
<td>Coarse Aggregate (in stockpile) See Note 1</td>
<td>Grading, SE, &amp; Fracture</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>Fine Aggregate (in stockpile) See Note 1</td>
<td>Grading, SE, &amp; Fracture</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>Blend Sand (in stockpile)</td>
<td>SE</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>Asphalt Treated Base Aggregate</td>
<td>Grading See Note 1 &amp; SE</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>Completed Mix</td>
<td>Grading &amp; Asphalt</td>
<td>1 – 1000 Ton</td>
<td>1000 Tonnes</td>
</tr>
<tr>
<td>See Note 4</td>
<td>Compaction, See Note 2</td>
<td>5 – Control Lot</td>
<td>5 – Control Lot</td>
</tr>
<tr>
<td>Asphalt Materials</td>
<td></td>
<td>Certification</td>
<td>Certification</td>
</tr>
<tr>
<td>Paving Asphalt (AR, AC, PBA, PG)</td>
<td>Verification:</td>
<td>2-1 quart</td>
<td>2-1 liter</td>
</tr>
<tr>
<td>liquid Asphalt (Cutback, Emulsion)</td>
<td>Verification:</td>
<td>2-1 quart</td>
<td>2-1 liter</td>
</tr>
<tr>
<td>Emulsion for ACP Tack Coat</td>
<td>Verification:</td>
<td>None required</td>
<td></td>
</tr>
<tr>
<td>Rubberized Asphalt</td>
<td></td>
<td>2-1 quart</td>
<td>2-1 liter</td>
</tr>
<tr>
<td>Compaction</td>
<td></td>
<td>every other mix acceptance sample, see Note 6</td>
<td>every other shipment</td>
</tr>
<tr>
<td>Embankment</td>
<td></td>
<td>1 – 2500 CY</td>
<td>2000 M³</td>
</tr>
<tr>
<td>Cut Section</td>
<td></td>
<td>1 – 500 LF</td>
<td>150 M</td>
</tr>
<tr>
<td>Surfacing</td>
<td></td>
<td>1 – 1,000 LF (per layer)</td>
<td>300 M (per layer)</td>
</tr>
<tr>
<td>Backfill</td>
<td></td>
<td>1 – 500 CY</td>
<td>400 M³</td>
</tr>
</tbody>
</table>

Note 1 Tests for grading will be performed only when aggregates are being produced and stockpiled for use on a future project.

Note 2 A control lot shall be a normal days production.

Note 3 For projects under statistical acceptance, the sample frequency shall be as prescribed in the contract and the sublot size may vary from 500 to 800 ton depending on the project quantities. For projects under nonstatistical acceptance, the sublot size may vary from 400 to 800 ton tonnes with a minimum of one sublot per day when the daily production is less than 100 ton

Note 4 Mix design conformation samples shall be submitted to the State Materials Laboratory Bituminous Concrete Section. For all projects, submit one sample per day from the first five days of production for each plant and one sample every fifth day of production there after. The conformation samples should be taken in conjunction with and be a representative quarter of the acceptance samples taken for the project as described in WSDOT Test Method 712. If no acceptance sample is required for any day of production no conformation sample will be required either.

Note 5 Cement may be accepted by the Engineer based on the Manufacturer’s Mill Test Report number indicating full conformance to the Specifications. The Engineer has the option of taking samples at the job site for submission to the State Materials Laboratory for testing.

Note 6 The first sample of paving asphalt will be taken with the second asphalt concrete pavement (ACP) mix sample. For nonstatistical of asphalt concrete pavement, take one sample for every 1,600 tons of mixture.
9-6 Radioactive Testing Devices

9-6.1 Administration and Safety

The purpose of this chapter is to provide a guide for personnelling, and administering the use of, nuclear density gauges. The instructions included in this Chapter will be used throughout the Washington State Department of Transportation for the express purpose of regulating the use of nuclear density gauge containing radioactive materials.

Each Region shall have a Regional Radiation Administration Officer and a Regional Radiation Safety Officer whose duties are described in Chapter 9-6.2 and 9-6.3. Only personnel who have successfully completed the WSDOT ‘Nuclear Gauge Operator Qualification’ course are authorized to use the nuclear density gauge. To perform acceptance testing with the nuclear density gauge all personnel must become a qualified or interim tester in either the Hot Mix Asphalt or Density modules. The operators responsibilities for safety and security of the gauges are described in Chapter 9-6.4.

All personnel using or responsible for the nuclear density gauge shall be:

1. Thoroughly familiar with the safe handling techniques for using radioactive materials.
2. Fully informed of the hazards to health that exists near radioactive materials.
3. Completely familiar and in compliance with the following rules and regulations:
   a. Rules and Regulations for Radiation Protection by the State Department of Health, Division of Radiation Protection, Title 246, WAC.

Copies of the above publications will be kept by the Region Radiation Safety Officer and at the storage location of the gauge. A copy of the Radiation Emergency Handbook will also be supplied with each nuclear density gauge. Authorized Operator will read this handbook before using the radioactive testing device for testing.

If an emergency as outlined in the Radiation Emergency Handbook occurs, the following people or agencies should be notified by the individual in charge of the nuclear density gauge:

1. Radiation Safety Officer.
2. Radiation Administration Officer

The RSO or the RAO will notify, the following people or agencies:

1. Radiation Control Program; Health Services Division; State Department of Health; Olympia, Washington 98504 (Phone 206/NUCLEAR).
2. Washington State Patrol, if a public hazard exists.
3. State Radiation Administration Officer or Radiation Safety Officer, at the Materials Laboratory.

The telephone numbers of these agencies or individuals will be posted at all storage sites and a copy of these numbers shall be kept with each nuclear density gauge.

It is paramount to the Department that it’s employees work in a healthy and safe environment. To this end each employee that works around or with nuclear gauges needs to know the potential hazards, of working with nuclear gauges and their individual rights. Each office that uses or stores nuclear gauges shall have a copy of the latest “ Sealed Source Edition Rules & Regulations for Radiation Protection” published by the Department of Health. Every employee that uses or works near the storage location of the nuclear gauges must sign the “ Acknowledgment of the Hazards of Working with Radiation Sources “ form after being instructed to review the applicable Chapters 246-220 Radiation - General Provisions; 246-221 Radiation Protection Standards; 246-222 Radiation Protection - Worker Rights. This form is available through the Radiation Safety Officer.

Personal monitoring of radiation received from the nuclear density gauge is one of the major items in the Health Safety Program. Anyone handling radioactive sources must wear a radiation exposure badge, which records any exposure that the body may receive. Radiation exposure badges are assigned to individuals. They are not to be used by any other person. Attention is to be made to the conditions outlined in WAC 246-221-010 and WAC 246-221-055 regarding the radiation exposure during pregnancy and dose limits to the embryo/fetus.

The acquisition of radiation exposure badges as needed by each Region shall be the responsibility of the Regional Radiation Safety Officer. These badges can be obtained from U.S. Dosimeter Technology Inc., 660-A George Washington Way, Richland, Washington 99352, Telephone (509) 946-8738, or from a firm recognized by the Department of Health to perform this service. Three month TLD (Thermal Luminescent Dosimeter) badges indicating exposure to gamma, beta, x-ray, and neutron radiation will be used as a minimum.

Each nuclear density gauge will be supplied in the manufacture’s shipping container with an adequate latch. While transporting and when storing the nuclear density gauge, it must be secured with a minimum of 3 locks. At all times, the key for the lock will be in the possession of the individual responsible for the nuclear density gauge. When a passenger vehicle is used for transporting, the shipping container containing the nuclear density gauge shall be kept in the trunk. When a station wagon or panel truck is used, the nuclear density gauge shall be placed at the back of the vehicle in such a manner as to prevent it from sliding.
around. When carried in a six passenger pickup with a
service body, the nuclear density gauge shall be carried in
the back, with the storage lid locked. Don’t carry the
nuclear density gauge in the back seat. When a pickup is
used, the box containing the nuclear density gauge will be
secured to the bed of the vehicle to prevent movement and
in such a way to prevent theft.

For en route overnight storage at a motel, hotel, or other
lodging place, the locked nuclear density gauge may be left
in the locked vehicle. In case of a pickup truck, the nuclear
density gauge must be locked in the cab of the truck.

9-6.2 Radiation Administration Officer
(Region Materials Engineer)

The Radiation Administration Officer (RAO) will be
responsible for administering the use of radioactive material
within the Region.

The RAO will obtain, revise, and renew the Region’s
Radioactive Material License issued by the Washington
State Department of Health. A license indicates the strength
and type of sources that a Region may possess.

Licenses are issued subject to all the requirements of the
Washington Rules and Regulations for Radiation Protection
and to the conditions specified in the license. Licenses are
also subject to any additional requirements of the
Department of Health as stated in letters issued by DOH.
Where a letter containing a license condition requirement
differs from the Regulations, the letter will supersede the
regulations insofar as the license is concerned.

When a change occurs in the radiation program which would
make untrue a statement in the current Radioactive Material
License, the Licensee (RSO) will notify the Department of
Health and request an appropriate amendment.

The Radiation Safety Officer must be listed on the license.
Individual operators are not required to be on the license,
but the Radiation Administration Officer or RSO must
maintain a list of authorized operators. This list of
authorized operators should include the operator’s name,
type of training, final test score, and a copy of the training
certificate. The RAO or RSO will be responsible for the
storage of the nuclear density gauge when not in field use,
and the assignment of nuclear density gauge to the
individual project offices. The RAO or RSO will be
responsible for maintaining the following records:

1. List of qualified operators within the Region.
2. Radioactive testing device location records.
3. Radioactive testing device shipping records.

Prior to shipping (or transferring) the nuclear density gauge
from one licensed organization to another, the shipper shall
check, and be assured, that the receiver has a valid license;
and that the shipped (or transferred) sources do not exceed
the limitations of the receiver’s license. Shipment to
authorized personnel within the Region is covered by the
Region’s license. The State Materials Laboratory shall be
notified of any repairs or calibration that is needed to the
nuclear density gauge. When the nuclear density gauge are
not in field use, the normal storage will be at the Region
office. This should be an area designated for this purpose
with the following information posted on the walls of the
room to notify personnel of the existence of radiation:

1. “CAUTION — RADIOACTIVE MATERIALS” sign.
2. DOH Form RHF-3 “Notice to Employees.”
3. WAC Chapters 246-220, 246-221, and 246-222 of the
   Rules and Regulations for Radiation Protection.
4. DOH Form “Notification of a Radiation Emergency.”

9-6.3 Radiation Safety Officer

The Radiation Safety Officer (RSO) will have the
responsibility for the Regional radiation protection program.
The RSO will be responsible for maintaining the following
records:

1. Wipe test records.
2. Medical records.
4. Minor testing device maintenance as outlined in the
   Radioactive Materials License.
5. The Acknowledgment of the Hazards of Working with
   Radiation Sources form.

Wipe tests or leak testing is required by law and is simply
a swabbing of the sealed source to ascertain that no
radioactive contamination has occurred from the nuclear
source. The Regional RSO shall be responsible for having
each source wiped every six months. The analysis of wipe
tests is done by a commercial firm licensed to do this work.

The service contract will be obtained by individual regions.
Records of leak tests results shall be kept in units of
micro-curies and maintained for inspection. Any leak test
revealing the presence of 1850 Bq (0.005 microcuries) or
more of removable radioactive material shall be reported
to the Department of Health, Division of Radiation
Protection, P.O. Box 47827, Olympia, WA 98504-7827,
within five days of the test. This report should include a
description of the defective source or device, the results of
the test, and the corrective action taken.
9-7 Vacant

9-8 WSDOT Testing Methods

9-8.1 Calibrated/Verified Equipment for Testing

The following listed equipment used in the Region Laboratory and in the Field Laboratory for acceptance testing is required to be verified and/or calibrated annually, and shall bear a tag indicating when the calibration or verification will expire. It is the responsibility of the testing personnel (i.e., Module Qualified Testers, Method Qualified Testers, or Interim Qualified Testers and Independent Assurance Inspectors) to check all equipment for serviceability and conformance to the requirements of the test procedure. No equipment with an expired calibration or verification shall be used for testing.

Aggregate Testing

Drying Ovens (AASHTO T-255, 265)

General Purpose Balances, Scales and Weights (AASHTO M-231)

Mechanical Sieve Shaker (AASHTO T-27)

Sand Equivalent Shaker (AASHTO T-176)

Sand Equivalent Weighted Foot Assembly (AASHTO T-176)

Sand Equivalent Irrigation Tube (AASHTO T-176)

Sieves (AASHTO M-92)

Thermometers

Timing Devices (AASHTO T-176)

Fine Aggregate Apparatus (AASHTO T-304)

Flat and Elongated Particle Shape Apparatus (ASTM D-4791)

Asphalt Testing

Drying Ovens (AASHTO T-255, 265, and WAQTC TM-6)

General Purpose Balances, Scales and Weights (AASHTO M-231)

Ignition Furnace (AASHTO T-308)

Mechanical Sieve Shaker (AASHTO T-30)

Sieves (AASHTO M-92)

Thermometer - ASTM 17C or 17F (AASHTO T-209)

Thermometer – drying temperature

Timing Devices

Vacuum System (AASHTO T-209)
Materials

9-8.2 Field Test Methods for Materials

The test method as specified by WSDOT Materials Manual will be used to perform the testing. All testing will be performed by Module Qualified Testers, Individual Method Qualified Testers, or Interim Qualified Testers as defined in Chapter 9-5 of this manual. The tester can be qualified in a testing module, or by individual test methods. Section 9-8.2A is the list of the tests that are included in each of the modules. A tester can be Individual Method Qualified in any test that are included in the modules or from the list of individual tests in Section 9-8.2B, however the tester is not limited to just these tests. All of the test methods listed in each of the testing modules can be found in the blue pages following this section, see Section 9-8.2C for the Contents. In addition the WSDOT and WAQTC test methods that are performed in the field and that are listed in Section 9-8.2B are included.

Concrete Testing

Concrete Air Meters - Pressure gauge (AASHTO T-152)
Concrete Air Meters - Volumetric gauge (AASHTO T-152)
Cube Molds and Tamper (AASHTO T106 and WSDOT T-813) (no tag on tamper required)
General Purpose Balances, Scales and Weights (AASHTO M-231)
Rebound Hammer Type N (ASTM C-805)
Single Use Molds (AASHTO M-205) (no tag required)
Slump Cone and Rod (AASHTO T-119) (no tag on rod required)
Thermometer (AASHTO T-309)
Compression Testing Devise and associated equipment (AASHTO T-22, WSDOT T-802)
Beam Molds (WSDOT T-808)

Embankment and Base Density Testing

Drying Ovens (AASHTO T-255, 265)
General Purpose Balances, Scales and Weights (AASHTO M-231)
Manual Hammer (AASHTO T-99)
Mechanical Sieve Shaker (AASHTO T-27)
Maximum Density Devise (WSDOT T-606)
Nuclear Density Gauge (AASHTO T-310)
Sieves (AASHTO M-92)
Speedy Moisture Meter (AASHTO T-217)
Soil Mold (AASHTO T-99 and WSDOT T-606)
Straight Edge (AASHTO T-99)

Asphalt Pavement Density Testing

Nuclear Density Gauge (WAQTC TM-8)
Thermometer
9-8.2A Testing Modules

Testing Modules Procedures

Aggregate Module

<table>
<thead>
<tr>
<th>Procedure Number</th>
<th>Test Method</th>
</tr>
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<tbody>
<tr>
<td>AASHTO T-2</td>
<td>WSDOT FOP for AASHTO for the Sampling of Aggregates</td>
</tr>
<tr>
<td>AASHTO T-27/T11</td>
<td>WAQTC FOP for AASHTO for the Sieve Analysis of Fine &amp; Coarse Aggregates &amp; Materials Finer Than 75 mm (No. 200) in Mineral Aggregates by Washing</td>
</tr>
<tr>
<td>AASHTO T-176</td>
<td>WSDOT FOP for AASHTO for Determining the Plastic Fines in Graded Aggregate by Use of the Sand Equivalent Test</td>
</tr>
<tr>
<td>AASHTO T-248</td>
<td>WSDOT FOP for AASHTO for Reducing Field Samples of Aggregates to Testing Size</td>
</tr>
<tr>
<td>AASHTO T-255</td>
<td>WSDOT FOP for AASHTO for Determining the Total Moisture Content of Aggregate by Drying</td>
</tr>
<tr>
<td>WAQTC TM-1</td>
<td>Determining the Percentage of Fracture in Coarse Aggregate</td>
</tr>
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</table>

Asphalt Module

<table>
<thead>
<tr>
<th>Procedure Number</th>
<th>Test Method</th>
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<tbody>
<tr>
<td>AASHTO T-168</td>
<td>WAQTC FOP for AASHTO for the Sampling Bituminous Paving Mixtures</td>
</tr>
<tr>
<td>AASHTO T-209</td>
<td>WSDOT FOP for AASHTO for Determining the Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures</td>
</tr>
<tr>
<td>AASHTO T-27/T11</td>
<td>WAQTC FOP for AASHTO for the Sieve Analysis of Fine &amp; Coarse Aggregates &amp; Materials Finer Than 75 mm (No. 200) in Mineral Aggregates by Washing</td>
</tr>
<tr>
<td>AASHTO T-40</td>
<td>WAQTC FOP for AASHTO for Sampling Bituminous Materials</td>
</tr>
<tr>
<td>AASHTO T-308</td>
<td>WSDOT FOP for AASHTO for Determining Asphalt Content of Hot Mix Asphalt(HMA) by the Ignition Method</td>
</tr>
<tr>
<td>WAQTC TM-6</td>
<td>Moisture Content of Bituminous Mixes by Oven</td>
</tr>
<tr>
<td>WSDOT 712</td>
<td>Standard Method of Reducing Bituminous Paving Mixtures</td>
</tr>
<tr>
<td>WSDOT 716</td>
<td>Method of Random Sampling for Location of Testing and Sampling Sites</td>
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Concrete Module

<table>
<thead>
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<th>Procedure Number</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO T-23</td>
<td>WSDOT FOP for AASHTO for Making and Curing Concrete test Specimens in the Field</td>
</tr>
<tr>
<td>AASHTO T-119</td>
<td>WSDOT FOP for AASHTO for Determining the Slump of Hydraulic Cement Concrete</td>
</tr>
<tr>
<td>AASHTO T-152</td>
<td>WAQTC FOP for AASHTO for Determining the Air Content of Freshly Mixed Concrete by the Pressure Method</td>
</tr>
<tr>
<td>WAQTC TM-2</td>
<td>Sampling Freshly Mixed Concrete</td>
</tr>
<tr>
<td>AASHTO T-309</td>
<td>WSDOT FOP for AASHTO for Determining the Temperature of Freshly Mixed Portland Cement Concrete</td>
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Embankment and Base Density Module

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<td>AASHTO T-224</td>
<td>WSDOT FOP for AASHTO for Correction for Coarse Particles in the Soil Compaction Test</td>
</tr>
<tr>
<td>AASHTO T-310</td>
<td>WSDOT FOP for AASHTO for In-Place Density and Moisture Content of Soil and Soil Aggregate by Nuclear Method</td>
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Asphalt Pavement Density Module

<table>
<thead>
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DETERMINING THE PERCENTAGE OF FRACTURE IN COARSE AGGREGATE

FOP FOR WAQTC TM 1

SIGNIFICANCE

Aggregate particles can be round or smooth, as is often the case for material mined from the bottom of a river. This material has been rounded or smoothed as the stone has been transported downstream through the years. Aggregate can also be fractured, exhibiting a rough surface. Material that has been mechanically crushed has at least one fractured, rough surface per particle.

Fractured material often exhibits better interlocking between particles than does smooth material. This improved interlocking results in stronger material from the standpoint of supporting a load in a road base. Using stronger material results in a lesser depth of material being used. Fractured material may also be used in portland cement (PCC) or asphalt cement concretes (ACC) to obtain a better bond between aggregate particles and the cement. Again, a stronger structure results.

SCOPE

This method determines the percentage of fractured particles in an aggregate sample.

This procedure covers the determination of the percentage, by mass, of a coarse aggregate (CA) sample that consists of fractured particles meeting specified requirements in accordance with WAQTC TM 1.

In this procedure, a sample of aggregate is screened on the sieve separating CA and fine aggregate (FA). This sieve will be identified in the agency’s specifications, but might be the 4.75 mm (No. 4) sieve. CA particles are visually evaluated to determine conformance to the specified fracture. The percentage of conforming particles, by mass, is calculated for comparison to the specifications.

Method 2 will be used by WSDOT for determining the fracture of aggregate as required by the Standard Specifications.

APPARATUS

- Balance – The balance shall have sufficient capacity, be readable to 0.1 percent of the sample mass, or better, and conform to the requirements of M231.
- Balance or scale: Capacity sufficient for the principle sample mass, accurate to 0.1 percent of the sample mass or readable to 0.1 g.
- Sieves, meeting requirements of AASHTO M 92.
- Splitter, meeting the requirements of AASHTO T 248.

TERMINOLOGY

1. Fractured Face – An angular, rough, or broken surface of an aggregate particle created by crushing or by other means. A face is considered a “Fractured Face” whenever one-half or more of the projected area, when viewed normal to that face, is fractured with sharp and well defined edges. This excludes small nicks.

2. Fractured particle – A particle of aggregate having at least the minimum number of fractured faces specified. (This is usually one or two.)
SAMPLING AND SAMPLE PREPARATION

1. Sample and reduce the aggregate in accordance with AASHTO T 2 and AASHTO T 248.

2. When the specifications list only a total fracture percentage, the sample shall be prepared in accordance with Method 1. When the specifications require that the fracture be counted and reported on each sieve, the sample shall be prepared in accordance with Method 2.

3. Method 1 - Combined Fracture Determination

   WSDOT has deleted this section.

4. Method 2 – Individual Sieve Fracture Determination

   Method 2 is to be used for all Aggregate.

   a. Dry the sample sufficiently to obtain a clean separation of CA and FA material in the sieving operation. Use a washed sample from the gradation determination.

   b. Sieve the sample in accordance with FOP for AASHTO T 27/11 over the sieves listed in the specifications for this material.

   If the separation of the material is performed using extra sieves, the material retained on the intermediate sieves shall be added to the material retained on the next smaller specified sieve. This material is to be thoroughly mixed then quartered or split to a mass as shown in Table 2. The fracture will be counted and reported for the specified sieve.

   c. Select a representative portion from each sieve by splitting or quartering in accordance with FOP for AASHTO T 248. The size of test sample for each sieve should be at least as large as shown in Table 2.

   **TABLE 2**
   Sample Size
   Method 2 (Individual Sieve Fracture)

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Minimum Sample Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>in. (mm)</td>
<td>lb (g)</td>
</tr>
<tr>
<td>1 1/4 (31.5)</td>
<td>3.5 (1500)</td>
</tr>
<tr>
<td>1 (25.0)</td>
<td>2.2 (1000)</td>
</tr>
<tr>
<td>3/4 (19.0)</td>
<td>1.5 (700)</td>
</tr>
<tr>
<td>5/8 (16.0)</td>
<td>1.0 (500)</td>
</tr>
<tr>
<td>1/2 (12.5)</td>
<td>0.7 (300)</td>
</tr>
<tr>
<td>3/8 (9.5)</td>
<td>0.5 (200)</td>
</tr>
<tr>
<td>1/4 (6.3)</td>
<td>0.2 (100)</td>
</tr>
<tr>
<td>No. 4 (4.75)</td>
<td>0.2 (100)</td>
</tr>
<tr>
<td>No. 8 (2.36)</td>
<td>0.1 (25)</td>
</tr>
<tr>
<td>No. 10 (2.00)</td>
<td>0.1 (25)</td>
</tr>
</tbody>
</table>

   Note 1: If fracture is determined on a sample obtained for gradation, use the mass retained on the individual sieves. Don’t count fracture if 5% or less of the total mass is retained on any specification sieve.

   If less than 5 percent of the total mass is retained on a single specification sieve, include that material on the next smaller specification sieve.
PROCEDURE

1. Where necessary, wash the sample over the sieve or sieves designated to remove any remaining fine material, and dry to a constant mass in accordance with FOP for AASHTO T 255 and allow to cool.

2. After cooling, spread the dried sample on a clean, flat surface large enough to permit careful inspection of each particle. To verify that a particle meets the fracture criteria, hold the aggregate particle so that the face is viewed directly.

3. To aid in making the fracture determination separate the sample into three categories:
   - fractured particles meeting the criteria
   - particles not meeting the criteria
   - questionable or borderline particles

4. Determine the dry mass of particles in each category to the nearest 0.1 g.

   **Note 4**: If, on any determination, more than 15 percent of the total mass of the sample is placed in the questionable category, repeat the procedure until no more than 15 percent is present in that category.

CALCULATION

Calculate the mass percentage of fractured faces to the nearest 1 percent using the following formula:

\[ P = \left( \frac{F + Q/2}{F+Q+N} \right) \times 100 \]

where:
- \( P \) = Percent of fracture
- \( F \) = Mass of fractured particles
- \( Q \) = Mass of questionable or borderline particles.
- \( N \) = Mass of unfractured particles

Example:

\[ F = 632.6 \text{ g}, \quad Q = 97.6 \text{ g}, \quad N = 352.3 \text{ g} \]

\[ P = \left[ \frac{(632.6 \text{ g} + 97.6 \text{ g}/2)}{(632.6 \text{ g} + 97.6 \text{ g} + 352.3 \text{ g})} \right] \times 100 = 63\% \]

REPORT

Results shall be reported on standard forms approved for use by the agency. Report fracture to the nearest 1 percent.

Report the results using WSDOT Form 350-161 EF, 422-020X, or other report approved by the State Materials Engineer.
Performance Exam Checklist

**Determining the Percentage of Fracture In Coarse Aggregate**

**FOP for WAQTC TM 1**

<table>
<thead>
<tr>
<th>Participant Name</th>
<th>Exam Date</th>
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</table>

### Procedure Element

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
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<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Sample reduced to correct size?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Sample properly sieved through specified sieve(s)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Sample dried and cooled, if necessary?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Particles separated into fractured, unfractured, and questionable categories?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Dry mass of each category determined to nearest 0.1 g?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Calculation performed correctly?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First attempt: Pass □ Fail □  
Second attempt: Pass □ Fail □

Signature of Examiner __________________________________________

Comments:

____________________________________________________________________

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WSDOT FOP for AASHTO T 2\

Standard Practice for Sampling Aggregates

1. Scope

   1.1 This practice covers sampling of coarse and fine aggregates for the following purposes:

      1.1.1 Preliminary investigation of the potential source of supply,
      1.1.2 Control of the product at the source of supply,
      1.1.3 Control of the operations at the site of use, and
      1.1.4 Acceptance or rejection of the materials.

      Note 1: Sampling plans and acceptance and control tests vary with the type of construction
      in which the material is used. Attention is directed to Practices E 105 and D 3665.

   1.2 The values stated in inch-pounds units are to be regarded as the standard.

   1.3 This standard does not purport to address all of the safety concerns, if any, associated with
      its use. It is the responsibility of the user of this standard to establish appropriate safety
      and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

   2.1 AASHTO Standards:
      T 248 Reducing Samples of Aggregate to Testing Size

   2.2 ASTM Standards:
      C 702 Practice for Reducing Field Samples of Aggregate to Testing Size
      D 2234 Test Method for Collection of a Gross Sample of Coal
      D 3665 Practice for Random Sampling of Construction Materials
      E 105 Practice for Probability Sampling of Materials
      E 122 Practice for Choice of Sample Size to Estimate the Average Quality of a Lot or Process
      E 141 Practice for Acceptance of Evidence Based on the Results of Probability Sampling

3. Significance and Use

   3.1 Sampling is equally as important as the testing, and the sampler shall use every precaution to
      obtain samples that will show the nature and condition of the materials which they represent.

   3.2 Samples for preliminary investigation tests are obtained by the party responsible for
      development of the potential source (Note 2). Samples of materials for control of the
      production at the source or control of the work at the site of use are obtained by the
      manufacturer, contractor, or other parties responsible for accomplishing the work. Samples
      for tests to be used in acceptance or rejection decisions by the purchaser are obtained by the
      purchaser or his authorized representative.

---

1This FOP is based on AASHTO T 2-91 (2000).
Note 2: The preliminary investigation and sampling of potential aggregate sources and types occupies a very important place in determining the availability and suitability of the largest single constituent entering into the construction. It influences the type of construction from the standpoint of economics and governs the necessary material control to ensure durability of the resulting structure, from the aggregate standpoint. This investigation should be done only by a responsible trained and experienced person. For more comprehensive guidance, see the Appendix.

4. SECURING SAMPLES

4.1 General — Where practicable, samples to be tested for quality shall be obtained from the finished product. Samples from the finished product to be tested for abrasion loss shall not be subject to further crushing or manual reduction in particle size in preparation for the abrasion test unless the size of the finished product is such that it requires further reduction for testing purposes.

Native soils within the contract limits to be used for embankment construction and/or backfill material do not require the sampling by a qualified tester. For material that requires gradation testing such as but not limited to manufactured aggregates and Gravel Borrow, a qualified testers shall be required for sampling.

4.2 Inspection — The material shall be inspected to determine discernible variations. The seller shall provide suitable equipment needed for proper inspection and sampling.

4.3 Procedure

4.3.1 Sampling from a Flowing Aggregate Stream (Bins or Belt Discharge) — Select units to be sampled by a random method, such as Practice D3665, from the production. Obtain at least three approximately equal increments, selected at random from the unit being sampled, and combine to form a field sample whose mass equals or exceeds the minimum recommended in 4.4.2. Take each increment from the entire cross section of the material as it is being discharged. It is usually necessary to have a special device constructed for use at each plant. This device consists of a pan of sufficient size to intercept the entire cross section of the discharge stream and hold the required quantity of material without overflowing. A set of rails may be necessary to support the pan as it is passed under the discharge stream. Insofar as is possible, keep bins continuously full or nearly full to reduce segregation.

Note 3: Sampling the initial discharge or the final few tones from a bin or conveyor belt increases the chances of obtaining segregated material and should be avoided.

4.3.2 Sampling from the Conveyor Belt — Select units to be sampled by a random method, such as Practice D 3665, from the production. Obtain at least three approximately equal increments, selected at random, from the unit being sampled and combine to form a field sample whose mass equals or exceeds the minimum recommended in 4.4.2. Stop the conveyor belt while the sample increments are being obtained. Insert two templates, the shape of which conforms to the shape of the belt in the aggregate stream on the belt, and space them such that the material contained between them will yield an increment of the required weight. Carefully scoop all material between the templates into a suitable container and collect the fines on the belt with a brush and dust pan and add to the container.

4.3.3 Sampling from Stockpiles or Transportation Units — Avoid sampling coarse aggregate or mixed coarse and fine aggregate from stockpiles or transportation units whenever possible, particularly when the sampling is done for the purpose of determining aggregate properties that may be dependent upon the grading of the sample.
If circumstances make it necessary to obtain samples from a stockpile of coarse aggregate or a stockpile of combined coarse and fine aggregate, design a sampling plan for the specific case under consideration. This approach will allow the sampling agency to use a sampling plan that will give a confidence in results obtained therefrom that is agreed upon by all parties concerned to be acceptable for the particular situation. The sampling plan shall define the number of samples necessary to represent lots and sublots of specific sizes. General principles for sampling from stockpiles are applicable to sampling from trucks, rail cars, barges or other transportation units. For general guidance in sampling from stockpiles, see the Appendix.

4.3.4 Sampling from Roadway (Bases and Subbases) — This section has been deleted.

4.4 Number and Masses of Field Samples

4.4.1 The number of field samples (obtained by one of the methods described in 4.3) required depends on the criticality of, and variation in, the properties to be measured. Designate each unit from which a field sample is to be obtained prior to sampling. The number of field samples from the production should be sufficient to give the desired confidence in test results.

**Note 4:** Guidance for determining the number of samples required to obtain the desired level of confidence in test results may be found in Test Method D 2234, Practice E 105, Proactive E 122, and Practice E 141.

4.4.2 The field sample masses cited are tentative. The masses must be predicated on the type and number of tests to which the material is to be subjected and sufficient material obtained to provide for the proper execution of these tests. Standard acceptance and control tests are covered by ASTM standards and specify the portion of the field sample required for each specific test. Generally speaking, the amounts specified in Table 1 will provide adequate material for routine grading and quality analysis. Extract test portions from the field sample according to T 248 or as required by other applicable test methods.

5. SHIPPING SAMPLES

5.1 Transport aggregates in bags or other containers so constructed as to preclude loss or contamination of any part of the sample, or damage to the contents from bang during shipment.

5.2 Shipping containers for aggregate samples shall have suitable individual identification attached and enclosed so that field reporting, laboratory logging, and test reporting may be facilitated.

All samples submitted for testing to the region or State laboratories shall be accompanied by completed sample transmittal (WSDOT Form 350-056) or equivalent.
Table 1
Size of Samples

<table>
<thead>
<tr>
<th>Maximum Nominal Size of Aggregates*</th>
<th>Approximate Minimum Mass of Field Samples, kg*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fine Aggregate</strong></td>
<td></td>
</tr>
<tr>
<td>2.36 mm</td>
<td>10</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>10</td>
</tr>
<tr>
<td><strong>Coarse Aggregate</strong></td>
<td></td>
</tr>
<tr>
<td>9.5 mm</td>
<td>10</td>
</tr>
<tr>
<td>12.5 mm</td>
<td>15</td>
</tr>
<tr>
<td>19.0 mm</td>
<td>25</td>
</tr>
<tr>
<td>25.0 mm</td>
<td>50</td>
</tr>
<tr>
<td>37.5 mm</td>
<td>75</td>
</tr>
<tr>
<td>50 mm</td>
<td>100</td>
</tr>
<tr>
<td>63 mm</td>
<td>125</td>
</tr>
<tr>
<td>75 mm</td>
<td>150</td>
</tr>
<tr>
<td>90 mm</td>
<td>175</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal Maximum Size* in (mm)</th>
<th>Minimum Mass lb (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4 (4.75)</td>
<td>5 (2)</td>
</tr>
<tr>
<td>1/4 (6.3)</td>
<td>10 (4)</td>
</tr>
<tr>
<td>3/8 (9.5)</td>
<td>10 (4)</td>
</tr>
<tr>
<td>1/2 (12.5)</td>
<td>20 (8)</td>
</tr>
<tr>
<td>5/8 (16.0)</td>
<td>20 (8)</td>
</tr>
<tr>
<td>3/4 (19.0)</td>
<td>30 (12)</td>
</tr>
<tr>
<td>1 (25.0)</td>
<td>55 (25)</td>
</tr>
<tr>
<td>11/4 (31.5)</td>
<td>70 (30)</td>
</tr>
<tr>
<td>11/2 (37.5)</td>
<td>80 (36)</td>
</tr>
<tr>
<td>2 (50)</td>
<td>90 (40)</td>
</tr>
<tr>
<td>21/2 (63)</td>
<td>110 (50)</td>
</tr>
<tr>
<td>3 (75)</td>
<td>140 (60)</td>
</tr>
<tr>
<td>31/2 (90)</td>
<td>180 (80)</td>
</tr>
</tbody>
</table>

*For processed aggregate the nominal maximum size of particles is the largest sieve size listed in the applicable specification, upon which any material is permitted to be retained.

*For combined coarse and fine aggregates (for example, base or subbase) minimum weight shall be coarse aggregate minimum plus 10 kg.

**Note 5:** For an aggregate specification having a generally unrestrictive gradation (i.e. wide range of permissible upper sizes), where the source consistently fully passes a screen substantially smaller than the maximum specified size, the nominal maximum size, for the purpose of defining sampling and test specimen size requirements may be adjusted to the screen, found by experience to retain no more than 5% of the materials.
APPENDIXES (Nonmandatory Information)

XI. SAMPLING AGGREGATE FROM STOCKPILES OR TRANSPORTATION UNITS

X1.1 Scope

X1.1.1 In some situations it is mandatory to sample aggregates that have been stored in stockpiles or loaded into rail cars, barges, or trucks. In such cases the procedure should ensure that segregation does not introduce a serious bias in the results.

X1.2 Sampling From Stockpiles

X1.2.1 In sampling material from stockpiles it is very difficult to ensure unbiased samples, due to the segregation which often occurs when material is stockpiles, with coarser particles rolling to the outside base of the pile. For coarse or mixed coarse and fine aggregate, every effort should be made to enlist the services of power equipment to develop a separate, small sampling pile composed of materials drawn from various levels and locations in the main pile after which several increments may be combined to compose the field sample. If necessary to indicate the degree of variability existing within the main pile, separate samples should be drawn from separate areas of the pile.

X1.2.2 Where power equipment is not available, samples from stockpiles should be made up of at least three increments taken from the top third, at the mid-point, and at the bottom third of the volume of the pile. A board shoved vertically into the pile just above the sampling point aids in preventing further segregation. In sampling stockpiles of fine aggregate the outer layer, which may have become segregated, should be removed and the sample taken from the material beneath. Sampling tubes approximately 30-mm min by 2-m min in length may be inserted into the pile at random locations to extract a minimum of five increments of material to form the sample.

X1.3 Sampling From Transportation Units

X1.3.1 In sampling coarse aggregates from railroad cars or barges, effort should be made to enlist the services of power equipment capable of exposing the material at various levels and random locations. Where power equipment is not available, a common procedure requires excavation of three or more trenches across the unit at points that will, from visual appearance, give a reasonable estimate of the characteristics of the load. The trench bottom should be approximately level, at least 0.3 m in width and in depth below the surface. A minimum of three increments from approximately equally spaced points along each trench should be taken by pushing a shovel downward into the material. Coarse aggregate in trucks should be sampled in essentially the same manner as for rail cars or barges, except for adjusting the number of increments according to the size of the truck. For fine aggregate in transportation units, sampling tubes as described in X1.2 may be used to extract an appropriate number of increments to form the sample.
X2. EXPLORATION OF POTENTIAL AGGREGATE SOURCES

X2.1 Scope

X2.1.1 Sampling for evaluation of potential aggregate sources should be performed by a responsible trained and experienced person. Because of the wide variety of conditions under which sampling may have to be done it is not possible to describe detailed procedures applicable to all circumstances. This appendix is intended to provide general guidance and list more comprehensive references.

X2.2 Sampling Stone from Quarries of Ledges

X2.2.1 Inspection — The ledge or quarry face should be inspected to determine discernible variations or strata. Differences in color and structure should be recorded.

X2.2.2 Sampling and Size of Sample — Separate samples having a mass of at least 55 lbs (25 kg) should be obtained from each discernible stratum. The sample should not include material weathered to such an extent that it is no longer suitable for the purpose intended. One or more pieces in each sample should be at least 6 X 6 X 4 inch (150 by 150 by 100 mm) in size with the bedding plane plainly marked, and this piece should be free of seams or fractures.

X2.2.3 Record — In addition to the general information accompanying all samples the following information should accompany samples taken from ledges or quarry faces:

- X2.2.3.1 Approximate quantity available. (If quantities is very large this may be recorded as practically unlimited.)
- X2.2.3.2 Quantity and character of overburden.
- X2.2.3.3 A detailed record showing boundaries and location of material represented by each sample.

Note X2.1: A sketch, plan, and elevation, showing the thickness and location of the different layers is recommended for this purpose.

X2.3 Sampling Roadside or Bank Run Sand and Gravel Deposits

X2.3.1 Inspection — Potential sources of bank run sand and gravel may include previously worked pits from which there is an exposed face or potential deposits discovered through air-photo interpretation, geophysical exploration, or other types of terrain investigation.

X2.3.2 Sampling — Samples should be so chosen from each different stratum in the deposit discernible to the sampler. An estimate of the quantity of the different materials should be made. If the deposit is worked as an open-face bank or pit, samples should be taken by channeling the face vertically, bottom to top, so as to represent the materials proposed for use. Overburdened or disturbed material should not be included in the sample. Test holes should be excavated or drilled at numerous locations in the deposit to determine the quality of the material and the extent of the deposit beyond the exposed face, if any. The number and depth of test holes will depend upon the quantity of the material needed, topography of the area, nature of the deposit, character of the material, and potential value of the material in the deposit. If visual inspection indicates that there is considerable variation in the material, individual samples should be selected from the material in each well defined stratum. Each sample should be thoroughly mixed and quartered if necessary so that the field sample thus obtained will be at least 25 lb (12 kg) for sand and 75 lb (35 kg) if the deposit contains an appreciable amount of coax aggregate.
X2.3.3 Record — In addition to the general information accompanying all samples the following information should accompany samples of bank run sand and gravel:

X2.3.3.1 Location of supply.
X2.3.3.2 Estimate of approximate quantity available.
X2.3.3.3 Quantity and character of overburden.
X2.3.3.4 Length of haul to proposed site of work.
X2.3.3.5 Character of haul (kind of road, maximum grades, etc.)
X2.3.3.6 Details as to extent and location of material represented by each sample.
## Performance Exam Checklist

**Sampling of Aggregates**  
**FOP for AASHTO T 2**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**General**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Samples taken in at least three increments?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. Increments mixed thoroughly to form sample?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Conveyor Belts – Method A**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Belt stopped?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. Sampling device set on belt, avoiding intrusion of adjacent material?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. Sample, including all fines, scooped off?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Conveyor Belts – Method B**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Container passed through full stream of material as it runs off end of belt? (Automatic Sampler Only)</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Transport Units**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Three or more trenches cut across the unit?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9. Trench bottom level and approximate 1 foot wide and 1 foot below surface of material in unit?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10. Three samples taken at equal spacing along each trench?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Stockpiles**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Created vertical face, if one does not exist?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12. At least three increments taken, at various levels along vertical face?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Procedure Element**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. If vertical face cannot be created, increment taken from at least three locations from top, middle, and bottom?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14. When sampling sand, outer layer removed and increments taken from at least five locations?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

First attempt:  Pass ☐  Fail ☐  
Second attempt:  Pass ☐  Fail ☐

Signature of Examiner ________________________________
SAMPLING FRESHLY MIXED CONCRETE  
FOP FOR WAQTC TM 2

SIGNIFICANCE

Testing fresh concrete in the field begins with obtaining and preparing the sample to be tested. Standardized procedures for obtaining a representative sample from various types of mixing and/or agitating equipment have been established. Specific time limits regarding when tests for temperature, slump, and air content must be started and for when the molding of test specimens must begin are also established.

Technicians must be patient and refrain from obtaining the sample too quickly. Doing so would be a violation of the specifications under which the concrete is being supplied and it may result in a nonrepresentative sample of concrete. If one considers that the specifications may require strength tests to be made only once every 50 cy (40 m$^3$), the need for a truly representative sample is apparent. The minimum 1 ft$^3$ (0.03 m$^3$) sample from which the compressive strength test specimens will be made represents only 0.07 to 0.08 percent of the total quantity of concrete placed. For this reason, every precaution must be taken to obtain a sample that is truly representative of the entire batch and then to protect that sample from the effects of evaporation, contamination, and physical damage.

SCOPE

This procedure provides instruction for obtaining samples of fresh concrete in accordance with WAQTC TM 2. Sources covered include stationary and paving mixers, revolving drum truck mixers or agitators, open-top truck mixers and the discharge of pump or conveyor placement systems.

APPARATUS

- Wheelbarrow
- Cover for wheelbarrow (plastic, canvas, or burlap)
- Shovel
- 5 gal (19 L) bucket for water

PROCEDURE

Use every precaution in order to obtain samples representative of the true nature and condition of the concrete being placed being careful not to obtain samples form the very first or very last portions of the batch. The size of the sample will be 1.5 times the volume of concrete required for the specified testing, but not less than 1 ft$^3$ (0.03 m$^3$).

RANDOM SAMPLE SELECTION

Concrete samples other than initial load samples or samples for questioned acceptance will be taken from each subplot by a random selection. Sublots are determined by the designated sampling frequency in the Standard Specifications. Random selection will be accomplished by using WSDOT Test Method T716, Method of Random Sampling for Locations of Testing and Sampling Sites

- Sampling from stationary mixers, except paving mixers

Sample the concrete after a minimum of 1/2 yd$^3$ (1/2 m$^3$) of concrete has been discharged. Perform sampling by passing a receptacle completely through the discharge stream, or by completely diverting the discharge into a sample container. If discharge of
the concrete is too rapid to divert the complete discharge stream, discharge the concrete into a container or transportation unit sufficiently large to accommodate the entire batch and then accomplish the sampling in the same manner as given above. Take care not to restrict the flow of concrete from the mixer, container, or transportation unit so as to cause segregation. These requirements apply to both tilting and nontilting mixers.

- **Sampling from paving mixers**
  Sample after the contents of the paving mixer have been discharged. Obtain material from at least five different locations in the pile and combine into one test sample. Avoid contamination with subgrade material or prolonged contact with absorptive subgrade. To preclude contamination or absorption by the subgrade, sample the concrete by placing a shallow container on the subgrade and discharging the concrete across the container. The container shall be of a size sufficient to provide a sample size that is in agreement with the nominal maximum aggregate size.

- **Sampling from revolving drum truck mixers or agitators**
  Sample the concrete after a minimum of 1/2 yd³ (1/2 m³) of concrete has been discharged. Do not obtain samples until after all of the water has been added to the mixer. Do not obtain samples from the very first or last portions of the batch discharge. Sample by repeatedly passing a receptacle through the entire discharge stream or by completely diverting the discharge into a sample container. Regulate the rate of discharge of the batch by the rate of revolution of the drum and not by the size of the gate opening.

- **Sampling from open-top truck mixers, agitators, non-agitating equipment or other types of open-top containers**
  Sample by whichever of the procedures described above is most applicable under the given conditions.

- **Sampling from pump or conveyor placement systems**
  Sample after a minimum of 1/2 yd³ (1/2 m³) of concrete has been discharged. Do not obtain samples until after all of the pump slurry has been eliminated. Sample by repeatedly passing a receptacle through the entire discharge system or by completely diverting the discharge into a sample container. Do not lower the pump arm from the placement position to ground level for ease of sampling, as it may modify the air content of the concrete being sampled. Do not obtain samples from the very first or last portions of the batch discharge.

Transport samples to the place where fresh concrete tests are to be performed and specimens are to be molded. They shall then be combined and remixed with a shovel the minimum amount necessary to ensure uniformity. Protect the sample from direct sunlight, wind, rain, and sources of contamination.

Complete test for temperature and start tests for slump and air content within 5 minutes of obtaining the sample. Complete tests as expeditiously as possible. Start molding specimens for strength tests within 15 minutes of obtaining the sample.
Performance Exam Checklist

Sampling Freshly Mixed Concrete
FOP for WAQTC TM 2

Participant Name __________________________________________ Exam Date ______________

Procedure Element

1. The tester has a copy of the current procedure on hand? Yes No

2. Obtain a representative sample:
   a. Sample the concrete after ½ cy (½ m³) discharged? Yes No
   b. Pass receptacle through entire discharge stream or completely divert discharge stream into sampling container? Yes No
   c. Transport samples to place of testing? Yes No
   d. Sample remixed? Yes No
   e. Sample protected? Yes No
   f. Minimum size of sample used for strength tests 1 ft³ (0.03 m³)? Yes No

3. Start tests for slump and air within 5 minutes of sample being obtained? Yes No

4. Start molding cylinders within 15 minutes of sample being obtained? Yes No

5. Protect sample against rapid evaporation and contamination? Yes No

First attempt: Pass □ Fail □  Second attempt: Pass □ Fail □

Signature of Examiners __________________________________________

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Comments:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
MOISTURE CONTENT OF BITUMINOUS MIXES BY OVEN
FOP FOR WAQTC TM 6

SIGNIFICANCE

Even though aggregate used in bituminous mixes is heated and dried at high temperatures, some types of rock retain moisture. The moisture content of the mix must be known in order to correctly determine the asphalt cement binder content of the mix. Moisture (water) in the mix will yield erroneously high binder content values whether binder content is determined by the nuclear content gauge or ignition furnace method.

SCOPE

This procedure covers the determination of moisture content of bituminous mixes in accordance with WAQTC TM 6.

BACKGROUND ON TEST METHOD

The standard for WSDOT is to determine asphalt content as a percent of initial mass of bituminous mixture. A test sample of bituminous mix is dried in an oven. The moisture content is calculated by one of two methods depending upon agency standards:

- When binder content is reported as a percent of the initial mass of bituminous mix, moisture content is reported as a percent of the initial, moist mass of mix.
- When binder content is reported as a percent of the mass of aggregate, moisture content is reported as a percent of the final, dry mass of mix.

APPARATUS

- Balance or scale: minimum 2 kg capacity, readable to 0.1 g conforming to AASHTO T-231
- Forced Air, Ventilated, or Convection Oven: Capable of maintaining the temperature surrounding the sample at 325 ±25°F (163 ±14°C)
- Sample Container: Clean, dry, not affected by heat and of sufficient size to contain a test sample without danger of spilling
- Temperature Measuring Device – The temperature measuring device shall be capable of measuring the temperature of the hot mix asphalt throughout the entire temperature range likely to be encountered. Thermometer with a temperature range of 10-260°C (50-500°F)

SAMPLE

The test sample shall be obtained in accordance with AASHTO T 168, and reduced in accordance with AASHTO T 248, Method B. The size of the test sample shall be a minimum of 500 g.

The test sample shall be obtained in accordance with FOP for AASHTO T 168, and reduced in accordance with WSDOT Test Method 712. The size of the test sample shall be a minimum of 500 g.

PROCEDURE

1. Set the oven to 325± 25°F (163±13.8 °C) a minimum of 105 ±5°C (221 ±9°F). In no case should the Job Mix Formula (JMF) mixing temperature be exceeded.
2. Determine and record the mass of the sample container to the nearest 0.1 g.
3. Place the test sample in the sample container, and record the temperature of the test sample.

4. Remove the thermometer from the sample. Determine and record the total mass of the sample container and test sample to the nearest 0.1g.

5. Calculate the initial, moist mass of the test sample by subtracting the mass of the sample container determined in Step 2 from total mass of the sample container and the test sample determined in Step 4.

6. Dry the test sample to a constant mass in the sample container.

   **Note 1:** Constant mass shall be defined as the mass at which further drying does not alter the mass by more than 0.1 percent. The sample shall be initially dried 90 minutes, and its mass determined at that time and at 30-minute intervals after that until a constant mass is reached.

7. Cool the sample container and test sample to approximately the same temperature as determined in Step 3.

8. Determine and record the total mass of the sample container and test sample to the nearest 0.1 g.

   **Note 2:** Do not attempt to remove the test sample from the sample container for the purposes of determining mass.

9. Calculate the final, dry mass of the test sample by subtracting the mass of the sample container determined in Step 2 from the total mass of the sample container and the test sample determined in Step 8.

   **Note 3:** Moisture content and the number of samples in the oven will affect the rate of drying at any given time. Placing wet samples in the oven with nearly dry samples could affect the drying process.

**CALCULATIONS**

Moisture Content:

Calculate the moisture content, as a percent, using one of the following two formulas.

**Percent of Initial, Moist Mass:**

\[
\text{Moisture Content} = \frac{M_i - M_f}{M_i} \times 100
\]

where

- \( M_i \) = initial, moist mass
- \( M_f \) = final, dry mass

**Example:**

\[
M_i = 541.2 \text{ g} \\
M_f = 536.0 \text{ g}
\]

\[
\text{Moisture Content} = \frac{541.2 \text{ g} - 536.0 \text{ g}}{541.2 \text{ g}} \times 100 = 0.961, \text{ say 0.96%}
\]

**REPORT**

Results shall be reported on standard forms approved for use by the agency. Report moisture content to 0.01 percent.

Report the moisture content on DOT Form 350-560EF or other report approved by the State Materials Engineer.
Performance Exam Checklist

Moisture Content of Bituminous Mixes By Oven
FOP for WAQTC TM 6

Participant Name ________________________________ Exam Date ________________

Procedure Element
1. The tester has a copy of the current procedure on hand? Yes No
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present? Yes No

Test for Moisture
1. Representative sample obtained; 500 g minimum? Yes No
2. Mass of sample determined to nearest 0.1 g? Yes No
3. Initial temperature recorded? Yes No
4. Sample placed in drying oven for a minimum of 90 minutes? Yes No
5. Sample dried to a constant weight at 325 ±25°F? Yes No
6. Sample and container cooled to approximately the initial temperature before mass determined? Yes No
7. Calculation of moisture content performed correctly? Yes No

% Moisture as percent of Wet Mass

\[
\frac{M_i - M_f}{M_i} \times 100
\]

First attempt: Pass ☐ Fail ☐ Second attempt: Pass ☐ Fail ☐

Signature of Examiner ________________________________

Comments:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
IN-PLACE DENSITY OF BITUMINOUS MixES USING THE NUCLEAR MOISTURE-DENSITY GAUGE
FOP FOR WAQTC TM 8

SIGNIFICANCE
The final in-place density of roadway pavement is critical to the quality and longevity of a highway project. Low density material will lead to excessive deflection under load and/or permanent deformation.

This procedure provides a rapid, nondestructive technique for determining the in-place density of compacted bituminous mixes. It can be used to establish the proper rolling effort and pattern to achieve the required density. The non-destructive nature of the test allows repetitive measurements to be made at a single test location between roller passes.

SCOPE
This procedure covers the determination of density of bituminous mixes in accordance with WAQTC TM 8. Direct transmission and backscatter methods are covered. Correlation with densities determined under the FOP for AASHTO T 166 is required by some agencies.

All operators will be trained in radiation safety prior to operating nuclear density gauges. Some agencies WSDOT requires the use of personal monitoring devices such as a thermoluminescent dosimeter or film badge which is monitored on a quarterly basis.

APPARATUS
• Nuclear density gauge with the factory matched standard reference block.
• Drive pin, guide, scraper plate, and hammer for testing in direct transmission mode.
• Transport case for properly shipping and housing the gauge and tools.
• Instruction manual for the specific make and model of gauge.
• Radioactive materials information and calibration packet containing:
  – Daily Standard Count Log
  – Factory and Laboratory Calibration Data Sheet
  – Leak Test Certificate
  – Shippers Declaration for Dangerous Goods
  – Procedure Memo for Storing, Transporting and Handling Nuclear Testing Equipment
  – Other radioactive materials documentation as required by local regulatory requirements.

MATERIAL
• Filler material: Fine graded sand from the source used to produce the asphalt pavement or other agency approved materials.

CALIBRATION AND STANDARDIZATION
1. WSDOT has deleted this section. WSDOT determines the standard count as listed in the manufacturer’s Operators Manual.
PROCEDURE

The standard for WSDOT is to run density tests in “Direct Transmission mode.” When the depth of Hot Mix Asphalt is less than 0.11 foot or when the driving of the drive pin is not possible to achieve the required depth for the gauge probe (i.e., underlying concrete) then a “Thin Lift Density gauge” or a Moisture Density Gauge in the “Thin Layer mode” will be allowed.

1. Turn the gauge on and allow it to stabilize according to the manufacturer’s recommendations for 10 to 20 minutes prior to use, and leave the power on during the day’s testing.

2. Standardize the gauge by performing standard counts as listed in the manufacturer’s Operators Manual.

2. Standardize the gauge by performing standard counts as covered in Step 2 above under Calibration and Standardization.

Note 2: New standard counts may be necessary more than once a day. See agency requirements.

3. Select a test location(s) in accordance with the project specifications. Test sites should be relatively smooth and flat. The gauge should not be used within 1.5 ft. (450 mm) of any vertical mass, or from a vertical pavement edge.

3. Select a test location(s) in accordance with the project specifications. Test sites should be relatively smooth and flat. If the gauge will be closer than 600 mm (24 in.) to any vertical mass, or less than 300 mm (12 in.) from a vertical pavement edge, use the gauge manufacturer’s correction procedure.

4. Maintain maximum contact between the base of the gauge and the surface of the material under test.

4. Maintain maximum contact between the base of the gauge and the surface of the material under test. Use filler material to fill surface voids. Spread a small amount of filler material over the test site surface and distribute it evenly. Strike off the surface with a straight edge guide or scraper plate, and remove excess material.

5. Mark the outline or footprint of the gauge with a crayon.

6. Direct transmission mode
   a. Use the guide and scraper plate as a template and drill a hole to a depth of at least 0.3 in. (7 mm) deeper than the measurement depth required for the gauge.
   b. Place the gauge on the prepared surface so the source rod can enter the hole. Insert the probe in the hole and lower the source rod to the desired test depth using the handle and trigger mechanism.

   Pull the gauge so that the probe is firmly against the side of the hole.

6. Direct transmission mode
   b. Place the gauge on the test site and extend the probe to a depth not to exceed the thickness of the lift of pavement being measured. Pull the gauge so that the probe is firmly against the side of the hole.

   Note: If the depth of the pavement lift under test is less than the depth of measurement of the gauge, the test count must be adjusted.
c. Take a one-minute test and record the wet density (WD) readings. Rotate the gauge 90 degrees. Reset the gauge by gently moving it side to side while pulling back. Take another one-minute test and record. If the two density readings are not within 3 lbs/ft$^3$ (50 kg/m$^3$) of each other see note 3.

Note 3: If two readings are not within tolerances stated, rotate gauge 90° and retest. Again compare both readings. If these reading are still not within tolerances stated move to another location to perform test.

7. Backscatter mode
   a. Place the gauge on the test site and extend the probe to the backscatter position.
   b. Take tests in accordance with manufacturer’s recommendation.
   c. Take a one-minute test and record. Rotate the gauge 90 degrees about the probe.
   d. Take another one-minute test and record.

   Note 4: If the difference between the two one minute tests is greater than 40 kg/m$^3$ (2.5 lb/ft$^3$), retest in both directions.

CALCULATION OF RESULTS

See WSDOT SOP 729 to determine the percent compaction. It should be stressed that the numbers obtained with the nuclear gauge are simply in-place densities and tell the operator nothing in regard to relative compaction. In-place densities are to be compared with theoretical maximum density as determined by the FOP for AASHTO T 209.

The density reported for each test site shall be the average of the two individual one-minute tests.

Percent compaction is determined by comparing the in-place wet density as determined by this method to the appropriate agency density standard. See appropriate agency policy for use of density standards.

CORRELATION WITH CORES

WSDOT has deleted this section, refer to WSDOT SOP 730.

REPORT

Report the test results for each sublot on WSDOT Form 350-092 or other report approved by the State Materials Engineer.

Results shall be reported on standard forms approved by the agency. Include the following information:

- Location of test and thickness of layer tested
- Mixture type
- Make, model and serial number of the nuclear moisture-density gauge
- Mode of measurement, depth, calculated wet density of each measurement and any adjustment data
- Standard density
- Percent compaction and/or percent air voids
- Name and signature of operator
### Tester Qualification Practical Exam Checklist

**In-place Density of Bituminous Mixes Using the Nuclear Moisture-Density Gauge FOP for WAQTC TM 8**

<table>
<thead>
<tr>
<th>Participant Name</th>
<th>Exam Date</th>
</tr>
</thead>
</table>

**Procedure Element**

<table>
<thead>
<tr>
<th>1. The tester has a copy of the current procedure on hand?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gauge turned on?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gauge calibrated and standard count recorded?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test location selected appropriately?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Transmission Mode:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Hole made ¼ inch deeper than measurement depth?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Gauge placed, probe extended, gauge pulled back so probe against hole?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. One-minute test made; gauge rotated 90°; another one-minute test made?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Wet densities averaged?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backscatter Mode:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Gauge placed, probe extended to backscatter position?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. One-minute test made; gauge rotated 90°; another one-minute test made?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Densities averaged?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If difference greater than 3 lb/ft³, retest made?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All calculations performed correctly?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First attempt:  Pass [ ] Fail [ ]  Second attempt:  Pass [ ] Fail [ ]

Signature of Examiner ________________________________

Comments:

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
WSDOT FOP for AASHTO T 23

Making and Curing Concrete Test Specimens in the Field

1. SCOPE

1.1 This method covers procedures for making and curing cylinder and beam specimens using job concrete that can be consolidated by rodding or vibration as described herein.

1.2 The concrete used to make the molded specimens shall be sampled after all on-site adjustments have been made to the mixture proportions, including the addition of mix water and admixtures, except as modified in Section 5.1. This practice is not satisfactory for making specimens from concrete not having measurable slump or requiring other sizes or shapes of specimens.

1.3 The values stated in English units are to be regarded as the standard. The metric equivalent given in the standard may be approximate.

1.4 This standard does not purport to address the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1 AASHTO Standards

M 195, Lightweight Aggregates for Structural Concrete
M 201 Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
M 205 Molds for Forming Concrete Test Cylinders Vertically
T 119 Slump of Hydraulic Cement Concrete
T 126 Making and Curing Concrete Test Specimens in the Laboratory
T 141 Sampling Freshly Mixed Concrete
T 152 Air Content of Freshly Mixed Concrete by the Pressure Method
T 196 Air Content of Freshly Mixed Concrete by the Volumetric Method
T 197, Time of Setting of Concrete Mixtures by Penetration Resistance
T 231 Capping Cylindrical Concrete Specimens
T 309 Temperature of Freshly Mixed Portland-Cement Concrete

Other Documents:

309 R, Guide for Consolidation of Concrete
CP-1, Concrete Field Testing Technician, Grade 1

3. SIGNIFICANCE AND USE

3.1 This practice provides standardized requirements for making, curing, protecting, and transporting concrete test specimens under field conditions.

3.2 If the specimens are made and standard cured, as stipulated here, the resulting strength test data where the specimens are tested are able to be used for the following purposes:

1 This FOP is based on AASHTO T 23-02
3.2.1 Acceptance testing for specified strength,
3.2.2 Checking the adequacy of laboratory mixture proportions for strength, and
3.2.3 Quality Control.

3.3 If the specimens are made and field cured, as stipulated herein, the resulting strength test data when the specimens are tested are able to be used for the following purposes:

3.3.1 Determination of whether a structure is capable of being put in service.
3.3.2 Comparison with test results of standard cured specimens or with test results from various in-place test methods,
3.3.4 Adequacy of curing and protection of concrete in the structure, or,
3.3.5 Form or shoring removal time requirements,

4. APPARATUS

4.1 Molds, General — Molds for specimens or fastenings thereto in contact with the concrete shall be made of steel, cast iron, or other nonabsorbent material, non-reactive with concrete containing portland or other hydraulic cements. Molds shall hold their dimensions and shape under all conditions of use. Reusable Molds shall be watertight during use as judged by their ability to hold water poured into them. Provisions for tests of water tightness are given in Section 6 of Specification M 205. A suitable sealant, such as heavy grease, modeling clay, or microcrystalline wax shall be used where necessary to prevent leakage through the joints. Positive means shall be provided to hold base plates firmly to the molds. Molds shall be lightly coated with mineral oil or a suitable non-reactive form release material before use.

4.2 Cylinder:

4.2.1 Molds for Casting Specimens Shall come from an approved shipment as verified by the Quality Systems Manual Verification Procedure No. 2.

4.3 Beam Molds — Beam molds shall be of the shape and dimensions required to produce the specimens stipulated in Section 5.2. The inside surfaces of the molds shall be smooth. The sides, bottom, and ends shall be at right angles to each other and shall be straight and true and free of warpage. Maximum variation from the nominal cross section shall not exceed \( \frac{1}{8} \) in. [3 mm] for molds with depth or breadth of 6 in. [152 mm] or more. Molds shall produce specimens at least as long but not more than \( \frac{1}{16} \) in. [2 mm] shorter than the required length in accordance with Section 5.2, but may exceed it by more than that amount.

4.4 Tamping Rod — Two sizes are specified as indicated in Table 1. Each shall be a round, straight steel rod with at least the tamping end rounded to a hemispherical tip of the same diameter as the rod. Both ends may be rounded if preferred.
Table 1—Tamping Rod Requirements

<table>
<thead>
<tr>
<th>Diameter of Cylinder or Width of Beam, in (mm.)</th>
<th>Rod Dimensions</th>
<th>Diameter, in (mm.)</th>
<th>Length of Rod, in (mm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6 (150)</td>
<td></td>
<td>⅛ (10)</td>
<td>12 (300)</td>
</tr>
<tr>
<td>6 (150)</td>
<td></td>
<td>⅜ (16)</td>
<td>20 (500)</td>
</tr>
<tr>
<td>9 (225)</td>
<td></td>
<td>⅝ (16)</td>
<td>26 (650)</td>
</tr>
</tbody>
</table>

a Rod tolerances length 100 mm (±4 in.) and diameter 2 mm (±1/16 in).

4.4.1 Large Rod — ⅝ in. (16 mm) in diameter and approximately 24 in. [610 mm] long.

4.4.2 Small Rod — ⅜ in. [10 mm] in diameter and approximately 12 in. [305 mm] long.

4.5 Vibrators — Internal vibrators shall be used. The vibrator frequency shall be at least 7,000 vibrations per minute (150 Hz) while the vibrator is operating in the concrete. The diameter of a round vibrator shall be no more than one-fourth the diameter of the cylinder mold or one-fourth the width of the beam mold. Other shaped vibrators shall have a perimeter equivalent to the circumference of an appropriate round vibrator. The combined length of the vibrator shaft and vibrating element shall exceed the depth of the section being vibrated by at least 3 in. (75 mm). The vibrator frequency shall be checked periodically.

Note 1—For information on size and frequency of various vibrators and a method to periodically check vibrator frequency, see ACI 309.

4.6 Mallet — A mallet with a rubber or rawhide head weighing 1.25 ± 0.50 lb [0.57 ± 0.23 kg] shall be used.

4.7 Small Tools — Tools and items that may be required are shovels, pails, trowels, wood float, metal float, blunted trowels, straightedge, feeler gauge, scoops, and rules.

4.8 Slump Apparatus — The apparatus for measurement of slump shall conform to the requirements of T 119.

4.9 Sampling and Mixing Receptacle — The receptacle shall be a suitable heavy gage metal pan, wheelbarrow, or flat, clean non-absorbent mixing board of sufficient capacity to allow easy remixing of the entire sample with a shovel or trowel.

4.10 Air Content Apparatus — The apparatus for measuring air content shall conform to the requirements of T 196 or T 152.

4.11 Temperature Measuring Devices—The temperature measuring devices shall conform to the applicable requirements of Test Method T 309.

5. TESTING REQUIREMENTS

Testing for determining the compressive strength at 28 days shall require a set of two specimens made from the same sample.

Testing for compressive strength at ages less than 28 days, a single cylinder specimen for each test age will be sufficient.
5.1 **Cylindrical Specimens** — Compressive strength cylindrical specimens shall be cylinders of concrete cast and allowed to set in an upright position, with a length equal to twice the diameter. The standard specimen shall be the 6 by 12-in. (150 by 300-mm) cylinder when the maximum size of the coarse aggregate does not exceed 2 in. (50 mm). When the maximum size of the coarse aggregate does exceed 2 in. [50 mm], either the concrete sample shall be treated by wet sieving as described in T 141 or the diameter of the cylinder shall be at least three times the nominal maximum size of coarse aggregate in the concrete. When the maximum size of coarse aggregate does not exceed 1 in. (25 mm) the specimens may be made with 4 by 8-in. (100 by 200-mm) cylinders.

5.2 **Flexural Strength Specimens** — Flexural strength specimens shall be beams of concrete cast and allowed to set in an upright position with long axes horizontal. The length shall be at least 2 in. [50 mm] greater than three times the depth as tested. The ratio of width to depth as molded shall not exceed 1.5. The standard beam shall be 6 by 6 in. [150 by 150 mm] in cross section and shall be used for concrete with nominal maximum size coarse aggregate up to 2 in. [50 mm]. When the nominal maximum size of the coarse aggregate exceeds 2 in. [50 mm], the smaller cross sectional dimension of the beam shall be at least three times the nominal maximum size of the coarse aggregate. Unless required by project specifications, beams made in the field shall not have a width or depth of less than 6 in. [150 mm].

Refer to WSDOT Test Method T 808

6. **SAMPLING CONCRETE**

6.1 The samples used to fabricate test specimens under this standard shall be obtained in accordance with T 144 FOP for WAQTC TM-2 unless an alternative procedure has been approved.

6.2 Record the identification of the sample with respect to the location of the concrete represented and the time of casting.

7. **SLUMP, AIR CONTENT, AND TEMPERATURE**

7.1 **Slump** — Measure and record the slump of each batch of concrete from which specimens are made immediately after remixing in the receptacle, as required in FOP FOR AASHTO T 119.

7.2 **Air Content** — Determine the air content in accordance with either FOP for AASHTO T 152 or FOP for AASHTO T 196. The concrete used in performing the air content test shall not be used in fabricating test specimens.
7.3 Temperature — Determine and record the temperature in accordance with FOP for AASHTO T 309.

Note 4—Some specifications may require the measurement of the unit weight of concrete. The volume of concrete produced per batch may be desired on some projects. Also, additional information on the air content measurements may be desired. Test Method T 121 is used to measure the unit weight, yield, and gravimetric air content of freshly mixed concrete.

8. MOLDING SPECIMENS

8.1 Place of Molding — Mold specimens promptly on a level, rigid horizontal surface, free of vibration and other disturbances, at a place as near as practicable to the location where they are to be stored.

8.2 Placing the Concrete — Place the concrete in the mold using a scoop, blunted trowel, or shovel. Select each scoopful, trowelful, or shovelful of concrete from the mixing pan to ensure that it is representative of the batch. Remix the concrete in the mixing pan with a shovel or trowel to prevent segregation during the molding of specimens. Move the scoop, trowel, or shovel around the perimeter of the mold opening when adding concrete so the concrete is uniformly distributed within each layer with a minimum of segregation. Further distribute the concrete by use of the tamping rod prior to the start of consolidation. In placing the final layer, the operator shall attempt to add an amount of concrete that will exactly fill the mold after consolidation. Underfilled molds shall be adjusted with representative concrete during consolidation of the top layer. Overfilled molds shall have excess concrete removed.

8.2.1 Number of Layers — Make specimens in layers as indicated in Table 2 or 3.

Table 2—Molding Requirements by Rodding

<table>
<thead>
<tr>
<th>Specimen Type and Size</th>
<th>Number of Layers of Approximately Equal Depth</th>
<th>Number of Roddings per Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinders:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter, mm (in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 (4)</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>150 (6)</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>225 (9)</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>Beams:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width, mm (in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150 (6) to 200 (8)</td>
<td>2</td>
<td>See 8.3.2</td>
</tr>
<tr>
<td>200 (&gt;8)</td>
<td>3 or more equal depths, each not to exceed 150 mm (6 in.)</td>
<td>See 8.3.2</td>
</tr>
</tbody>
</table>
Table 3—Molding Requirements by Vibration

<table>
<thead>
<tr>
<th>Specimen Type and Size</th>
<th>Number of Layers</th>
<th>Number of Vibrator Insertions per Layer</th>
<th>Approximate Depth of Layer, mm (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinders:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter, mm (in.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 (4)</td>
<td>2</td>
<td>1</td>
<td>one-half depth of specimen</td>
</tr>
<tr>
<td>150 (6)</td>
<td>2</td>
<td>2</td>
<td>one-half depth of specimen</td>
</tr>
<tr>
<td>225 (9)</td>
<td>2</td>
<td>4</td>
<td>one-half depth of specimen</td>
</tr>
<tr>
<td>Beams:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width, mm (in.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150 (6) to 200 (8)</td>
<td>1</td>
<td>See 8.4.2</td>
<td>depth of specimen 200 (8) as near as practicable</td>
</tr>
<tr>
<td>over 200 (8)</td>
<td>2 or more</td>
<td>See 8.4.2</td>
<td>depth of specimen 200 (8) as near as practicable</td>
</tr>
</tbody>
</table>

8.2.2 Select the proper tamping rod from 4.4 and Table 1 or the proper vibrator from 4.5. If the method of consolidation is rodding, determine molding requirements from Table 2. If the method of consolidation is vibration, determine molding requirements from Table 3.

8.3 Consolidation:

8.3.1 Method of Consolidation — Preparation of satisfactory specimens require different methods of consolidation. The methods of consolidation are rodding and vibration. Base the selection of the method of consolidation on slump, unless the method is stated in the specifications under which the work is being performed. Rod or vibrate concretes with slumps greater than 1 in. (25 mm). Vibrate concretes with slumps less than or equal to 1 in. (25 mm). Concretes of such low water content that they cannot be properly consolidated by the method herein, or requiring other sizes and shapes of specimens to represent the product or structure, are not covered by this method. Specimens for such concretes shall be made in accordance with the requirements of Method T 126 with regards to specimen size and shape and method of consolidation.

8.3.2 Rodding — Place the concrete in the mold, in the required number of layers of approximately equal volume. Rod each layer with the rounded end of the rod using the required number of roddings specified in Table 2 or 3. The number of roddings per layer required for beams is one for each 2 in² (13 cm²) top surface area of the specimen. Rod the bottom layer throughout its depth. Distribute the strokes uniformly over the cross section of the mold. After each layer is rodded, tap the outsides of the mold lightly 10 to 15 times with the mallet, to close any holes left by rodding and to release any large air bubbles that may have been trapped. Use an open hand to tap light-gage single-use molds which are susceptible to damage if tapped with a mallet. After tapping, spade each layer of the concrete along the sides and ends of beam molds with a trowel or other suitable tool.

8.3.3 Vibration — Maintain a uniform time period for duration of vibration for the particular kind of concrete, vibrator, and specimen mold involved. The duration of vibration required will depend upon the workability of the concrete and the effectiveness of the vibrator. Usually, sufficient vibration has been applied as soon as the surface of the concrete has become relatively smooth and large air bubbles cease to break through the top surface. Continue vibration only long enough to achieve proper consolidation of the concrete. (See Note 5.) Fill the molds and vibrate in the required number of approximately equal layers. Place all the concrete
for each layer in the mold before starting vibration of that layer. Compacting the specimen, insert the vibrator slowly and do not allow it to rest on the bottom or sides of the mold. Slowly withdraw the vibrator so that no large air pockets are left in the specimen. When placing the final layer, avoid overfilling by more than 1/4 in. (6 mm).

Note 2—Generally, no more than 5 s of vibration should be required for each insertion to adequately consolidate concrete with a slump greater than 3 in. (75 mm). Longer times may be required for lower slump concrete, but the vibration time should rarely have to exceed 10 s per insertion.

8.3.3.1 Cylinders — The number of insertions of a vibrator at per layer is given in Table 3. When more than one insertion per layer is required, distribute the insertion uniformly within each layer. Allow the vibration to penetrate through the layer being vibrated, and into the layer below, approximately 1 in. (25 mm). After each layer is vibrated, tap the outsides of the mold at least 10 times with the mallet, to close holes left by vibrating and to release entrapped air voids. Use an open hand to tap cardboard and single-use metal molds, that are susceptible to damage if tapped with a mallet.

8.3.3.2 Beam — Insert the vibrator at intervals not exceeding 6 in. [150 mm] along the centerline of the long dimension of the specimen. For specimens wider than 6 in., use alternating insertions along two lines. Allow the shaft of the vibrator to penetrate into the bottom layer approximately 1 in. (25 mm). After each layer is vibrated, tap the outsides of the mold lightly at least 10 times with the mallet, to close holes left by vibrating and to release entrapped air voids.

8.4 Finishing — After consolidation, strike off excess concrete from the surface and float or trowel it as required. Perform all finishing with the minimum manipulation necessary to produce a flat even surface that is level with the rim or edge of the mold and that has no depressions or projections larger than 1/8 in. (3.2 mm).

8.4.1 Cylinders — After consolidation, finish the top surfaces by striking them off with the tamping rod where the consistency of the concrete permits or with a wood float or trowel. If desired, cap the top surface of freshly made cylinders with a thin layer of stiff Portland cement paste which is permitted to harden and cure with the specimen. See section on Capping Materials of T 231.

8.4.2 Beams — After consolidation of the concrete, strike off the top surface to the required tolerance to produce a flat even surface. A wood float may be used.

8.5 Initial Storage — Immediately after being struck off, the specimens shall be move to the storage place were they will remain undisturbed for the initial curing period. If specimens made in single use mold are move, lift and support the specimens from the bottom of the molds with a large trowel or similar device.

9. CURING

9.1 Standard Curing — Standard curing is the curing method used when the specimens are made and cured for the purposes stated in 3.2.

9.1.1 Storage — If specimens cannot be molded at the place where they will receive initial curing, immediately after finishing, move the specimens to an initial curing place for storage. The supporting surface on which specimens are stored shall be level to
within 1/4 in. per ft (20 mm per m.). If cylinders in the single-use molds are moved, lift and support the cylinders from the bottom of the molds with a large trowel or similar device. If the top surface is marred during movement to place of initial storage, immediately refinish.

9.1.2 Initial Curing—Immediately after molding and finishing, the specimens shall be stored for a period of 24 ± 8 hours up to 48 h, in at a desirable temperature range from 60 to 80°F (16 to 27°C), and in an environment preventing moisture loss from the specimens. For concrete mixtures with a specified strength of 6000 psi (40 Mpa) or greater, the initial curing temperature shall be between 68 and 78°F (20 and 26°C). Various procedures are capable of being used during the initial curing period to maintain the specified moisture and temperature conditions. An appropriate procedure or combination of procedures shall be used (Note 6). Shield all specimens from direct sunlight and, if used, radiant heating devices. The storage temperature shall be controlled by the use of heating and cooling devices, as necessary. Record the temperature using a maximum-minimum thermometer. If cardboard molds are used, protect the outside surface of the molds from contact with wet burlap or other sources of water.

Note 6—A satisfactory moisture environment can be created during the initial curing of the specimens by one or more of the following procedures: (1) immediately immerse molded specimens with plastic lids in water saturated with calcium hydroxide, (2) store in properly constructed wood boxes or structures, (3) place in damp sand pits, (4) cover with removable plastic lids, (5) place inside plastic bags, or (6) cover with plastic sheets or nonabsorbent plates if provisions are made to avoid drying and damp burlap is used inside the enclosure, but the burlap is prevented from contacting the concrete surfaces. A satisfactory temperature environment can be controlled during the initial curing of the specimens by one or more of the following procedures: (1) use of ventilation, (2) use of ice, (3) use of thermostatically controlled heating or cooling devices, or (4) use of heating methods such as stoves or light bulbs. Other suitable methods may be used if the requirements limiting specimen storage temperature and moisture loss are met. For concrete mixtures with a specified strength of 6000 psi (40 Mpa) or greater, heat generated during the early ages may raise the temperature above the required storage temperature. When specimens are to be immersed in water saturated with calcium hydroxide, specimens in cardboard molds or other molds that expand when immersed in water should not be used. Early-age strength test results may be lower when stored at 60°F (16°C) and higher when stored at 80°F (27°C). On the other hand, at later ages, test results may be lower for higher initial storage temperatures.

9.1.3 Final Curing:

9.1.3.1 Cylinders—Upon completion of initial curing and within 30 minutes after removing the molds, cure specimens with free water maintained on their surfaces at all times at a temperature of 73 ± 3°F (23 ± 2°C) using water storage tanks or moist rooms complying with the requirements of Specification M 201, except when capping with sulfur mortar capping compound and immediately before testing. When capping with sulfur mortar capping compounds, the ends of the cylinder shall be dry enough to preclude the formation of steam or foam pockets under or in cap larger than 1/4 in (6 mm.) as described in T 231. For a period not to exceed 3 h immediately prior to test, standard curing temperature is not required provided free moisture is maintained on the cylinders and ambient temperature is between 68 to 80°F (20 and 30°C).
9.1.3.2 Beams—Beams are to be cured the same as cylinders (see 9.1.3.1), except that they shall be stored in water saturated with calcium hydroxide at 73 ± 3°F (23 ± 2°C) at least 20 h prior to testing. Drying of the surfaces of the beam shall be prevented between removal from water storage and completion of testing (Note 7).

Note 7 — Relatively small amounts of surface drying of flexural specimens can induce tensile stresses in the extreme fibers that will markedly reduce the indicated flexural strength.

9.2 Field Curing—Field curing is the curing method used for the specimens made for the purposes stated in 3.3.

9.2.1 Cylinders — Store cylinders in or on the structure as near to the point of deposit of the concrete represented as possible. Protect all surfaces of the cylinders from the elements in as near as possible the same way as the formed work. Provide the cylinders with the same temperature and moisture environment as the structural work. Test the specimens in the moisture condition resulting from the specified curing treatment. To meet these conditions, specimens made for the purpose of determining when a structure is capable of being put in service shall be removed from the molds at the time of removal of form work.

9.2.2 Beams — As nearly as practicable, cure beams in the same manner as the concrete in the structure. At the end of 48 ± 4 h after molding, take the molded specimens to the storage location and remove from the molds. Store specimens representing pavements of slabs on grade by placing them on the ground as molded, with their top surfaces up. Bank the sides and ends of the specimens with earth or sand that shall be kept damp, leaving the top surfaces exposed to the specified curing treatment. Store specimens representing structure concrete as near the point in the structure they represent as possible and afford them the same temperature protection and moisture environment as the structure. At the end of the curing period leave the specimens in place exposed to the weather in the same manner as the structure. Remove all beam specimens from field storage and store water saturated with calcium hydroxide at 73 ± 3°F (23 ± 2°C) for 24 ± 4 h immediately before time of testing to ensure uniform moisture condition from specimen to specimen. Observe the precautions given in 9.1.3.2 of removal from curing to testing.

9.3 Structural Lightweight Concrete Curing—Cure structural lightweight concrete cylinders in accordance with M 195.

10. TRANSPORTATION OF SPECIMENS TO LABORATORY

10.1 Prior to transporting, cure and protect specimens as required in Section 9. Specimens shall not be transported until at least 8 h after final set. (See Note 8.) During transporting, protect the specimen with suitable cushioning material to prevent damage from jarring. During cold weather, protect the specimens from freezing with suitable insulation material. Prevent moisture loss during transportation by wrapping the specimens in plastic, wet burlap, by surrounding them with wet sand or tight-fitting plastic caps on plastic molds. Transportation time shall not exceed 4 h.

Note 8—Setting time may be measured by T 197. If a specimen does not attain final set within 48 hours, it is to remain in place until final set is reached. After final set is reached, it can then be transported. The time of final set shall be provided by the concrete producer.
11 REPORT

11.1 Report the following information to the laboratory that will test the specimens:

11.1.1 Identification number;

11.1.2 Location of concrete represented by the samples;

11.1.3 Date, time, and name of individual molding specimens;

11.1.4 Slump, air content, and concrete temperature, test results and results of any other
tests on the fresh concrete and any deviations from referenced standard test methods, and

11.1.5 Curing method. For standard curing method, report the initial curing method with
maximum and minimum temperatures and final curing method. For field curing
method, report the location where stored, manner of protection from the elements,
temperature and moisture environment, and time of removal from molds.

Record all information required on WSDOT Form 350-009 Concrete Cylinder
Transmittal.
### Performance Exam Checklist

**Making and Curing Concrete Test Specimens in the Field**  
**FOP for AASHTO T 23**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Molds placed on a level, rigid, horizontal surface free of vibration?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Representative sample selected?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Making of specimens begun within 15 minutes of sampling?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Concrete placed in the mold, moving a scoop or trowel around the perimeter of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the mold to evenly distribute the concrete as discharged?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Mold filled in three equal layers, attempting to exactly fill the mold on the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>last layer?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Each layer rodded throughout its depth 25 times with hemispherical end of rod,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>uniformly distributing strokes?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Bottom layer rodded throughout its depth?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Middle and top layers rodded, each throughout their depths, and penetrating 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mm into the underlying layer?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Sides of the mold tapped 10-15 times after rodding each layer?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. with mallet for reusable steel molds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. with the open hand for flexible light-gauge molds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Concrete struck off with tamping rod or, if necessary, finished with a trowel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or float, using a minimum of manipulation?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Specimens covered with nonabsorptive, nonreactive cap or plate?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First attempt: Pass [ ]  Fail [ ]  
Second attempt: Pass [ ]  Fail [ ]

Signature of Examiner __________________________________________

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FOP FOR AASHTO T 27/T 11
SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES
FOP FOR AASHTO T 27

MATERIALS FINER THAN No. 200 (75 µm) SIEVE IN MINERAL AGGREGATE BY WASHING
FOP FOR AASHTO T 11

SIGNIFICANCE

Sieve analyses are performed on aggregates used in roadway bases and in portland cement and asphalt cement concretes. Sieve analyses reveal the size makeup of aggregate particles – from the largest to the smallest. A gradation curve or chart showing how evenly or unevenly the sizes are distributed between largest and smallest is created in this test. How an aggregate is graded has a major impact on the strength of the base or on the properties and performance of concrete. In portland cement concrete (PCC), for example, gradation influences shrinkage and shrinkage cracking, pumpability, finishability, permeability, and other characteristics.

Generally, well-graded material having an even distribution of particle sizes will have better load handling properties than poorly graded material consisting of a few size classes. Although other characteristics of aggregates contribute to its strength, the better a material is graded, the less material will be needed.

SCOPE

This procedure covers sieve analysis in accordance with AASHTO T 27 and materials finer than 75 µm (No.200) in accordance with AASHTO T 11. The procedure combines the two test methods.

Sieve analyses determine the gradation or distribution of aggregate particles within a given sample in order to determine compliance with design and production standards.

Accurate determination of material smaller than No. 200 (75 µm) cannot be made with AASHTO T 27 alone. If quantifying this material is required, it is recommended that AASHTO T 27 be used in conjunction with AASHTO T 11. Following AASHTO T 11, the sample is washed through a No. 200 (75 µm) sieve. The amount of material passing this sieve is determined by comparing dry sample masses before and after the washing process. The procedure herein is a combination of the two methods.

APPARATUS

• Balance or scale: Capacity sufficient for the masses shown in Table 1, accurate to 0.1 percent of the sample mass or readable to 0.1 g. Meeting better and conform to the requirements of AASHTO M 231.
• Sieves – Meeting the requirements of AASHTO M 92.
• Mechanical sieve shaker – Meeting the requirements of AASHTO T 27.
• Suitable drying equipment (see FOP for AASHTO T 255)
• Containers and utensils: A pan or vessel of a size sufficient to contain the sample covered with water and to permit vigorous agitation without loss of any part of the sample or water
SAMPLE PREPARATION

Obtain samples in accordance with the FOP for AASHTO T 2 and reduce to the size shown in Table 1 in accordance with the FOP for AASHTO T 248.

If the gradation sample is obtained from FOP for AASHTO T-308, the Ignition Furnace, proceed to Procedure Step 1.

### TABLE 1
Sample Sizes for Aggregate Gradation Test

<table>
<thead>
<tr>
<th>Nominal MaximumSize*</th>
<th>Minimum Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kg (lb)</td>
</tr>
<tr>
<td>4.75 (No. 4)</td>
<td>0.5 (1)</td>
</tr>
<tr>
<td>6.3 (1/4)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>9.5 (3/8)</td>
<td>2 (4)</td>
</tr>
<tr>
<td>12.5 (1/2)</td>
<td>5 (11)</td>
</tr>
<tr>
<td>25.0 (1)</td>
<td>10 (22)</td>
</tr>
<tr>
<td>37.5 (1 1/2)</td>
<td>15 (33)</td>
</tr>
<tr>
<td>50 (2)</td>
<td>20 (44)</td>
</tr>
<tr>
<td>63 (2 1/2)</td>
<td>35 (77)</td>
</tr>
<tr>
<td>75 (3)</td>
<td>60 (130)</td>
</tr>
<tr>
<td>90 (2 1/2)</td>
<td>100 (220)</td>
</tr>
<tr>
<td>100 (4)</td>
<td>150 (330)</td>
</tr>
<tr>
<td>125 (5)</td>
<td>200 (440)</td>
</tr>
</tbody>
</table>

* One sieve larger than the first sieve to retain more than 10 percent of the material, using specification sieves. See definition on page 18.
**Note 1:** These sample sizes are standard for aggregate testing but, due to equipment restraints, samples may need to be partitioned into several “subsamples.” For example, a gradation that requires 220lbs (100 kg) of material would not fit into a large tray shaker in one batch.

**Note 2:** Some agencies permit reduced sample sizes if it is proven that doing so is not detrimental to the test results. Some agencies require larger sample sizes. Check agency guidelines for required or permitted test sample sizes.

**PROCEDURE**

1. Dry the sample to a constant mass in accordance with the FOP for AASHTO T 255, and record to the nearest 0.1 g percent of total mass or better.

**Note 3:** AASHTO T 27 allows for coarse aggregate to be run in a moist condition unless the nominal maximum size of the aggregate is smaller than 12.5 mm (1/2 in.), the coarse aggregate (CA) contains appreciable material finer than 4.75 mm (No. 4), or the coarse aggregate is highly absorptive. AASHTO also allows for sample drying on a hot plate so long as the particles do not fracture and the aggregate does not change chemically under the heat.

2. When the specification requires that the amount of material finer than No. 200 (75 µm) be determined, do Step 3 through Step 9 – otherwise, skip to Step 10.

**Note 4:** If the applicable specification requires that the amount passing the No. 200 (75 µm) sieve be determined on a portion of the sample passing a sieve smaller than the nominal maximum size of the aggregate, separate the sample on the designated sieve and determine the mass of the material passing that sieve to 0.1 percent of the mass of this portion of the test sample. Use the mass as the original dry mass of the test sample.

3. Nest a sieve, such as a No. 10 (2 mm), above the No. 200 (75 µm) sieve.

4. Place the test sample in a container and add sufficient water to cover it.

WSDOT requires the use of a detergent, dispersing agent, or other wetting solution when washing a sample from FOP for AASHTO T308, an ignition furnace sample.

**Note 5:** A detergent, dispensing agent, or other wetting solution may be added to the water to assure a thorough separation of the material finer than the No. 200 (75 µm) sieve from the coarser particles. There should be enough wetting agent to produce a small amount of suds when the sample is agitated. Excessive suds may overflow the sieves and carry material away with them.

5. Agitate vigorously to ensure complete separation of the material finer than No. 200 (75 µm) from coarser particles and bring the fine material into suspension above the coarser material.

**Note:** The use of a mechanical aggregate washer is permitted in the accomplishment of step 4, through 9 Caution must be exercised that prolonged agitation does not cause degradation of the aggregate.

6. Immediately pour the wash water containing the suspended and dissolved solids over the nested sieves, being careful not to pour out the coarser particles.

7. Add a second change of water to the sample remaining in the container, agitate, and repeat Step 6. Repeat the operation until the wash water is reasonably clear.

8. Return all material retained on the nested sieves to the container by flushing into the washed sample.
9. Dry the washed aggregate to constant mass in accordance with the FOP for AASHTO T 255, and then cool prior to sieving. AASHTO also allows for sample drying on a hot plate so long as the particles do not fracture and the aggregate does not change chemically under the heat. Record the dry, constant mass if required by the agency.

10. Select sieves to furnish information required by the specifications. Nest the sieves in order of decreasing size from top to bottom and place the sample, or a portion of the sample, on the top sieve.

   **Note 6:** Additional sieves may be necessary to provide other information, such as fineness modulus, or to keep from overloading the specified sieves. The sample may also be sieved in increments.

11. Place sieves in mechanical shaker and shake for a minimum of 10 minutes, or the minimum time determined to provide complete separation for the sieve shaker being used.

   **Note 7:** The 10-minute requirement should be evaluated for each shaker at least annually.

   **Note 8:** Continue shaking for a sufficient period and in such a manner that, after completion, not more than 0.5 percent by mass of the total sample passes any sieve during one minute of continuous hand sieving. Provide a snug-fitting pan and cover, and hold in a slightly inclined position in one hand. Strike the side of the sieve sharply and with an upward motion against the heel of the other hand at the rate of about 150 times per minute, turning the sieve about one sixth of a revolution at intervals of about 25 strokes. In determining sufficiency of sieving for sizes larger than 4.75 mm (No. 4), limit the material on the sieve to a single layer of particles.

   **Note 9:** For sieves with openings smaller than No. 4 (4.75 mm), the mass retained on any sieve shall not exceed 4g/in² (7 kg/m²) of sieving surface. For sieves with openings No. 4 (4.75 mm) and larger, the mass, in m²/kg of sieving surface, shall not exceed the product of 2.5 x (sieve opening in mm)x (effective sieving area). See Table 2.

12. Determine the mass retained on each sieve to the nearest 0.1 percent of the total mass or better. Ensure that all material trapped in the openings of the sieve are cleaned out and included in the mass retained.

   **Note 10:** Use coarse wire brushes to clean the No. 30 (600 µm) and larger sieves, and soft hair brushes for smaller sieves.

In the case of CA and fine aggregate (FA) mixtures, the portion of the sample finer than No. 4 (4.75 mm) may be distributed among two or more sets of sieves to prevent overloading of individual sieves. Alternatively, the portion finer than No. 4 (4.75 mm) may be reduced in size using a mechanical splitter in accordance with FOP for AASHTO T 248. If this procedure is followed, compute the mass of the size increment of the original sample as follows:

\[
A = \frac{M_1}{M_2} \times R
\]

where:  
\( A \) = mass of the size increment on total sample basis  
\( M_1 \) = mass of fraction finer than No. 4 (4.75 mm) sieve in total sample  
\( M_2 \) = mass of reduced portion of material finer than No. 4 (4.75 mm) sieve actually sieved  
\( B \) = mass of the size increment in the reduced portion sieved.
13. Divide the masses, or the corrected masses, on the individual sieves by the total mass of the initial dry sample (prior to washing) to determine the percent retained on and passing each sieve. Calculate the percent retained on and passing each sieve. Report percent passing as indicated in the “Report” section at the end of this FOP.

14. The total mass of material after sieving should check closely with the mass before sieving. If performing T 11 with T 27 this would be the dry mass after wash. If performing just T 27 this would be the original dry mass. When the masses before and after sieving differ by more than 0.3 percent do not use the results for acceptance purposes.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>203 φ (8)</th>
<th>305 φ (12)</th>
<th>305 x 305 (12 x 12)</th>
<th>350 x 350 (14 x 14)</th>
<th>372 x 580 (16 x 24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieving Area m²</td>
<td>0.0285</td>
<td>0.0670</td>
<td>0.0929</td>
<td>0.1225</td>
<td>0.2158</td>
</tr>
<tr>
<td>3 1/2 (90)</td>
<td>*</td>
<td>15.1</td>
<td>20.9</td>
<td>27.6</td>
<td>48.5</td>
</tr>
<tr>
<td>3 (75)</td>
<td>*</td>
<td>12.6</td>
<td>17.4</td>
<td>23.0</td>
<td>40.5</td>
</tr>
<tr>
<td>2 1/2 (63)</td>
<td>*</td>
<td>10.6</td>
<td>14.6</td>
<td>19.3</td>
<td>34.0</td>
</tr>
<tr>
<td>2 (50)</td>
<td>3.6</td>
<td>8.4</td>
<td>11.6</td>
<td>15.3</td>
<td>27.0</td>
</tr>
<tr>
<td>1 1/2 (37.5)</td>
<td>2.7</td>
<td>6.3</td>
<td>8.7</td>
<td>11.5</td>
<td>20.2</td>
</tr>
<tr>
<td>1 (25.0)</td>
<td>1.8</td>
<td>4.2</td>
<td>5.8</td>
<td>7.7</td>
<td>13.5</td>
</tr>
<tr>
<td>3/4 (19.0)</td>
<td>1.4</td>
<td>3.2</td>
<td>4.4</td>
<td>5.8</td>
<td>10.2</td>
</tr>
<tr>
<td>5/8 (16.0)</td>
<td>1.1</td>
<td>2.7</td>
<td>3.7</td>
<td>4.9</td>
<td>8.6</td>
</tr>
<tr>
<td>1/2 (12.5)</td>
<td>0.89</td>
<td>2.1</td>
<td>2.9</td>
<td>3.8</td>
<td>6.7</td>
</tr>
<tr>
<td>3/8 (9.5)</td>
<td>0.67</td>
<td>1.6</td>
<td>2.2</td>
<td>2.9</td>
<td>5.1</td>
</tr>
<tr>
<td>1/4 (6.3)</td>
<td>0.44</td>
<td>1.1</td>
<td>1.5</td>
<td>1.9</td>
<td>3.4</td>
</tr>
<tr>
<td>No. 4 (4.75)</td>
<td>0.33</td>
<td>0.80</td>
<td>1.1</td>
<td>1.5</td>
<td>2.6</td>
</tr>
<tr>
<td>Less than (No. 4)</td>
<td>0.20</td>
<td>0.47</td>
<td>0.65</td>
<td>1.2</td>
<td>1.3</td>
</tr>
</tbody>
</table>

**TABLE 2**
Maximum Allowable Mass of Material Retained on a Sieve, kg
Nominal Sieve Size, mm (in.)
exact size is smaller see AASHTO T-27

**CALCULATION**

- **Sample Calculation for Percent Retained On and Passing**
  Calculate percent retained on and passing each sieve on the basis of the total mass of the initial dry sample. This will include any material finer than No. 200 (75 µm) that was washed out.

**EXAMPLE:**
Dry mass of total sample, before washing: 5168.7 g
Dry mass of sample, after washing out the No. 200 (75 µm) minus: 4911.3 g
Amount of No. 200 (75 µm) minus washed out: 5168.7 g – 4911.3 g = 257.4 g
### Gradation on All Screens

<table>
<thead>
<tr>
<th>Sieve Size in. (mm)</th>
<th>Mass Retained g</th>
<th>Percent Retained</th>
<th>Cumulative Mass Retained g</th>
<th>Cumulative Percent Retained</th>
<th>Percent Passing*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 (19.0)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>1/2 (12.5)</td>
<td>723.6</td>
<td>14</td>
<td>723.6</td>
<td>14</td>
<td>84</td>
</tr>
<tr>
<td>3/8 (9.50)</td>
<td>620.2</td>
<td>12</td>
<td>1343.8</td>
<td>26</td>
<td>74</td>
</tr>
<tr>
<td>No. 4 (4.75)</td>
<td>1188.8</td>
<td>23</td>
<td>2532.6</td>
<td>49</td>
<td>51</td>
</tr>
<tr>
<td>No. 8 (2.36)</td>
<td>878.7</td>
<td>17</td>
<td>3411.3</td>
<td>66</td>
<td>34</td>
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<tr>
<td>No. 16 (1.18)</td>
<td>574.1</td>
<td>11</td>
<td>3985.2</td>
<td>77</td>
<td>23</td>
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<tr>
<td>No. 30 (0.600)</td>
<td>330.7</td>
<td>6</td>
<td>4315.9</td>
<td>84</td>
<td>16</td>
</tr>
<tr>
<td>No. 50 (0.300)</td>
<td>229.5</td>
<td>4</td>
<td>4545.4</td>
<td>88</td>
<td>12</td>
</tr>
<tr>
<td>No. 100 (0.150)</td>
<td>208.0</td>
<td>2</td>
<td>4753.4</td>
<td>92</td>
<td>8</td>
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<tr>
<td>No. 200 (0.075)</td>
<td>136.6</td>
<td>2.6</td>
<td>4890.0</td>
<td>94.6</td>
<td>5.4</td>
</tr>
<tr>
<td>Pan</td>
<td>15.9</td>
<td></td>
<td>4905.9</td>
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<td></td>
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</tbody>
</table>

Check sum: 4911.3 - 5905.9 / 4911.3 X 100 = 0.11 % is within the 0.3 percent requirement

* Report No. 200 (75 µm) sieve to 0.1 percent. Report all others to 1 percent.

- Sample Calculation for Percent Retained On and Passing, Including a Split on the No. 4 (4.75 mm) Sieve

Calculate percent retained on and passing each sieve on the basis of the total mass of the initial dry sample. This will include any material finer than No. 200 (75 µm) that was washed out.

When material passing the No. 4 (4.75 mm) sieve is split and only a portion of that is tested, the proportionate share of the amount passing the No. 200 (75 µm) sieve must be added to the sample mass to obtain a corrected test mass. This corrected test mass is used to calculate the gradation of the material passing the No. 4 (4.75 mm) sieve.

Example showing calculations when the No. 4 (4.75 mm) minus material is split:

Dry mass of total sample, before washing: 3214.0 g

Dry mass of sample, after washing out the No. 200 (75 µm) minus: 3085.1 g

Amount of No. 200 (75 µm) minus washed out: 3214.0 g – 3085.1 g = 128.9 g

### Gradation on Coarse Screens

<table>
<thead>
<tr>
<th>Sieve Size in. (mm)</th>
<th>Mass Retained g</th>
<th>Percent Retained</th>
<th>Cumulative Mass Retained g</th>
<th>Cumulative Percent Retained</th>
<th>Percent Passing*</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8 (16.0)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>1/2 (12.5)</td>
<td>161.1</td>
<td>5.0</td>
<td>161.1</td>
<td>5.0</td>
<td>95</td>
</tr>
<tr>
<td>3/8 (9.50)</td>
<td>481.4</td>
<td>15.0</td>
<td>642.5</td>
<td>20.0</td>
<td>80</td>
</tr>
<tr>
<td>No. 4 (4.75)</td>
<td>475.8</td>
<td>14.8</td>
<td>1118.3</td>
<td>34.8</td>
<td>65</td>
</tr>
<tr>
<td>Pan</td>
<td>1966.7</td>
<td></td>
<td>3085.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The actual mass of material passing the No. 4 (4.75 mm) sieve and retained in the pan is 3085 g – 1118.3 g = 1966.7 g. This is $M_1$.

**Note 11:** The pan mass determined in the laboratory and the calculated $M_1$ should be the same.

The pan (1966.7 grams) was reduced in accordance with the FOP for AASHTO T 248, so that at least 500 g are available. In this case, the mass determined was 512.8 g. This is $M_2$. 

---

Note: The document contains a table of material gradation on all screens and coarse screens. The calculations and sample calculations for percent retained on and passing, including a split on the No. 4 (4.75 mm) sieve, are detailed. The gradation on coarse screens is also presented, with a calculation example showing the determination of $M_1$ and $M_2$. The actual mass passing the No. 4 (4.75 mm) sieve and retained in the pan is calculated, and the pan mass determined in the laboratory is compared with the calculated $M_1$. The pan mass is reduced according to the FOP for AASHTO T 248, resulting in a mass of 512.8 g, which is compared to the calculated $M_2$. 

---

November 2002
In order to account for the fact that only a portion of the minus No. 4 (4.75 mm) material was sieved, the mass of material retained on the smaller sieves is adjusted by a factor equal to \( \frac{M_1}{M_2} \). In this example,

\[
M_2 = \text{mass before sieving from the split of the No. 4 (4.75) minus.} \\
M_1 = \text{mass of the No. 4 (4.75) minus after split}
\]

\[
\frac{M_1}{M_2} = \frac{1966.7 \text{ g}}{512.8 \text{ g}} = 3.835
\]

Each “mass retained” on the fine sieves must be multiplied by this factor.

For example, the overall mass retained on the No. 10 (2.00 mm) sieve is:

\[
207.1 \text{ g} \times \frac{1966.7 \text{ g}}{512.8 \text{ g}} = 794.2 \text{ g}
\]

as shown in the following table

<table>
<thead>
<tr>
<th>Sieve Size in. (mm)</th>
<th>Mass Retained g</th>
<th>Adjusted Mass Retained g</th>
<th>Percent Retained</th>
<th>Percent Passing*</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8 (16.0)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>1/2 (12.5)</td>
<td>161.1</td>
<td>161.1</td>
<td>5</td>
<td>95</td>
</tr>
<tr>
<td>3/8 (9.5)</td>
<td>481.4</td>
<td>481.4</td>
<td>15</td>
<td>80</td>
</tr>
<tr>
<td>No. 4 (4.75)</td>
<td>475.8</td>
<td>475.8</td>
<td>15</td>
<td>65</td>
</tr>
<tr>
<td>No. 10 (2.0)</td>
<td>207.1 ( \times 3.835 )</td>
<td>794.2</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>No. 40 (0.425)</td>
<td>187.9 ( \times 3.835 )</td>
<td>720.6</td>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>No. 80 (0.210)</td>
<td>59.9 ( \times 3.835 )</td>
<td>229.7</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>No. 200 (0.075)</td>
<td>49.1 ( \times 3.835 )</td>
<td>188.3</td>
<td>5.9</td>
<td>5.1</td>
</tr>
<tr>
<td>Pan</td>
<td>9.2 ( \times 3.835 )</td>
<td>35.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Check sum: 3085.1 - 3081.0 / 3085.1 \( \times 100 = 0.17 \% \) is within the 0.3 percent requirement

* Report No. 200 (75 µm) sieve to 0.1 percent. Report all others to 1 percent.

---

<table>
<thead>
<tr>
<th>Sieve Size in. (mm)</th>
<th>Cumulative Mass Retained g</th>
<th>Adjusted Cumulative Mass Retained g</th>
<th>Cumulative Mass Retained g</th>
<th>Cum. Percent Retained</th>
<th>Percent Passing*</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8 (16.0)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100.0</td>
</tr>
<tr>
<td>1/2 (12.5)</td>
<td>161.1</td>
<td>161.1</td>
<td>1912.5</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>3/8 (9.5)</td>
<td>642.5</td>
<td>642.5</td>
<td>2633.1</td>
<td>82</td>
<td>18</td>
</tr>
<tr>
<td>No. 4 (4.75)</td>
<td>1118.3</td>
<td>1118.3</td>
<td>3051.1</td>
<td>94.9</td>
<td>5.1</td>
</tr>
<tr>
<td>No. 10 (2.0)</td>
<td>207.1 ( \times 3.835 )</td>
<td>794.2 + 1118.3</td>
<td>3086.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 40 (0.425)</td>
<td>395.0 ( \times 3.835 )</td>
<td>1514.8 + 1118.3</td>
<td>89</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>No. 80 (0.210)</td>
<td>454.9 ( \times 3.835 )</td>
<td>1744.5 + 1118.3</td>
<td>82</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>No. 200 (0.075)</td>
<td>504.0 ( \times 3.835 )</td>
<td>1932.8 + 1118.3</td>
<td>94.9</td>
<td>5.1</td>
<td></td>
</tr>
<tr>
<td>Pan</td>
<td>513.2 ( \times 3.835 )</td>
<td>1968.1 + 1118.3</td>
<td>3086.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Check sum: 3085.1 - 3081.1 / 3085.1 \( \times 100 = 0.16 \% \) is within the 0.3 percent requirement

* Report No. 200 (75 µm) sieve to 0.1 percent. Report all others to 1 percent.
Sample Calculation for Fineness Modulus

Fineness Modulus (FM) is used in determining the degree of uniformity of aggregate gradation in PCC mix designs. It is an empirical number relating to the fineness of the aggregate. The higher the FM, the coarser the aggregate. Values of 2.40 to 3.00 are common for FA in PCC.

The sum of the percentages retained on specified sieves 6” (150), 3” (75), 11/2 (37.5), 3/4 (19.0), 3/8 (9.5), No. 4 (4.75), No.8 (2.36), No.16 (1.18), No. 30 (0.60), No. 50 (0.30), and No. 100 (0.15 mm) divided by 100 gives the FM.

### Example A

<table>
<thead>
<tr>
<th>Sieve Size in. (mm)</th>
<th>Passing</th>
<th>Retained</th>
<th>On Spec’d Sieves*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (75*)</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21/2 (63)</td>
<td>100</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>2 (50)</td>
<td>100</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>11/2 (37.5 *)</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 (25)</td>
<td>53</td>
<td>47</td>
<td>100</td>
</tr>
<tr>
<td>3/4 (19*)</td>
<td>15</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>1/2 (12.5)</td>
<td>0</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>3/8 (9.5*)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1/4 (6.3)</td>
<td>0</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>No. 4 (4.75*)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No.8 (2.36*)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No.10 (1.18 *)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No.30 (0.60*)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No.50 (0.30*)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>100 (0.15*)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

- **FM** = 7.85

### Example B

<table>
<thead>
<tr>
<th>Sieve Size in. (mm)</th>
<th>Passing</th>
<th>Retained</th>
<th>On Spec’d Sieves*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (75*)</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21/2 (63)</td>
<td>100</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>2 (50)</td>
<td>100</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>11/2 (37.5 *)</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 (25)</td>
<td>53</td>
<td>47</td>
<td>100</td>
</tr>
<tr>
<td>3/4 (19*)</td>
<td>15</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>1/2 (12.5)</td>
<td>0</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>3/8 (9.5*)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1/4 (6.3)</td>
<td>0</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>No. 4 (4.75*)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No.8 (2.36*)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No.10 (1.18 *)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No.30 (0.60*)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No.50 (0.30*)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>100 (0.15*)</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

- **FM** = 2.78

* In decreasing size order, each sieve is one-half the size of the preceding sieve.

REPORT

Results shall be reported on standard forms approved for use by the agency. Depending on the agency, this may include:

- Mass retained on each sieve
- Percent retained on each sieve
- Cumulative mass retained on each sieve
- Cumulative percent retained on each sieve
- Percent passing each sieve to the nearest 1 percent except for the percent passing the No. 200 (75 µm) sieve, which shall be reported to the nearest 0.1 percent
- FM to the nearest 0.01 percent

Report results using WSDOT Form 422-020, or other report approved by the State Materials Engineer.
Performance Exam Checklist

*Sieve Analysis of Fine and Coarse Aggregates*  
**FOP for AASHTO T 27**

*Materials Finer Than 75 µm (No. 200) Sieve in Mineral Aggregate by Washing*  
**FOP for AASHTO T 11**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. Minimum sample mass meets requirement of Table 1 or from FOP for AASHTO T308?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. Test sample dried to a constant mass by FOP for AASHTO T 255?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. Test sample cooled and mass determined to nearest 0.1 percent of mass?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. Sample placed in container and covered with water? (If specification requires that the amount of material finer than the No. 200 sieve is to be determined.)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7. Contents of the container vigorously agitated?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8. Complete separation of coarse and fine particles achieved?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9. Wash water poured through nested sieves such as No. 10 and No. 200?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10. Operation continued until wash water is clear?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11. Material retained on sieves returned to washed sample?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12. Washed aggregate dried to a constant mass by FOP for AASHTO T 255?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13. Washed aggregate cooled and mass determined to nearest 0.1 percent of mass?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14. Sample placed in nest of sieves specified? (Additional sieves may be used to prevent overloading as allowed in FOP.)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15. Material sieved in verified mechanical shaker for minimum of 10 minutes?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16. Mass of residue on each sieve determined to 0.1 percent of mass?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>17. Total mass of material after sieving agrees with mass before sieving to within 0.3 percent?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16. Percentages calculated to the nearest 0.1 percent and reported to the nearest whole number, except No. 200 - reported to the nearest 0.1 percent?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Procedure Element</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----</td>
<td>----</td>
</tr>
<tr>
<td>18. Percentage calculations based on original dry sample mass?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Calculations performed properly? If material passing No. 4 sieve is split and only a portion is tested, calculation as noted in FOP performed properly?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First attempt:  Pass ☐  Fail ☐  Second attempt:  Pass ☐  Fail ☐

Signature of Examiner __________________________________________

Comments:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
**SAMPLING BITUMINOUS MATERIALS**

**FOP FOR AASHTO T 40**

**SIGNIFICANCE**

The quality of bituminous materials has a tremendous impact on a roadway project. The grade of binder selected is based on a number of factors, including local temperature extremes and characteristics of expected traffic. Using a grade of binder material other than that specified will have serious impacts on roadway performance and durability.

**SCOPE**

The procedure covers obtaining samples of liquid bituminous materials in accordance with AASHTO T 40. Sampling of solid and semi-solid bituminous materials (included in AASHTO T 40) is not covered here.

WSDOT personnel need to observe the contractor’s personnel sampling to assure that proper sampling procedures are followed.

If proper sampling procedures are not followed it shall be noted on the sample transmittal “Proper sampling procedures not followed.” See Std. Spec 1-06.

Samples of Emulsions and Liquid Asphalt for BST to be taken by WDOT personnel.

**PROCEDURE**

1. Coordinate sampling with constructor or supplier.
2. Use appropriate safety equipment and precautions.
3. Allow a minimum of 1 gal (4 L) to flow before obtaining samples.
4. Obtain samples as indicated below.
   - Hot Mix Asphalt (HMA) Plants: Obtain the samples from the line between the storage tank and the mixing plant while the plant is in operation, or from the delivery truck.
   - Distributors: Obtain the sample directly from the spray bar or application device if the bituminous liquid has not been diluted; otherwise, sample at delivery or prior to dilution.
   - Distributors: Obtain the sample directly from the distributor’s sampling valve, the spray bar or application device if the bituminous liquid has not been diluted; otherwise, sample at delivery or prior to dilution.

**CONTAINERS**

Sample containers must be new, and the inside may not be washed or rinsed. The outside may be wiped with a clean, dry cloth.

All samples shall be put in 1 qt (1 L) containers and properly identified on the outside of the container with contract number, date sampled, data sheet number, brand and grade of material, and sample number. Include lot and sublot numbers when appropriate.

Note: The filled sample container shall not be submerged in solvent, nor shall it be wiped with a solvent saturated cloth. If cleaning is necessary, use a clean dry cloth.

- Emulsified asphalt: Use wide-mouth plastic jars with screw caps. Protect the samples from freezing since water is a part of the emulsion.
- All other bituminous liquids: Use metal cans.

Standard sample labels (WSDOT Form 350-016) shall be completely filled out and attached to each sample container.
**Performance Exam Checklist**

**Sampling Bituminous Materials**

**FOP for AASHTO T 40**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Appropriate containers used?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Wide-mouth plastic containers (emulsified).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Metal cans (all other bituminous liquids).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Containers not washed or rinsed on inside?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Minimum of 1 gallon allowed to flow before sample taken?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Material obtained at correct location?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Line between storage tank and mixing plant or flow delivery vehicle (HMA plants).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Spray bar or application device, if not diluted (distributors).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. From delivery vehicle or prior to dilution, if diluted (distributors).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sample taken by: Contractor [ ] WSDOT [ ]

First attempt: Pass [ ] Fail [ ]

Second attempt: Pass [ ] Fail [ ]

Signature of Examiner __________________________________________

Comments:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
WSDOT FOP for AASHTO T 99

Moisture-Density Relations of Soils Using a 5.5-lb (2.5-kg) Rammer and a 12-in. (305-mm) Drop

1. SCOPE

1.1 These methods of test are intended for determining the relation between the moisture content and density of soils compacted in a mold of a given size with a 5.5-lb (2.5-kg) rammer dropped from a height of 12-in. (305-mm). Four alternate procedures are provided as follows:

**Method A**
A 4-in. (101.60-mm) mold: Soil material passing a No. 4 (4.75-mm) sieve
Sections 3 and 4.

**Method B**
A 6-in. (152.40-mm) mold: Soil material passing a No. 4 (4.75-mm) sieve
Sections 5 and 6.

**Method C**
A 4-in. (101.60-mm) mold: Soil material passing a 3/4-in. (19.0-mm) sieve
Sections 7 and 8.

**Method D**
A 6-in. (152.40-mm) mold: Soil material passing a 3/4-in. (19.0-mm) sieve
Sections 9 and 10.

The preferred method of WSDOT is to use Method A.

WSDOT recommends that the bulk specific gravity of coarse aggregate be determined.

Native soils within the contract limits to be used for embankment construction and/or backfill material do not require the sampling by a qualified tester. For material that requires gradation testing such as but not limited to manufactured aggregates and Gravel Borrow, a qualified testers shall be required for sampling.

1.2 The method to be used should be indicated in the specifications for the material being tested. If no method is specified, the provisions of Method A shall govern.

1.3. This test method applies to soils mixtures that have 40% or less retained on the No. 4 (4.75 mm) sieve, when Method A or B is used and 30% or less retained on the 3/4-in. (19.0-mm) sieve, when Method C or D is used. The material retained on these sieves shall be defined as oversized particles (coarse particles).

1.4. If the test specimen contains oversize particles, and the test specimen is used for field density compaction control, corrections must be made according to T 224 to compare the total field density with the compacted specimen density. The person or agency specifying this method shall specify a minimum percentage below which correction for oversize need not be applied. If no minimum percentage is specified, correction shall be applied to samples with more than 5% by weight of oversize particles.

1.5. If the specified oversized maximum tolerances are exceeded, other methods of compaction control must be used.

---

1This Test Method is based on AASHTO T 99-01
Note 1 – One method for the design and control of the compaction of such soils is to use a test fill to determine the required degree of compaction and a method to obtain that compaction. Then use a method specification to control the compaction by specifying the type and size of compaction equipment, the lift thickness and the number of passes.

1.6. The following applies to all specified limits in this standard: For the purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded off “to the nearest unit” in the last right-hand place of figures used in expressing the limiting value, in accordance with R 11.

1.7. The values stated in SI units are to be regarded as the standard.

2. Referenced Documents

2.1. AASHTO Standards:
   • M 92, Wire-Cloth Sieves for Testing Purposes
   • M 231, Weighing Devices Used in the Testing of Materials
   • R 11, Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values
   • T 19/T 19M, Bulk Density ("Unit Weight") and Voids in Aggregate
   • T 224, Correction for Coarse Particles in the Soil Compaction Test
   • T 255, Total Evaporable Moisture Content of Aggregate by Drying
   • T 265, Laboratory Determination of Moisture Content of Soils

2.2. ASTM Standard:
   • D 2168, Calibration of Laboratory Mechanical-Rammer Soil Compactors

3. APPARATUS

3.1 Molds — The molds shall be solid-wall, metal cylinders manufactured with dimensions and capacities shown in Sections 3.1.1 and 3.1.2 below. They shall have a detachable collar assembly approximately 2.375 in. (60 mm) in height, to permit preparation of compacted specimens of soil-water mixtures of the desired height and volume. The mold and collar assembly shall be so constructed that it can be fastened firmly to a detachable base plate made of the same material (Note 2). The base plate shall be plane to 0.005 in. as shown in Figures 1 and 2.

Note 2: Alternate types of molds with capacities as stipulated herein may be used, provided the test results are correlated with those of the solid-wall mold on several soil types and the same moisture-density results are obtained. Records of such correlation shall be maintained and readily available for inspection, when alternate types of molds are used.

3.1.1 A 4-in. (101.6-mm) mold having a capacity of 1/30 (0.0333) ± 0.0003 cu. ft. (0.000943 ± 0.000008 m³) with an internal diameter of 4.000 ± 0.016 in. (101.60 ± 0.41 mm) and a height of 4.584 ± 0.005 in. (116.43 ± 0.13 mm) (Figure 1).

3.1.2 A 6-in. (152.4-mm) mold having a capacity of 1/13.33 (0.07500) ± 0.00075 cu. ft. (0.002124 ± 0.000021 m³) with an internal diameter of 6.000 ± 0.026 in. (152.40 ± 0.66 mm) and a height of 4.584 ± 0.005 in. (116.43 ± 0.13 mm) (Figure 2).

3.1.3 Molds Out of Tolerance Due to Use — A mold that fails to meet manufacturing tolerances after continued service may remain in use provided those tolerances are not exceeded by more than 50 percent; and the volume of the mold, calibrated in
Cylindrical Mold and Base Plate (101.6-mm mold)

Figure 1

(A) WING NUT (4)
(B) STUD (2)
(C) HANGER (4)
(D) WELD (Top and bottom of each hanger)
(E) COLLAR (1)
(F) MOLD (1)
(G) BASE PLATE (1)

NOTE:
ALL DIMENSIONS SHOWN IN MILLIMETERS UNLESS OTHERWISE NOTED.

LOCATION OF STUDS IN BASE PLATE

<table>
<thead>
<tr>
<th>Dimensional Equivalents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>mm</strong></td>
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<tr>
<td>3.18 ± 0.64</td>
</tr>
<tr>
<td>3.81</td>
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<tr>
<td>6.35 ± 1.27</td>
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<tr>
<td>7.62</td>
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<tr>
<td>9.53 ± 0.64</td>
</tr>
<tr>
<td>12.70 ± 2.54</td>
</tr>
<tr>
<td>17.78 ± 1.27</td>
</tr>
<tr>
<td>20.32</td>
</tr>
<tr>
<td>38.10 ± 2.54</td>
</tr>
</tbody>
</table>

0.000943 ± 0.000008 m³ 1/30 ± 0.0003 ft³
Cylindrical Mold and Base Plate (152.4-mm mold)

Figure 2

(A) WING NUT (4)
(B) STUD (2)
(C) HANGER (4)
(D) WELD (Top and bottom of each hanger)
(E) COLLAR (1)
(F) MOLD (1)
(G) BASE PLATE (1)

NOTE:
ALL DIMENSIONS SHOWN IN MILLIMETERS UNLESS OTHERWISE NOTED.

<table>
<thead>
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</tr>
<tr>
<td>38.10 ± 2.54</td>
</tr>
</tbody>
</table>

0.002123 ± 0.000021 m³ / 1/13.33 ± 0.00075 ft³
ac cor dance with Section 8 (Calibration of Measure) of T 19/T 19M, for Unit Mass of Aggregate, is used in the calculations.

3.2 Rammer

3.2.1 Manually Operated — Metal rammer with a mass of 5.5 ± 0.02 lb (2.495 ± 0.009 kg), and having a flat circular face of 2.000-in. (50.80-mm) diameter with a manufacturing tolerance of 0.01 in. (± 0.25 mm). The in-service diameter of the flat circular face shall be not less than 1.985 in. (50.42 mm). The rammer shall be equipped with a suitable guide-sleeve to control the height of drop to a free fall of 12.00 ± 0.06 in. (305 ± 2 mm) above the elevation of the soil. The guide-sleeve shall have at least 4 vent holes, no smaller than 3/8-in. (9.5-mm) diameter spaced approximately 90 degrees (1.57 rad) apart and approximately 3/4 in. (19 mm) from each end; and shall provide sufficient clearance so the free fall of the rammer shaft and head is unrestricted.

3.2.2 Mechanically Operated — A metal rammer which is equipped with a device to control the height of drop to a free fall of 12.00 ± 0.06 in. (305 ± 2 mm) above the elevation of the soil and uniformly distributes such drops to the soil surface (Note 3). The rammer shall have a mass of 5.5 ± 0.02 lb (2.495 ± 0.009 kg), and have a flat circular face of 2.000-in. (50.80 mm) diameter with a manufactured tolerance of 0.01 in. (± 0.25 mm). The in-service diameter of the flat circular face shall be not less than 1.985 in. (50.42 mm). The mechanical rammer shall be calibrated by ASTM D 2168.

Note 3: It may be impractical to adjust the mechanical apparatus so the free fall is 12 in. (305 mm) each time the rammer is dropped, as with the manually operated rammer. To make the adjustment of free fall, the portion of loose soil to receive the initial blow should be slightly compressed with the rammer to establish the point of impact from which the 12 in. (305 mm) drop is determined. Subsequent blows on the layer of soil being compacted may all be applied by dropping the rammer from a height of 12 in. (305 mm) above the initial-setting elevation; or, when the mechanical apparatus is designed with a height adjustment for each blow, all subsequent blows should have a rammer free fall of 12 in. (305 mm) measured from the elevation of the soil as compacted by the previous blow. A more detailed calibration procedure for laboratory mechanical-rammer soil compactors can be found in ASTM D 2168.

3.2.3 Rammer Face — The circular face rammer shall be used but a sector face may be used as an alternative provided the report shall indicate type of face used other than the 2-in. (50.8-mm) circular face and it shall have an area equal to that of the circular face rammer.

3.3 Sample Extruder (for Solid-Walled Molds Only) — A jack, lever, frame, or other device adopted for the purpose of extruding compacted specimens from the mold.

3.4 Balances and Scales — A balance or scale conforming to the requirements of AASHTO M 231, Class G 20. Also, a balance conforming to the requirements of AASHTO M 231, Class G 2.

Note 4: The capacity of the metric balance or scale should be approximately 11.5 kg when used to weigh the 6-in. (152.40-mm) mold and compacted, moist soil; however, when the 4-in. (101.60-mm) mold is used, a balance or scale of lesser capacity than the 11.5 kg may be used, if the sensitivity and readability is 5 g.

3.5 Drying Oven — A thermostatically controlled drying oven capable of maintaining a temperature of 230 ± 9°F (110 ± 5°C) for drying moisture samples.

3.6 Straightedge — A hardened-steel straightedge at least 10 in. (250 mm) in length. It shall have one beveled edge, and at least one longitudinal surface (used for final trimming) shall be plane
within 0.01 in. per 10 in. (0.250 mm per 250 mm) (0.1 percent) of length within the portion used for trimming the soil (Note 5).

**Note 5:** The beveled edge may be used for final trimming if the edge is true within a tolerance of 0.01 in. per 10 in. (0.250 mm per 250 mm) (0.1 percent) of length; however, with continued use, the cutting edge may become excessively worn and not suitable for trimming the soil to the level of the mold. The straightedge should not be so flexible that trimming the soil with the cutting edge will cause a concave soil surface.

3.7 Sieves — 2-in. (50-mm), 3/4-in. (19.0-mm), and No. 4 (4.75-mm) sieves conforming to the requirements of M 92.

3.8 Mixing Tools — Miscellaneous tools such as mixing pan, spoon, trowel, spatula, etc., or a suitable mechanical device for thoroughly mixing the sample of soil with increments of water.

3.9 Containers — Suitable containers made of material resistant to corrosion and not subject to change in mass or disintegration on repeated heating and cooling. Containers shall have close-fitting lids to prevent loss of moisture from samples before initial mass determination and to prevent absorption of moisture from the atmosphere following drying and before final mass determination. One container is needed for each moisture content determination.

### METHOD A

4. **SAMPLE**

4.1 If the soil sample is damp when received from the field, dry it until it becomes friable under a trowel. Drying may be in air or by use of a drying apparatus which is maintained at a temperature not exceeding 140°F (60°C). Then thoroughly break up the aggregations in such a manner as to avoid reducing the natural size of individual particles.

4.2 Sieve an adequate quantity of the representative pulverized soil over the No. 4 (4.75-mm) sieve. Discard the coarse material, if any, retained on the No. 4 (4.75-mm) sieve.

4.3 Select a representative sample, with a mass of approximately 7 lb (3 kg) or more, of the soil prepared as described in Sections 4.1 and 4.2.

**Note 6**—When developing a compaction curve for free draining soils, such as uniform sands and gravels, where seepage occurs at the bottom of the mold and base plate, taking a representative moisture content sample from the mixing bowl may be preferred in order to determine the amount of moisture available for compaction.

5. **PROCEDURE**

5.1 Thoroughly mix the selected representative sample with sufficient water to dampen it to approximately four percentage points below optimum moisture content.

5.2 Form a specimen by compacting the prepared soil in the 4-in. (101.60-mm) mold (with collar attached) in three approximately equal layers to give a total compacted depth of about 5 in. (125 mm). Prior to compaction, place the loose soil into the mold and spread into a layer of uniform thickness. Lightly tamp the soil prior to compaction until it is not in a loose or fluffy state, using either the manual compaction rammer or similar device having a face diameter of approximately 2 in. (50 mm). Following compaction of each of the first two layers, any soil adjacent to the mold walls that has not been compacted or extends above the compacted surface shall be trimmed using a knife or other suitable device, and be evenly distributed on top of the layer. Compact each layer by 25 uniformly distributed blows from the rammer dropping free from a height of 12 in. (305 mm) above the elevation of the soil when a sleeve-type rammer is used, or from 12 in. (305 mm) above the approximate elevation of
compacted soil when a stationary mounted type of rammer is used. During compaction, the mold shall rest firmly on a dense, uniform, rigid, and stable foundation or base. This base shall remain stationary during the compaction process (Note 7).

**Note 7:** Each of the following has been found to be a satisfactory base on which to rest the mold during compaction of the soil: A block of concrete, with a mass not less than 200 lb (90 kg), supported by a relatively stable foundation; a sound concrete floor; and for field application, such surfaces as are found in concrete box culverts, bridges, and pavements.

5.2.1 Following compaction, remove the extension collar, carefully trim the compacted soil even with the top of the mold by means of the straightedge, and determine the mass of the mold and moist soil in kilograms to the nearest 5 grams, or determine the mass in pounds to the nearest 0.01 pounds. For molds conforming to tolerances given in Section 3.1.1 and masses recorded in kilograms, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 1060, and record the result as the wet density, \(W_1\), in kilograms per cubic meter, of compacted soil. For molds conforming to tolerances given in Section 3.1.1 and masses recorded in pounds, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 30, and record the result as the wet density, \(W_1\), in pounds per cubic foot, of compacted soil. For used molds out of tolerance by not more than 50 percent (Section 3.1.3), use the factor for the mold as determined in accordance with Calibration of Measure in AASHTO T 19/T 19M.

5.3 Remove the material from the mold and slice vertically through the center. Take a representative sample of the material from one of the cut faces, weigh immediately and dry in accordance with T 255 or T 265, to determine the moisture content, and record the results.

5.4 Thoroughly break up the remaining portion of the molded specimen until it will pass a No. 4 (4.75-mm) sieve as judged by eye, and add to the remaining portion of the sample being tested. Add water in sufficient amount to increase the moisture content of the soil one to two percentage points (water content increments should not exceed 2.5 percent except when heavy clay soils or organic soils exhibiting flat elongated curves are encountered, the water content increments may be increased to a maximum of 4 percent), and repeat the above procedure for each increment of water added. Continue this series of determinations until there is either a decrease or no change in the wet unit mass, \(W_1\), per cubic foot (cubic meter) of the compacted soil (Note 8).

**Note 8:** This procedure has been found satisfactory in most cases. However, in instances where the soil material is fragile in character and will reduce significantly in grain size due to repeated compaction, and in cases where the soil is a heavy-textured clayey material into which it is difficult to incorporate water, a separate and new sample shall be used in each compaction test. In these cases, separate samples shall be thoroughly mixed with amounts of water sufficient to cause the moisture contents of the samples to vary by approximately two percentage points. The moisture points selected shall bracket the optimum moisture content, thus providing samples which, when compacted, will increase in mass to the maximum density and then decrease in mass. The samples of soil-water mixtures shall be placed in covered containers and allowed to stand for not less than 12 hours before making the moisture-density test.

5.4.1 In instances where the soil material is fragile in character and will be reduced significantly in grain size by repeated compaction, a separate and new sample shall be used in each compaction test.
METHOD B

6. SAMPLE

6.1 Select the representative sample in accordance with Section 3.3, except that it shall have a mass of approximately 16 lb (7 kg).

7. PROCEDURE

7.1 Follow the same procedure as described for Method A in Section 4, except for the following: Form a specimen by compacting the prepared soil in the 6-in. (152.4-mm) mold (with collar attached) in three approximately equal layers to give a total compacted depth of about 5 in. (125 mm), each layer being compacted by 56 uniformly distributed blows from the rammer. For molds conforming to tolerances given in Section 2.1.2, and masses recorded in kilograms, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 471, and record the result as the wet density, \( W_1 \), in kilograms per cubic meter, of compacted soil. For molds conforming to tolerances given in Section 2.1.2, and masses recorded in pounds, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 13.3, and record the result as the wet density, \( W_1 \), in pounds per cubic foot, of compacted soil. For used molds out of tolerance by not more than 50 percent (Section 3.1.3), use the factor for the mold as determined in accordance with Calibration of Measure in 19/T 19M.

METHOD C

8. SAMPLE

8.1 If the soil sample is damp when received from the field, dry it until it becomes friable under a trowel. Drying may be in air or by use of a drying apparatus which is maintained at a temperature not exceeding 140°F (60°C). Then thoroughly break up the aggregations in such a manner as to avoid reducing the natural size of individual particles.

8.2 Sieve an adequate quantity of the representative pulverized soil over the 19.0-mm sieve. Discard the coarse material, if any, retained on the 3/4 in. (19.0-mm) sieve (Note 9).

Note 9: If it is advisable to maintain the same percentage of coarse material (passing a 2 in. (50-mm) sieve and retained on a No. 4 (4.75-mm) sieve) in the moisture-density sample as in the original field sample, the material retained on the 3/4 in. (19.0-mm) sieve shall be replaced as follows: Sieve an adequate quantity of the representative pulverized soil over the 2 in. - 3/4 in. (50- and 19.0-mm) sieves. Determine the mass of the material passing the 2 in. (50-mm) sieve and retained on the 3/4 in. (19.0-mm) sieve and replace it with an equal mass of material passing the 3/4 in. (19.0-mm) sieve and retained on the No. 4 (4.75-mm) sieve. Take the material for replacement from the remaining portion of the sample.

8.3 Select a representative sample, having a mass of approximately 11 lb (5 kg) or more, of the soil prepared as described in Sections 8.1 and 8.2.

9. PROCEDURE

9.1 Thoroughly mix the selected representative sample with sufficient water to dampen it to approximately 4 percentage points below optimum moisture content.
9.2 Form a specimen by compacting the prepared soil in the 4-in. (101.60-mm) mold (with collar attached) in three approximately equal layers to give a total compacted depth of about 5 in. (125 mm). Prior to compaction, place the loose soil into the mold and spread into a layer of uniform thickness. Lightly tamp the soil prior to compaction until it is not in a loose or fluffy state, using either the manual compaction rammer or similar device having a face diameter of approximately 2 in. (50 mm). Following compaction of each of the first two layers, any soil adjacent to the mold walls that has not been compacted or extends above the compacted surface shall be trimmed using a knife or other suitable device, and be evenly distributed on top of the layer. Compact each layer by 25 uniformly distributed blows from the rammer dropping free from a height of 12 in. (305 mm) above the elevation of the soil when a sleeve-type rammer is used, or from 12 in. (305 mm) above the approximate elevation of each finely compacted layer when a stationary mounted type rammer is used. During compaction, the mold shall rest firmly on a dense, uniform, rigid and stable foundation (Note 7).

9.2.1 Following compaction, remove the extension collar, carefully trim the compacted soil even with the top of the mold by means of the straightedge. Holes developed in the surface by removal of coarse material shall be patched with smaller sized material. Determine the mass of the mold and moist soil in kilograms to the nearest 5 grams, or determine the mass in pounds to the nearest 0.01 pounds. For molds conforming to tolerances given in Section 3.1.1 and masses recorded in kilograms, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 1060, and record the result as the wet density, \( W_1 \), in kilograms per cubic meter, of compacted soil. For molds conforming to tolerances given in Section 3.1.1 and masses recorded in pounds, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 30, and record the result as the wet density, \( W_1 \), in pounds per cubic foot, of compacted soil. For used molds out of tolerance by not more than 50 percent (3.1.3), use the factor for the mold as determined in accordance with Section 8 (Calibration of Measure), AASHTO T 19/T 19M.

9.3 Remove the material from the mold and slice vertically through the center. Take a representative sample of the material from one of the cut faces, determine the mass immediately and dry in accordance with T 255 or T 265, to determine the moisture content, and record the results.

9.4 Thoroughly break up the remainder of the material until it will pass a 3/4 in. (19.0-mm) sieve and 90 percent of the soil aggregations will pass a No. 4 (4.75-mm) sieve as judged by eye, and add to the remaining portion of the sample being tested. Add water in sufficient amounts to increase the moisture content of the soil sample by one or two percentage points, and repeat the above procedure for each increment of water added. Continue this series of determinations until there is either a decrease or no change in the wet mass, \( W_1 \), per cubic foot (cubic meter) of compacted soil (Note 8).

**METHOD D**

10. SAMPLE

10.1 Select the representative sample in accordance with Section 8.3 except that it shall have a mass of approximately 25 lb (11 kg).

11. PROCEDURE

11.1 Follow the same procedure as described for Method C in Section 9, except for the following:
Form a specimen by compacting the prepared soil in the 6-in. (152.4-mm) mold (with collar attached) in three approximately equal layers to give a total compacted depth of about 5 in.
(125 mm), each layer being compacted by 56 uniformly distributed blows from the rammer. For molds conforming to tolerances given in Section 3.1.2, and masses recorded in kilograms, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 471, and record the result as the wet density, $W_1$, in kilograms per cubic meter, of compacted soil. For molds conforming to tolerances given in Section 3.1.2, and masses recorded in pounds, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 13.33, and record the result as the wet density, $W_1$, in pounds per cubic foot, of the compacted soil. For used molds out of tolerance by not more than 50 percent (Section 3.1.3), use the factor for the mold as determined in accordance with Section 9 (Calibration of Measure), T 19/T 19M.

**CALCULATIONS AND REPORT**

12. **CALCULATIONS**

12.1 Calculate the moisture content and the dry unit mass of the soil as compacted for each trial, as follows:

$$w = \frac{A-B}{B-C} \times 100$$

and

$$W = \frac{W_1}{W+100} \times 100$$

where:

- $w$ = percentage of moisture in the specimen, based on oven dry mass of soil;
- $A$ = mass of container and wet soil;
- $B$ = mass of container and dry soil;
- $C$ = mass of container;
- $W$ = dry mass, in kilograms per cubic meter of compacted soil, or pounds per cubic foot of compacted soil; and
- $W_1$ = wet mass, in kilograms per cubic meter of compacted soil, or pounds per cubic foot of compacted soil.

13. **MOISTURE-DENSITY RELATIONSHIP**

13.1 The calculations in Section 12.1 shall be made to determine the moisture content and corresponding oven-dry unit mass (density) in kilograms per cubic meter or pounds per cubic foot of the compacted samples. The oven-dry densities (unit mass) of the soil shall be plotted as ordinates and the corresponding moisture content as abscissas.

13.2 Optimum Moisture Content — When the densities and corresponding moisture contents for the soil have been determined and plotted as indicated in Section 13.1, it will be found that by connecting the plotted points with a smooth line, a curve is produced. The moisture content
corresponding to the peak of the curve shall be termed the “optimum moisture content” of the soil under the above compaction.

13.3 Maximum Density — The oven-dry density in pounds per cubic foot (kilograms per cubic meter) of the soil at optimum moisture content shall be termed “maximum density” under the above compaction.

14. REPORT

14.1 The report shall include the following:

14.1.1 The method used (Method A, B, C, or D).

14.1.2 The optimum moisture content, as a percentage, to the nearest whole number.

14.1.3 The maximum density in pounds per cubic foot to the nearest whole number (kilograms per cubic meter to the nearest 10 kg/m³).

14.1.4 In Methods C and D indicate if the material retained on the 3/4 in. (19.0-mm) sieve was removed or replaced.

14.1.5 Type of face if other than 2 in. (50.8 mm) circular.

15. PRECISION STATEMENT

15.1 Repeatability — (Single operator) – Two results obtained by the same operation on the same sample in the same laboratory using the same apparatus, and on different days should be considered suspect if they differ by more than 10 percent of their mean for optimum moisture content and 2.2 lb/ft³ (35 kg/m³) for maximum density.

15.2 Reproducibility — (Multi-Laboratory) – Two results obtained by different operators in different laboratories should be considered suspect if they differ by more than 15 percent of their mean for optimum moisture and 4.5 lb/ft³ (72 kg/m³) for maximum density.
Tester Qualification Practical Exam Checklist

**Moisture-Density Relations of Soils Using a 5.5-lb (2.5-kg) Rammer and a 12-in. (305-mm) Drop**

**FOP for AASHTO T 99**

<table>
<thead>
<tr>
<th>Procedure Element</th>
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</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. If damp, sample dried in air or drying apparatus, not exceeding 140°F (60°C)?</td>
</tr>
<tr>
<td>2. Sample pulverized and adequate amount sieved over the No. 4 (4.75 mm) sieve?</td>
</tr>
<tr>
<td>3. Material retained on the sieve discarded?</td>
</tr>
<tr>
<td>4. Sample passing the sieve has appropriate mass?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sample mixed with water to approximately 4 percent below expected optimum moisture content?</td>
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<tr>
<td>2. Layer of soil placed in mold with collar attached?</td>
</tr>
<tr>
<td>3. Mold placed on rigid and stable foundation?</td>
</tr>
<tr>
<td>4. Lightly tamp soil in mold?</td>
</tr>
<tr>
<td>5. Soil compacted with 25 blows?</td>
</tr>
<tr>
<td>6. Scrape sides of mold and evenly distributed on top of the layer?</td>
</tr>
<tr>
<td>7. Soil placed and compacted in three equal layers?</td>
</tr>
<tr>
<td>8. Collar removed and soil trimmed to top of mold with straightedge?</td>
</tr>
<tr>
<td>9. Mass of mold and contents determined to appropriate precision?</td>
</tr>
<tr>
<td>10. Wet mass of specimen multiplied by appropriate factor to obtain wet density (.03333 lbs/ft³)?</td>
</tr>
<tr>
<td>11. Soil removed from mold using sample extruder?</td>
</tr>
<tr>
<td>12. Soil sliced vertically through center?</td>
</tr>
<tr>
<td>13. Moisture sample removed from one cut face and moist mass determined immediately?</td>
</tr>
<tr>
<td>14. Moisture sample mass of at least 100 g?</td>
</tr>
</tbody>
</table>
Procedure

15. Sample dried and water content determined according to AASHTO T 255 or T 265?  
   [ ] Yes  [ ] No

16. Remainder of material from mold broken up to about passing sieve size and added to remainder of original test sample?  
   [ ] Yes  [ ] No

17. Water added to increase moisture content in approximately 2 percent increments?  
   [ ] Yes  [ ] No

18. Steps 2 through 15 repeated for each increment of water added?  
   [ ] Yes  [ ] No

19. If soil is plastic (clay types):
   
   a. Sample mixed with water varying moisture content by approximately 2 percent, bracketing the optimum moisture content?  
      [ ] Yes  [ ] No
   
   b. Samples placed in covered containers and allowed to stand for at least 12 hours?  
      [ ] Yes  [ ] No

20. Process continued until wet density either decreases or stabilizes?  
   [ ] Yes  [ ] No

21. Water content and dry density calculated for each sample?  
   [ ] Yes  [ ] No

22. Dry density plotted on vertical axis, moisture content plotted on horizontal axis, and points connected with a smooth curve?  
   [ ] Yes  [ ] No

23. Water content at peak of curve recorded as optimum water content and recorded to nearest 1 percent?  
   [ ] Yes  [ ] No

24. Dry density at optimum water content reported as maximum density, to nearest 1 lb/ft³ (10 kg/m³)?  
   [ ] Yes  [ ] No

25. All calculations performed correctly?  
   [ ] Yes  [ ] No

First attempt:  Pass [ ] Fail [ ]  
Second attempt:  Pass [ ] Fail [ ]

Signature of Examiner __________________________________________

Comments:

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
WSDOT FOP for AASHTO T 119

Standard Test Method for Slump of Hydraulic-Cement Concrete

1. SCOPE
   1.1 This test method covers determination of slump of concrete, both in the laboratory and in the field.
   1.2 The values stated in English units are to be regarded as the standard.
   1.3 This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.
   1.4 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

2. REFERENCED DOCUMENTS
   2.1 AASHTO Standards:
      T 141 Sampling Freshly Mixed Concrete
   2.2 ASTM Standards:
      C 172 Practice for Sampling Freshly Mixed Concrete

3. SUMMARY OF TEST METHOD
   3.1 A sample of freshly mixed concrete is placed and compacted by rodding in a mold shaped as the frustum of a cone. The mold is raised, and the concrete allowed to subside. The distance between the original and displaced position of the center of the top surface of the concrete is measured and reported as the slump of the concrete.

4. SIGNIFICANCE AND USE
   4.1 This test method is intended to provide the user with a procedure to determine slump of plastic hydraulic-cement concretes.

   Note 1: This test method was originally developed to provide a technique to monitor the consistency of unhardened concrete. Under laboratory conditions, with strict control of all concrete materials, the slump is generally found to increase proportionally with the water content of a given concrete mixture, and thus to be inversely related to concrete strength. Under field conditions, however, such a strength relationship is not clearly and consistently shown. Care should therefore be taken in relating slump results obtained under field conditions to strength.

   4.2 This test method is considered applicable to plastic concrete having coarse aggregate up to 1½ in. (37.5 mm) in size. If the coarse aggregate is larger than 1½ in. (37.5 mm) in size, the test method is applicable when it is performed on the fraction of concrete passing a 1½-in. (37.5-mm) sieve, with the larger aggregate being removed in accordance with the section titled “Additional Procedure for Large Maximum Size Aggregate Concrete” in Practice T 141.

   4.3 This test method is not considered applicable to non-plastic and non-cohesive concrete.

†This FOP is based on AASHTO T 119-99.
Note 2—Concretes having slumps less than 0.5 in. (15 mm) may not be adequately plastic and concretes having slumps greater than about 9 in. (230 mm) may not be adequately cohesive for this test to have significance. Caution should be exercised in interpreting such results.

5. APPARATUS

5.1 Mold — The test specimen shall be formed in a mold made of metal not readily attacked by the cement paste. The metal shall not be thinner than 0.060 in. (1.5 mm) and if formed by the spinning process, there shall be no point on the mold at which the thickness is less than 0.045 in. (1.15 mm). The mold shall be in the form of the lateral surface of the frustum of a cone with the base 8 in. (200 mm) in diameter, the top 4 in. (100 mm) in diameter, and the height 12 in. (300 mm). Individual diameters and heights shall be within $\pm \frac{1}{8}$ in. (3.2 mm) of the prescribed dimensions. The base and the top shall be open and parallel to each other and at right angles to the axis of the cone. The mold shall be provided with foot pieces and handles similar to those shown in Figure 1. The mold shall be constructed without a seam. The interior of the mold shall be relatively smooth and free from projections. The mold shall be free from dents, deformation or adhered mortar. A mold which clamps to a nonabsorbent base plate is acceptable instead of the one illustrated provided the clamping arrangement is such that it can be fully released without movement of the mold and the base is large enough to contain all of the slumped concrete in an acceptable test.

5.1.1 Mold with alternative materials.

5.1.1.1 Molds other than metal are permitted if the following requirements are met:

The mold shall meet the dimensional requirements of 5.1. The mold shall be sufficiently rigid to maintain the specified dimensions and tolerances during use, resistant to impact forces, and shall be nonabsorbent. The mold shall be demonstrated to provide test results comparable to those obtained when using a metal mold meeting the requirements of 5.1. Comparability shall be demonstrated on behalf of the manufacturer by an independent testing laboratory. Test for comparability shall consist of not less than 10 individual comparisons performed at each of 3 different slumps ranging from 2 in. (50 mm) to 6 in. (150 mm). No individual test results shall vary by more than 0.50 in. (15 mm) from that obtained using the metal mold. The average test results of each slump range obtained using the mold constructed of alternative material shall not vary by more than 0.30 in. (10 mm) from the average of test results obtained using the metal mold. If any changes in material or method of manufacture are made, tests for comparability shall be repeated.

5.1.1.2 If the condition of any individual mold is suspected of being out of tolerance from the as manufactured condition, a single comparative test shall be performed. If the test results differ by more than 0.50 in. (15 mm) from that obtained using the metal mold, the mold shall be removed from service.

5.2 Tamping Rod — The tamping rod shall be a round, straight steel rod $\frac{5}{8}$ in. (16 mm) in diameter and approximately 24 in. (600 mm) in length, having the tamping end or both ends rounded to a hemispherical tip, the diameter of which is $\frac{3}{4}$ in. (16 mm).

5.3 Torpedo level

5.4 Base — Flat, nonabsorbent, rigid surface.
6. SAMPLE

6.1 The sample of concrete from which test specimens are made shall be representative of the entire batch. It shall be obtained in accordance with FOP for WAQTC TM 2.

7. PROCEDURE

7.1 Dampen the mold and place it on a firm, flat, nonabsorbent, level surface. It shall be held firmly in place during filling by the operator standing on the two foot pieces. From the sample of concrete obtained in accordance with Section 6, immediately fill the mold in three layers, each approximately one third the volume of the mold.

*Note 3:* One third of the volume of the slump mold fills it to a depth of 25/8 in. (67 mm); two thirds of the volume fills it to a depth of 6 1/8 in. (155 mm).

7.2 Rod each layer with 25 strokes of the tamping rod. Uniformly distribute the strokes over the cross section of each layer. For the bottom layer this will necessitate inclining the rod slightly and making approximately half of the strokes near the perimeter, and then progressing with vertical strokes spirally toward the center. Rod the bottom layer throughout its depth. Rod the second layer and the top layer each throughout its depth, so that the strokes just penetrate into the underlying layer.
7.3 In filling and rodding the top layer, heap the concrete above the mold before rodding is started. If the rodding operation results in subsidence of the concrete below the top edge of the mold, add additional concrete to keep an excess of concrete above the top of the mold at all times. After the top layer has been rodded, strike off the surface of the concrete by means of a screeding and rolling motion of the tamping rod.

Remove the mold immediately from the concrete by raising it carefully in a vertical direction. Raise the mold a distance of approximately 12 in. (300 mm) in 5 + 2 seconds by a steady upward lift with no lateral or torsional motion. Complete the entire test from the start of the filling through removal of the mold without interruption and complete it within an elapsed time of 2½ min.

7.4 Immediately measure the slump by determining the vertical difference between the top of the mold and the displaced original center of the top surface of the specimen. If a decided falling away or shearing off of concrete from one side or portion of the mass occurs (Note 4), disregard the test and make a new test on another portion of the sample.

*Note 4:* If two consecutive tests on a sample of concrete show a falling away or shearing off of a portion of the concrete from the mass of the specimen, the concrete probably lacks necessary plasticity and cohesiveness for the slump test to be applicable. Report material cannot be slumped due to shearing or falling away.

8. REPORT

8.1 Report the slump in terms of inches (millimeters) to the nearest ¼ in. (5 mm) of subsidence of the specimen during the test as follows:

\[
\text{Slump} = 12 \text{ inches of height after subsidence}
\]

\[
\text{Slump} = 300 \text{ mm of height after subsidence}
\]

Report results on concrete delivery ticket (i.e., Certificate of Compliance).

9. PRECISION AND BIAS

9.1 Precision:

9.1.1 *Interlaboratory Test Method*—No interlaboratory test program has been run on this test method. Since it is not possible to provide equivalent concretes at various test sites free of errors from sources other than the slump measurement, a multilaboratory precision statement would not be meaningful.

9.1.2 *Multi-Operator Test Results*—Extensive field data\(^1\) allow a statement regarding the multi-operator precision of this test method.

*Test Range*, 1.5 to 2.76 in. (38 to 70 mm)

*Total number of samples*, 2,304

*Pooled repeatability Standard deviation (1S)*, 0.30 in. (8 mm)

*95 percent Repeatability Limit (D2S)*, 0.83 in. (21 mm)

Therefore, results of two properly conducted tests by different operators in the same laboratory on the same material should not differ by more than 0.83 in. (21 mm). Due to the limited slump range in the concrete used in this test program, caution should be exercised in applying these precision values.
9.2 *Bias*—This test method has no bias since slump is defined in terms of this test method.

Note 5—The precision data are based upon the use of metal cones. No specific data are available for multi-operator test results with alternative cone materials.
**Performance Exam Checklist**

*Slump of Hydraulic Cement Concrete*

**FOP for AASHTO T 119**

**Participant Name** ____________________________________________  
**Exam Date** ______________

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure, and if required,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>has the current calibration/verification tags present?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Cone and floor or base plate dampened?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Cone held firmly against the base by standing on the two foot pieces?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cone not allowed to move in any way during filling?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Representative samples scooped into the cone?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Cone filled in three approximately equal layers (by volume), the first to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a depth of 25/8 in. (67 mm), the second to a depth of 61/8 in. (155 mm),</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and the third to just over the top of the cone?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Each layer rodded throughout its depth 25 times with hemispherical end of rod,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>uniformly distributing strokes?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Middle and top layers rodded to just penetrate into the underlying layer?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. When rodding the top layer, excess concrete kept above the mold at all times?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Concrete struck off level with top of cone using tamping rod?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Cone lifted upward approximately 12 in. (300 mm) in one smooth motion, without</td>
<td></td>
<td></td>
</tr>
<tr>
<td>twisting the cone, in 5 ± 2 seconds?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Slump measured to the nearest 1/4 in. (5 mm) from the top of the cone to the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>displaced original center of the top surface of the specimen?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Test performed from start to finish within 2½ minutes?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**First attempt:**  Pass ☐ Fail ☐  
**Second attempt:** Pass ☐ Fail ☐

Signature of Examiner ____________________________________________

**Comments:**

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
WSDOT Test Method T 123

Method of Test for Bark Mulch

1. SCOPE
   a. This method covers a procedure for determining the sieve analysis and material finer than \( \frac{1}{4} \) in. (6.3 mm) using a loose volume bucket.

2. EQUIPMENT
   a. A mechanical sieve shaker.
   b. Sieves — A 11/2 in. (37.5 mm) and No. 4 (4.75 mm) sieves conforming to the requirements of AASHTO M-92. Breaker sieves may be used.
   c. Volume Bucket — A container calibrated in 1 gal. (1 L) increments from 1 to 5 gal. (1 to 20 L). A 5-gal. bucket may be used when calibrated as follows:
      On a level surface calibrate the container by gradually filling it with water in 1 gal. (1 L) increments. Mark the inner wall of the container after the addition of each liter.

3. PROCEDURE
   a. Air dry (140°F (60°C) max.) the sample for 15 hours, ± 4 hours.
   b. Reduce the sample to testing size per the FOP for AASHTO T 248.
   c. Place the sample in the volume bucket and record the volume as the total volume.
   d. Shake the sample over the 11/2 in. (37.5 mm) and No. 4 (4.75 mm) sieves. Using breaker sieves inserted between the two specified sieves so the No. 4 (4.75 mm) sieve will not be overloaded. Use caution to avoid over sieving as the wood material breaks down.
   e. The material retained on the 11/2 in. (37.5 mm) sieve is measured in the volume bucket and recorded.
   f. The material on the breaker sieves is added to the material retained on the No. 4 (4.75 mm) sieve and the volume measured in the volume bucket and recorded.
   g. The percent passing is calculated as follows:

\[
100 - \left( \frac{\text{Volume on sieve} \times 100}{\text{Total Volume}} \right) = \% \text{ passing}
\]
Performance Exam Checklist

Method of Test for Bark Mulch
WSDOT T 123

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure,</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>and if required, has the current calibration/verification tags present?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. Bark mulch sample dried @ 140°F (60°C)?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. Five (5) gallon bucket calibrated in 1 gal. (1 L) increments?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. Sample quartered or split and placed in calibrated bucket?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. Volume of sample in bucket recorded as total volume?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7. Sample screened in the Gilson shaker through 1 1/2 in. (37.5 mm) screen,</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>breaker screens and No. 4 (4.75 mm) screen?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8. Do not over shake to prevent degrading of sample?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9. Remove 1 1/2 in. (37.5 mm) screen and damp material in calibrated bucket</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>and record volume as volume on 1 1/2 in. (37.5 mm) screen?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10. Place all breaker screen material down to No. 4 (4.75 mm) screen in bucket</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>and record volume as volume on No. 4 (4.75 mm) screen?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11. Calculate:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% passing 1 1/2 in. (37.5 mm) =</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>100 – (volume on 1 1/2 in. (37.5 mm) screen x 100)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Volume</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% passing No. 4 (4.75 mm) =</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>100 – (volume on No. 4 (4.75 mm) screen x 100)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Volume</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. All calculations performed correctly?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13. Report results?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

First attempt: Pass ☐ Fail ☐  Second attempt: Pass ☐ Fail ☐

Signature of Examiner __________________________________________
AIR CONTENT OF FRESHLY MIXED CONCRETE BY THE PRESSURE METHOD

FOP for AASHTO T 152

SIGNIFICANCE

Concrete is not a solid, but rather a solid with void spaces. The voids may contain gas such as air, or liquid, such as water. All concrete contains air voids, and the amount can be increased by the addition of an air entraining agent to the mix. When such an agent is used, the size of the voids drastically decreases and the number of voids greatly increases, providing a much greater dispersal of voids.

Air entrainment is necessary in concrete that will be saturated and exposed to cycles of freezing and thawing, and to deicing chemicals. The microscopic entrained air voids provide a site for relief of internal pressure that develops as water freezes and thaws inside the concrete. Without the proper entrained-air content, normal concrete that is saturated and is exposed to cycles of freezing and thawing can fail prematurely by scaling, spalling, or cracking.

Care must be taken, however, not to have too much entrained air. As the air content increases, there will be a corresponding reduction in the strength and other desirable properties of the concrete. Typically, this strength reduction will be on the order of 3 to 5 percent for each 1 percent of air content above the mix design value. Concrete proportioned for 5 percent air, for example, will be approximately 15 to 25 percent lower in strength if the air content were to double.

SCOPE

This procedure covers determination of the air content in freshly mixed portland cement concrete containing dense aggregates in accordance with AASHTO T 152 (Type B meter). It is not for use with lightweight or highly porous aggregates. This procedure includes calibration of the "Type B" air meter gauge, and two methods for calibrating the gauge are presented. Concrete containing aggregate that would be retained on the 2 in (50 mm) sieve must be wet sieved. Sieve a sufficient amount of the sample over the 1 ½ in (37.5 mm) sieve per AASHTO 141.

APPARATUS

- Air meter: Type B, as described in AASHTO T 152
- Balance or scale: Accurate to 0.3 percent of the test load at any point within the range of use (for Method 1 calibration only)
- Tamping rod: 5/8 in. (16 mm) diameter and approximately 24 in. (600 mm) long, having a hemispherical tip. (Hemispherical means half a sphere; the tip is rounded like half of a ball.)
- Vibrator: 7000 vibrations per minute, 0.75 to 1.50 in. (19 to 38 mm) in diameter, at least 3 in. (75 mm) longer than the section being vibrated for use with low slump concrete
- Scoop
- Container for water: rubber syringe (may also be a squeeze bottle)
- Strike-off bar: Approximately 12 in. x 3/4 in. x 1/8 in. (300 mm x 22 mm x 3 mm).
- Strike-off Plate: A flat rectangular metal plate at least 1/4 in. (6 mm) thick or a glass or acrylic plate at least 1/2 in. (12 mm) thick, with a length and width at least 2 in. (50 mm) greater than the diameter of the measure with which it is to be used. The edges of the plate shall be straight and smooth within tolerance of 1/16 in. (1.5 mm).
Note 1: Use either the strike-off bar or strike-off plate; both are not required.

- Mallet: With a rubber or rawhide head having a mass of 1.25 ±0.5 lb (0.57 ±0.23 kg)

CALIBRATION OF AIR METER GAUGE

Note 2: There are two methods for calibrating the air meter, mass or volume.

1. Screw the short piece of straight tubing into the threaded petcock hole on the underside of the cover. Determine the mass of the dry, empty air meter base and cover assembly (Mass Method only).

2. Fill the base nearly full with water.

3. Clamp the cover on the base with the tube extending down into the water. Mark the petcock with the tube attached for future reference.

4. Add water through the petcock having the pipe extension below until all air is forced out the other petcock. Rock the meter slightly until all air is expelled through the petcock.

5. Wipe off the air meter base and cover assembly, and determine the mass of the filled unit (Mass Method only).

6. Pump up the air pressure to a little beyond the predetermined initial pressure indicated on the gauge. Wait a few seconds for the compressed air to cool, and then stabilize the gauge hand at the proper initial pressure by pumping up or relieving pressure, as needed.

7. Close both petcocks and immediately open the main air valve exhausting air into the base. Wait a few seconds until the meter needle stabilizes. The gauge should now read 0 percent. If two or more tests show a consistent variation from 0 percent in the result, change the initial pressure line to compensate for the variation, and use the newly established initial pressure line for subsequent tests.

8. Determine which petcock has the straight tube attached to it. Attach the curved tube to external portion of the same petcock.

9. Pump air into the air chamber. Open the petcock with the curved tube attached to it. Open the main air valve for short periods of time until 5 percent of water by mass or volume has been removed from the air meter. Remember to open both petcocks to release the pressure in the base and drain the water in the curved tube back into the base. To determine the mass of the water to be removed, subtract the mass found in Step 1 from the mass found in Step 5. Multiply this value by 0.05. This is the mass of the water that must be removed. To remove 5 percent by volume, remove water until the external calibrating vessel is level full.

Note 3: Many air meters are supplied with a calibration vessel(s) of known volume that are used for this purpose. Calibration vessel(s) should be brass, not plastic, and must be protected from crushing or denting.

If an external calibration vessel is used, confirm what percentage volume it represents for the air meter being used. Vessels commonly represent 5 percent volume, but they are for specific size meters. This should be confirmed by mass.

10. Remove the curved tube. Pump up the air pressure to a little beyond the predetermined initial pressure indicated on the gauge. Wait a few seconds for the compressed air to cool, and then stabilize the gauge hand at the proper initial pressure by pumping up or relieving pressure, as needed.
11. Close both petcocks and immediately open the main air valve exhausting air into the base. Wait a few seconds until the meter needle is stabilized. The gauge should now read 5.0 ± 0.1 – 5.0 ± 0.2 percent. If the gauge is outside that range, the meter needs adjustment. (Consult the Region Materials Lab) The adjustment could involve adjusting the starting point so that the gauge reads 5.0 ± 0.1 – 5.0 ± 0.2 percent when this calibration is run, or could involve moving the gauge needle to read 5.0 percent. Any adjustment should comply with the manufacturer’s recommendations.

**Note 4:** Calibration shall be performed at the frequency required by the agency. Record the date of the calibration, the calibration results, and the name of the technician performing the calibration in the log book kept with each air meter.

12. When the gauge hand reads correctly at 5.0 percent, additional water may be withdrawn in the same manner to check the results at other values such as 10 percent or 15 percent.

13. If an internal calibration vessel is used follow steps 1 thru 8 to set initial reading.

14. Release pressure from the base and remove cover. Place the internal calibration vessel into the base. This will displace 5 percent of the water in the base. (see AASHTO 152 for more information on internal calibration vessels)

15. Place the cover back on the base and add water through the petcock until all the air has been expelled.

16. Pump up the air pressure chamber to the initial pressure. Wait a few seconds for the compressed air to cool, and then stabilize the gauge hand at the proper initial pressure by pumping up or relieving pressure, as needed.

17. Close both petcocks and immediately open the main air valve exhausting air into the base. Wait a few seconds until the meter needle stabilizes. The gauge should now read 5 percent.

**Note 5:** Remove the extension tubing from threaded petcock hole in the underside of the cover before starting the test procedure.

**PROCEDURE - GENERAL**

**Note 6:** There are two methods of consolidating the concrete – rodding and internal vibration. If the slump is greater than 3 in. (75 mm), consolidation is by rodding. When the slump is 1 to 3 in. (25 to 75 mm), internal vibration or rodding can be used to consolidate the sample, but the method used must be that required by the agency in order to obtain consistent, comparable results. For slumps less than 1 in. (25 mm), consolidate the sample by internal vibration. The internal vibration procedure follows this general procedure.

1. Obtain the sample in accordance with the FOP for WAQTC TM 2. With concrete using 1½ in. (37.5 mm) or larger aggregate, the 1½ in. (37.5 mm) aggregate must be removed.

**Note 7:** Testing shall begin within five minutes of obtaining the sample.

2. Dampen the inside of the air meter base.

3. Fill the base approximately 1/3 full with concrete.

4. Consolidate the layer with 25 strokes of the tamping rod, using the rounded end. Distribute the strokes evenly over the entire cross section of the concrete. Rod throughout its depth without hitting the bottom too hard.
5. Tap the sides of the base smartly 10 to 15 times with the mallet to close voids and release trapped air.
6. Add the second layer, filling the base about 2/3 full.
7. Consolidate this layer with 25 strokes of the tamping rod, penetrating about 1 in (25 mm) into the bottom layer.
8. Tap the sides of the base 10 to 15 times with the mallet.
9. Add the final layer, slightly overfilling the base.
10. Consolidate this layer with 25 strokes of the tamping rod, penetrating about 1 in. (25 mm) into the second layer.
11. Tap the sides of the base smartly 10 to 15 times with the mallet.

**Note 8:** The base should be slightly over full, about 1/8 in. (3 mm) above the rim. If there is a great excess of concrete, remove a portion with the trowel or scoop. If the base is under full, add a small quantity. This adjustment may be done only after consolidating the final layer and before striking off the surface of the concrete.

12. Strike off the surface of the concrete and finish it smoothly with a sawing action of the strike-off bar or plate, using great care to leave the base just full. The surface should be smooth and free of voids, as much as possible.
13. Clean the top flange of the base to ensure a proper seal.
14. Moisten the inside of the cover and check to see that both petcocks are open and the main air valve is closed.
15. Clamp the cover on the base.
16. Inject water through the funneled petcock until water emerges from the second petcock.
17. Jar the air meter gently until no air bubbles appear to be coming out of the second petcock.
18. Close the air bleeder valve and pump air into the air chamber until the needle goes past the starting point. Allow a few seconds for the compressed air to cool.
19. Tap the gauge gently with one hand while slowly opening the air bleeder valve until the needle rests on the initial starting point. Close the air bleeder valve.
20. Close both petcocks.
21. Open the main air valve.
22. Tap the sides of the base smartly with the mallet.
23. Lightly tap the gauge to settle the needle, and then read the air content to the nearest 0.1 percent.
24. Close the main air valve.
25. Open both petcocks to release pressure, remove the concrete, and thoroughly clean the cover and base with clean water.
26. Open the main air valve to relieve the pressure in the air chamber.
PROCEDURE - INTERNAL VIBRATION

1. Perform Steps 1 and 2 in the general procedure.
2. Fill the base approximately half full.
3. Insert the vibrator at three different points. Do not let the vibrator touch the bottom or sides of the base.
   
   **Note 9:** Remove the vibrator slowly, so that no air pockets are left in the material.
   
   **Note 10:** Continue vibration only long enough to achieve proper consolidation of the concrete. Over vibration may cause segregation and loss of appreciable quantities of intentionally entrained air.
4. Fill the base a bit over full.
5. Insert the vibrator as in Step 3. Do not let the vibrator touch the sides of the base, and penetrate the first layer approximately 1 in. (25 mm).
6. Return to Step 12 of the general procedure and continue.

REPORT

Results shall be reported on standard forms approved for use by the agency. Record the percent of air to the nearest 0.1 percent.

Report results on concrete delivery ticket, (i.e. Certificate of Compliance).

**Note 11:** Some agencies require an aggregate correction factor in order to determine total percent entrained air.

AGGREGATE CORRECTION FACTOR

WSDOT requires the use of an aggregate correction factor to determine the total percent entrained air as follows:

\[ A_s = A_1 - G \]

- \( A_s \) = Corrected Air content of sample tested, percent
- \( A_1 \) = Apparent air content of sample tested from air meter, percent
- \( G \) = Aggregate correction factor from the mix design, percent
Performance Exam Checklist

Air Content of Freshly Mixed Concrete by the Pressure Method
FOP for AASHTO T 152

Participant Name ___________________________________________ Exam Date ________________

Procedure Element                                                                 Yes    No
1. The tester has a copy of the current procedure on hand?           ☐    ☐
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present? ☐    ☐
3. Representative sample selected?                                  ☐    ☐
4. Container filled in three equal layers, slightly overfilling the last layer? ☐    ☐
5. Each layer rodded throughout its depth 25 times with hemispherical end of rod, uniformly distributing strokes? ☐    ☐
6. Bottom layer rodded throughout its depth, without forcibly striking the bottom of the container? ☐    ☐
7. Middle and top layers rodded, each throughout their depths and penetrating 1 in. (25 mm) into the underlying layer? ☐    ☐
8. Sides of the container tapped 10 to 15 times with the mallet after rodding each layer? ☐    ☐
9. Concrete struck off level with top of container using the bar and rim cleaned off? ☐    ☐
10. Inside of cover cleaned and moistened before clamping to base? ☐    ☐

Using a Type B Meter

10. Both petcocks open?                                             ☐    ☐
11. Air valve closed between air chamber and the bowl?             ☐    ☐
12. Water injected through petcock until it flows out the other petcock? ☐    ☐
13. Water injection into the petcock continued while jarring and tapping the meter to insure all air is expelled? ☐    ☐
14. Air pumped up to initial pressure line?                        ☐    ☐
15. A few seconds allowed for the compressed air to stabilize? ☐    ☐
16. Gauge adjusted to the initial pressure?                        ☐    ☐
17. Both petcocks closed?                                          ☐    ☐
18. Air valve opened between chamber and bowl?                     ☐    ☐
19. Sides of bowl tapped with the mallet?                          ☐    ☐
20. Air percentage read after lightly tapping the gauge to stabilize the hand? ☐    ☐
21. Air valve closed and then petcocks opened to release pressure before removing the cover?
   ✔ ☐

22. Aggregate correction factor applied if required?  ☐ ☐

23. Air content recorded to 0.1 percent?  ☐ ☐

23. All calculations performed correctly?  ☐ ☐

First attempt:  Pass ☐ Fail ☐
Second attempt: Pass ☐ Fail ☐

Signature of Examiner __________________________________________

This checklist is derived, in part, from copyrighted material printed in ACI CP-1, published by the American Concrete Institute.

Comments:
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WSDOT FOP for AASHTO T 166¹

Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

1. SCOPE

1.1 This method of test covers the determination of bulk specific gravity of specimens of compacted asphalt concrete mixtures as defined in M 132, Terms Relating to Density and Specific Gravity of Solids, Liquids, and Gases.

1.2 This method should not be used with samples that contain open or inter-connecting voids and/or absorb more than 2 percent of water by volume, as determined in Sections 5.2 or 8.2 herein.

1.3 The bulk specific gravity of the compacted asphalt concrete mixtures may be used in calculating the unit mass of the mixture.

1.4 The values stated in English units are to be regarded as the standard.

Note: Method A shall be used for laboratory compacted samples, and field samples compacted using gyratory compactor.

Method C shall be used for asphalt concrete pavement cores.

2. TEST SPECIMENS

2.1 Test specimens may be either laboratory-molded asphalt mixtures or from asphalt concrete HMA pavements. The mixtures may be surface, wearing, leveling or base course materials, surface or wearing course, binder or leveling course, or hot mix base.

2.2 Size of Specimens — It is recommended that: (1) the diameter of cylindrically molded or cored specimens, or the length of the sides of sawed specimens, be at least equal to four times the maximum size of the aggregate; and (2) the thickness of specimens be at least one-and-one-half times the maximum size of the aggregate.

2.3 Specimens shall be taken from pavements with core drill, diamond or carborundum saw, or by other suitable means.

2.4 Care shall be taken to avoid distortion, bending, or cracking of specimens during and after the removal from pavement or mold. Specimens shall be stored in a safe, cool place.

2.5 Specimens shall be free from foreign materials such as seal coat, tack coat, foundation material, soil, paper, or foil.

2.6 If desired, specimens may be separated from other pavement layers by sawing or other suitable means. Care should be exercised to ensure sawing does not damage specimens.

¹This Test Method is based on AASHTO T 166-00.
METHOD A

3. APPARATUS

3.1 Weighing Device — The weighing device shall have sufficient capacity, be readable to 0.1 percent of the sample mass, or better, and conform to the requirements of M 231. The weighing device shall be equipped with suitable suspension apparatus and holder to permit weighing the specimen while suspended from the center of scale pan of the weighing device.

3.2 Suspension Apparatus — The wire suspending the container shall be the smallest practical size to minimize any possible effects of a variable immersed length. The suspension apparatus shall be constructed to enable the container to be immersed to a depth sufficient to cover it and the test sample during weighing. Care should be exercised to ensure no trapped air bubbles exist under the specimen.

3.3 Water Bath — for immersing the specimen in water while suspended under the weighing device, equipped with an overflow outlet for maintaining a constant water level.

4. PROCEDURE

4.1 Dry the specimen to a constant mass (Note 1). Cool the specimen to room temperature at 77 ± 9°F (25 ± 5°C), and record the dry mass as A. Immerse each specimen in water at 77 ± 1.8°F (25 ± 1°C) for 4 ± 1 minute and record the immersed mass as C. Remove the specimen from the water, damp dry the specimen by blotting with a damp towel as quickly as possible, and determine the surface-dry mass as, B. Any water that seeps from the specimen during the weighing operation is considered part of the saturated specimen (Note 1). Each specimen shall be immersed and weighed individually.

Note 1: Constant mass shall be defined as the mass at which further drying at 125 ± 5°F (52 ± 3°C) does not alter the mass by more than 0.05 percent. Samples saturated with water shall initially be dried overnight at 125 ± 5°F (52 ± 3°C) and then weighed at 2-hour drying intervals. Recently molded laboratory samples which have not been exposed to moisture do not require drying.

Note 2: If desired, the sequence of testing operations may be changed to expedite the test results. For example, first the immersed mass (C) can be taken, then the surface-dry mass (B), and finally the dry mass (A).

Note 3: Terry cloth has been found to work well for an absorbent cloth. Damp is considered to be when no water can be wrung from towel.

5. CALCULATION

5.1 Calculate the bulk specific gravity of the specimens as follows (round and report the value to the nearest three decimal places):

\[
\text{Bulk Sp. Gr.} = \frac{A}{B-C}
\]

where:

A = mass in grams of sample in air,
B = mass in grams of surface-dry specimen in air,
C = mass in grams of sample in water.
5.2 Calculate the percent water absorbed by the specimen (on volume basis) as follows:

\[
\text{Percent Water Absorbed by Volume} = \frac{B-A}{B-C} \times 100
\]

5.3 If the percent water absorbed by the specimen in Section 5.2 exceeds 2 percent, use T 275 (Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens) to determine the bulk specific gravity.

**METHOD B**

WSDOT has removed this section

**METHOD C (RAPID TEST)**

9. **PROCEDURE**

9.1 This procedure can be used for testing specimens which are not required to be saved and which contain substantial amount of moisture. Specimens obtained by coring or sawing can be tested the same day by this method.

9.2 The testing procedure shall be the same as given in Sections 4 and 7 except for the sequence of operations. The dry mass (A) of the specimen is determined last as follows.

*Note 4:* A microwave oven can be used to speed up the process by initially heating the sample so that it can be broken into small pieces prior to placing it into the drying oven.

9.3 Place the specimen in a large flat bottom drying pan of known mass. Place the pan and specimen in a 230 ± 9°F (110 ± 5°C) oven. Leave the specimen in the oven until it can be easily separated to the point where the particles of the fine aggregate-asphalt portion are not larger than 1/4 in. (6.4 mm). Place the separated specimen in the 230°F (110°C) oven and dry to a constant mass. Constant mass shall be defined as the weight at which further drying at 230 ± 9°F (110 ± 5°C) does not alter the mass by more than 0.05 percent when weighed at 2-hour intervals.

9.4 Cool the pan and specimen to room temperature at 77 ± 9°F (25 ± 5°C). Determine the mass of the pan and specimen, subtract the mass of the pan and record the dry mass, A.

10. **CALCULATIONS**

10.1 Calculate the bulk specific gravity in Sections 5.1 and 8.1.

11. **REPORT**

11.1 The report shall include the following:

11.1.1 *The method used (A, B, or C).*

11.1.2 *Bulk Specific Gravity reported to the nearest thousandth.*

11.1.3 *Absorption reported to the nearest hundredth.*

12. **PRECISION**

12.1 Duplicate specific gravity results by the same operator should not be considered suspect unless they differ more than 0.02.
Performance Exam Checklist

Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-dry Specimens
AASHTO T 166

Participant Name ________________________________ Exam Date ____________

Procedure Element Yes No

1. The tester has a copy of the current procedure on hand? ☐ ☐

2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present? ☐ ☐

Method A (For use with laboratory compacted specimens.)

1. Compacted specimen cooled to room temperature, 77 ± 9 F, and record the dry mass? ☐ ☐

2. Immerse each specimen in water at 77 ± 2 F for 3 to 5 minutes and record the immersed mass to the nearest 0.1 gram? ☐ ☐

3. Remove sample from water, surface dry with damp towel and weigh the specimen in air at 77 ± 9 F to the nearest 0.1 gram? ☐ ☐

4. Calculate the bulk specific gravity of the specimens by following the calculation in AASHTO T166 (Section 5.1)? ☐ ☐

Method C (For use with pavement cores and chunks.)

1. Immerse specimen in water at 77 ± 2 F for 3 to 5 minutes and record the immersed weight to the nearest 0.1 gram? ☐ ☐

2. Remove sample from water, surface dry by blotting with damp towel and immediately weigh specimen in air at 77 ± 9 F to the nearest 0.1 gram? ☐ ☐

3. Place specimen in container (noting the empty container weight), then into an oven set at 230 ± 9 F until sample can be broken into small pieces? ☐ ☐

4. Return container to oven until it has reached a constant weight? ☐ ☐

5. Remove container and sample from oven and allow to cool to room temperature, 77 ± 9 F? ☐ ☐

6. Weigh pan with sample and record to nearest 0.1 gram, deducting known weight of pan to arrive at oven-dried sample weight? ☐ ☐

7. Calculate the bulk specific gravity of the specimen by following the calculation in AASHTO T166 (Section 5.1)? ☐ ☐

First attempt: Pass ☐ Fail ☐ Second attempt: Pass ☐ Fail ☐

Signature of Examiner __________________________________________
SAMPLING OF BITUMINOUS PAVING MIXTURES
FOP FOR WAQTC T 168

SIGNIFICANCE

Testing bituminous paving mixtures in the field begins with obtaining and preparing the sample to be tested. Standardized procedures for obtaining a representative sample have been established. Producing strong, durable, reliable pavement in roadways requires careful sampling and accurate testing.

Technicians must be patient and follow these procedures. If one considers that the specifications require quality tests to be made on only a small portion of the total material placed, the need for a truly representative sample is apparent. For this reason, every precaution must be taken to obtain a sample that is truly representative of the entire batch and then to protect that sample from contamination and physical damage.

SCOPE

This procedure covers the sampling of bituminous paving mixtures in accordance with AASHTO T 168. The sampling of aggregate used in bituminous paving mixtures shall be in accordance with the FOP for AASHTO T 2.

The Standard Specifications require that sample of Hot Mix Asphalt mixtures be taken from the hauling vehicle.

APPARATUS

- Flat-bottomed scoop 150 x 400 x 100 mm (6 x 16 x 4 in.) if sampling from a roadway
- Shovel
- Sample containers: such as cardboard boxes, metal cans, stainless steel bowls, or other agency-approved containers
- Template to match conveyor belt shape
- Scoops, trowels, or other equipment to obtain mix
- Sampling plate: heavy gauge metal plate 380 mm x 380 mm (15 in x 15in) minimum 8 gauge thick with a wire attached to one corner long enough to reach from the center of the paver to the outside of the farthest auger extension. Holes ¼ in diameter should be provide in each corner.
- Cookie cutter sampling device: A 330mm (13 in.) square sampling template, constructed from 75mm x 50mm x 3mm (3 in. x 2 in. x 1/8 in.) formed steel angle with two 100mm x 150 mm x 9mm (4 in. x 6 in. x 3/8 in. handles. See diagram

GENERAL COMMENTS

1. Sampling is as important as testing, and every precaution must be taken to obtain a truly representative sample.

2. Care shall be taken to prevent contamination of bituminous mixes by dust or other foreign matter, and to avoid segregation of aggregate and bituminous materials.

3. Samples of mix upon which acceptance or rejection is based shall be selected at random, and may be obtained by, or under the observation of, the purchaser or authorized representative. Random selection will be accomplished by using WSDOT Test Method T716, Method of Random Sampling for Locations of Testing and Sampling Sites.
4. Some agencies require mechanical sampling devices for hot mix asphalt (HMA) and cold
feed aggregate on some projects. These are normally permanently attached devices that allow
a sample container to pass perpendicularly through the entire stream of material or divert the
entire stream of material into the container. Operation may be hydraulic, pneumatic, or
manual and allows the sample container to pass through the stream twice, once in each
direction, without overfilling. Special caution is necessary with manually operated systems
since a consistent speed is difficult to maintain and non-representative samples may result.
Check agency requirements for the specifics of required sampling systems.

SAMPLE SIZE

Sample size depends on the test methods specified by the agency for acceptance.
Check agency requirement for the size required. Commonly, 10 kg are required for
determining asphalt cement binder content by the ignition method (AASHTO TP 53)
and up to 20 kg may be required when using the nuclear method (WAQTC TM 4).
The normal acceptance field sample should be a minimum of 100 lbs (45 kg)
approximately four times the amount required for testing.

SAMPLING

• General
  1. The material shall be inspected to determine variations. The seller shall provide
equipment for safe and appropriate sampling including sampling devices on plants,
when required.
  2. Place dense graded mixture samples in cardboard boxes or stainless steel bowls or other
agency approved containers. Place open graded mixture samples in stainless steel bowls.
Do not put open graded mixture samples in boxes until they have cooled to the point that
bituminous material will not migrate from the aggregate.

• Sampling from a Conveyor Belt
  WSDOT has deleted this section.

• Attached Sampling Devices
  WSDOT has deleted this section.

• Sampling from Truck Transports
  1. Obtain samples in four approximately equal increments from haul units.
  2. Obtain each increment from approximately 12 in. (300 mm) below the surface,
in each of the four quadrants of load.
  3. Combine the increments to form a sample of the required size.

• Sampling from a Roadway Prior to Compaction (Scoop Method)
  WSDOT has deleted this section.

• Sampling from Roadway Prior to Compaction (Plate Method)
  WSDOT has deleted this section.

• Sampling from a Paver
  WSDOT has deleted this section.
IDENTIFICATION AND SHIPPING

1. Identify sample containers as required by the agency.
2. Ship samples in containers that will prevent loss, contamination, or damage.
3. Refer to the sample identification requirements in FOP for WSDOT Test Method 712.
Performance Exam Checklist

Sampling Bituminous Paving Mixtures
FOP for AASHTO T 168

Participant Name __________________________________________ Exam Date ______________

Procedure Element

1. The tester has a copy of the current procedure on hand? Yes No
2. Containers of correct type and ample size available? Yes No
3. Samples from truck transports taken from four quadrants at required depth 12 inches? Yes No
4. Sample size meets agency requirements? Yes No
5. Sample identified as required? Yes No

First attempt: Pass ☐ Fail ☐ Second attempt: Pass ☐ Fail ☐

Signature of Examiner __________________________________________

Comments:
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WSDOT FOP For AASHTO T 176
Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

1. SCOPE
1.1 This test is intended to serve as a rapid field test to show the relative proportions of fine dust or claylike material in soils or graded aggregates.
1.2 The following applies to all specified limits in this standard: For the purpose of determining conformance with these specifications, an observed value or a calculated value shall be rounded off “to the nearest unit” in the last right-hand place of figures used in expressing the limiting value, in accordance with R 11, Recommended Practice for Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values.
1.3 The values stated in English units are to be regarded as the standard.
1.4 Refer to R 16 for regulatory information for chemicals.

2. APPARATUS
2.1 A graduated plastic cylinder, rubber stopper, irrigator tube, weighted foot assembly, and siphon assembly, all conforming to their respective specifications and dimensions shown in Figure 1. Fit the siphon assembly to a 1 gal (4-L) bottle of working calcium chloride solution (see Section 2.8) placed on a shelf 36 ± 1 in. (915 ± 25 mm) above the work surface. In lieu of the specified 1 gal (4-L) bottle, a glass or plastic vat having a larger capacity may be used provided the liquid level of the working solution is maintained between 36 and 46 inches (915 and 1170 mm) above the work surface. (See Figure 2.)

Note 1: An older model of weighted foot assembly has a guide cap that fits over the upper end of the graduated cylinder and centers the rod in the cylinder, and the foot of the assembly has a conical upper surface and three centering screws to center it loosely in the cylinder. The older model does not have the same reading indicator affixed to the rod (Figure 1), but a slot in the centering screws of the weighted foot is used to indicate the sand reading. Apparatus with the sand reading indicator (Figure 1) is preferred for testing clayey materials.

Note 2: Glass or stainless steel may be substituted as a material type for the copper siphon and blow tubing.

'This FOP is based on AASHTO T 176-00.
ASSEMBLY C

Note: all dimensions are shown in mm unless otherwise indicated.

FIGURE 1 Sand Equivalent Apparatus (continued)
LIST OF MATERIAL

<table>
<thead>
<tr>
<th>Assembly</th>
<th>No. Reg.</th>
<th>Description</th>
<th>Stock size</th>
<th>Material</th>
<th>Heat Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>SIPHON ASSEMBLY</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Siphon Tube</td>
<td>6.4 dia X 400</td>
<td>Copper Tube</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Siphon Hose</td>
<td>4.8 I.D. X 1220</td>
<td>Rubber Tube</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Blow Hose</td>
<td>4.8 I.D. X 50.8</td>
<td>Rubber Tube</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Blow Tube</td>
<td>6.4 dia X 50.8</td>
<td>Copper Tube</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Two-Hole Stopper</td>
<td>N0. 6</td>
<td>Rubber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Irrigator Tube</td>
<td>6.4 O.D. 0.89 Wall X 500 Stainless Steel Tube, Type 316</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Clamp</td>
<td>Pinchcock, Day, BKH No. 21730 or Equiv.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| B        | GRADUATE ASSEMBLY                                   |            |                                      |               |
| 8        | Tube                                               | 38.1 O.D. X 430 | Trans. Acrylic Plastic              |               |
| 9        | Base                                               | 12.7 X 102 X 102 | Trans. Acrylic Plastic              |               |

| C        | WEIGHTED FOOT ASSEMBLY                             |            |                                      |               |
| 10       | Sand Reading Indicator                             | 6.4 dia X 14.9 | Nylon 101 Type 66 Annealed          |               |
| 11       | Rod                                                | 6.4 dia X 438.2 | Brass                           |               |
| 12       | Weight                                             | 50.8 dia X 52.78 | C.R. SH                        |               |
| 13       | Roll Pin                                           | 0.16 dia X 12.7 | Steel                           |               |
| 14       | Foot                                               | 0.16 Hex. X 13.7 | Brass                           |               |
| 15       | Solid Stopper                                      | No. 7       | Rubber                          |               |

Notes:

1. "C" Mounted Foot Assembly to weigh 1000 ± 5 g.
2. Graduations of graduate to be 2.54 mm apart and every tenth mark to be numerically designated as shown. Every fifth line should be approximately 9.5 mm long. All other lines should be approximately 5.5 mm long. Depth to be 0.4 mm. Width to be 0.8 mm across the top.
3. Accuracy of scale to be ± 0.25 mm. Error at any point on scale to be ± 0.75 mm of true distance to zero.
4. Glass or stainless steel may be substituted as a material type for the copper siphon and blow tubing.

**FIGURE 1 Sand Equivalent Apparatus (continued)**

2.2 A tinned measure, having a capacity of 3 oz (85 ± 5 mL), approximately 2.25 in. (57 mm) in diameter.
2.3 A wide-mouth funnel approximately 4 in. (100 mm) in diameter at the mouth.
2.4 A clock or watch reading in minutes and seconds.
2.5 A mechanical shaker having a throw of 8.00 ± 0.04 in. (203.2 ± 1.0 mm) and operating at 175 ± 2 cycles per minute (2.92 ± 0.03 Hz) (Note 2). Prior to use, fasten the mechanical sand equivalent shaker securely to a firm and level mount.

*Note 2:* The mechanical shaker shall be used when performing referee sand equivalent determinations. Either the mechanical or manually operated shaker should be used in lieu of the hand method whenever possible.
2.6 A manually operated shaker capable of producing an oscillating motion at the rate of 100 complete cycles in 45 ± 5 seconds, with a hand-assisted half stroke length of 5.0 ± 0.2 in. (127 ± 5 mm). The shaker shall be fastened securely to a firm and level mount by bolts or clamps if a large number of determinations are to be made.
2.7 **Stock Solution** – The materials listed in 2.7.1, 2.7.2 or 2.7.3 may be used to prepare the stock solution. If the use of formaldehyde as the biocide is of concern, the materials in 2.7.2 or 2.7.3 should be used. A fourth alternative is not to use any biocide provided the time of storage of stock solution is not sufficient to promote the growth of fungi.

2.7.1 Stock solution with formaldehyde.

2.7.1.1 *Anhydrous Calcium Chloride*, 1.0 lb (454 g) of technical grade.

2.7.1.2 *USP Glycerin*, 2050 g (1640 mL).

2.7.1.3 *Formaldehyde*, (40 volume % solution) 47 g (45 mL).

2.7.1.4 Dissolve the 454 g (1.0 lb) of calcium chloride in \( \frac{1}{2} \) gal (1.89 L) of distilled water. Cool and filter it through ready pleated rapid filtering paper. Add the 2050 g of glycerin and the 47 g of formaldehyde to the filtered solution, mix well, and dilute to 1 gal (3.78 L).

2.7.2 Stock solution with glutaraldehyde.

2.7.2.1 *Calcium Chloride Dihydrate*, 1.27 lb (577 g) of A.C.S. grade.

**Note 3:** A.C.S. grade calcium chloride dihydrate is specified for the stock solution prepared with glutaraldehyde because tests indicate that impurities in the technical grade anhydrous calcium chloride may react with the glutaraldehyde resulting in an unknown precipitate.

2.7.2.2 *USP Glycerin*, 2050 g (1640 mL).

2.7.2.3 *1.5-Pentanedial (Glutaraldehyde)*, 50% solution in water 59 g (53 mL).

2.7.2.4 Dissolve the 577 g (1.27 lb) of calcium chloride dihydrate in \( \frac{1}{2} \) gal (1.89 L) of distilled water. Cool and add the 2050 g of glycerin and the 59 g of glutaraldehyde to the solution, mix well, and dilute to 1 gal (3.78 L).

**Note 4:** 1.5 pentanedial, also known as glutaraldehyde, glutaric dialdehyde and trade name UCARCIDE 250, may be obtained as Glutaraldehyde Solution 50%.

2.7.3 Stock solution with Kathon CG/ICP.

2.7.3.1 *Calcium Chloride Dihydrate*, 577 g (1.27 lb) of A.C.S. Grade.

2.7.3.2 *USP Glycerin*, 2050 g (1640 mL).

2.7.3.3 *Kathon CG/ICP*, 563 g (53 mL).

2.7.3.4 Dissolve the 1.27 lb (577 g) of calcium chloride dihydrate in \( \frac{1}{2} \) gal (1.89 L) of distilled water. Cool and add the 2050 g of glycerin and the 63 g of Kathon CG/ICP to the solution, mix well and dilute to 1 gal (3.78 L).

---

2Available from Aldrich Chemical Company, P.O. Box 2060, Milwaukee, WI 53201 or Fisher Scientific, 711 Forbes Ave., Pittsburg, PA 15219

3Kathon CG/ICP may be obtained from Rohm and Hass Chemical Company, Independence Mall West, Philadelphia, PA 19105
2.8 Working calcium chloride solution: Prepare the working calcium chloride by diluting one measuring tin full 3 oz. (85 ± 5 mL), or from a graduated cylinder of the stock calcium chloride solution to 1 gal (3.8 L) with water. Use distilled or demineralized water for the normal preparation of the working solution. However, if it is determined that the local tap water is of such purity that it does not affect the test results, it is permissible to use in lieu of distilled or demineralized water except in the event of dispute record the date made on the gallon bottle. Working solutions more than 30 days old shall be discarded.

2.9 A straightedge or spatula, suitable for striking off the excess oil from the tin measure.

2.10 A thermostatically controlled drying oven capable of maintaining a temperature of 230 ± 9°F (110 ± 5°C).

2.11 Quartering or splitting cloth, approximately 2 ft square, nonabsorbent material such as plastic or oil cloth.

2.12 Operational Handle for Irrigation Tube — A 25-mm diameter wooden dowel to aid in pushing the irrigation tube into firm materials. See Figure 1, Assembly B.

3. CONTROL

3.1 The temperature of the working solution should be maintained at 72 ± 5°F (22 ± 3°C) during the performance of this test. If field conditions preclude the maintenance of the temperature range, frequent reference samples should be submitted to a laboratory where proper temperature control is possible. It is also possible to establish temperature correction curves for each material being tested where proper temperature control is not possible. However, no general correction curve should be utilized for several materials even within a narrow range of sand equivalent values. Samples which meet the minimums and equivalent requirement at a working solution temperature below the recommended range need not be subject to reference testing.

4. SAMPLE PREPARATION

4.1 The sand equivalent test shall be performed on soils or graded aggregate materials passing the No. 4 (4.75-mm) sieve. All aggregations of fine-grained soil material shall be pulverized to pass the No. 4 (4.75-mm) sieve, and all fines shall be cleaned from the particles retained on the No. 4 (4.75-mm) sieve and included with the material passing the No. 4 (4.75-mm) sieve.

4.2 Split or quarter enough of the original sample to yield approximately 1,000 g, slightly more than eight 3 oz (85 mL) tin measures of material passing the No. 4 (4.75-mm) sieve. Use extreme care to obtain a truly representative portion of the original sample (Note 5).

Note 5: Experiments show that as the amount of material being reduced by splitting or quartering is decreased, the accuracy of providing representative portions is reduced. It is imperative that the sample be split or quartered carefully. When it appears necessary, dampen the material before splitting or quartering, to avoid segregation or loss of fines.

4.3 Prepare the desired number of test samples by one of the following methods:

4.3.1 Alternate Method No. 1 — Air Dry

4.3.1.1 Split or quarter enough material from the portion passing the No. 4 (4.75-mm) sieve to fill the 30-oz (85-mL) tin measure so it is slightly rounded above the brim. While filling the measure, tap the bottom edge of the tin on the worktable or other hard surface to cause consolidation of the material and allow the maximum amount to be placed in the tin. Strike off the tin measure level full with a spatula or straightedge.
4.3.2 Alternate Method No. 2 — Pre-Wet

4.3.2.1 The sample must be in the proper moisture condition to achieve reliable results. This condition is determined by tightly squeezing a small portion of the thoroughly mixed sample in the palm of the hand. If the cast that is formed permits careful handling without breaking, the correct moisture range has been obtained. If the materials is too dry, the cast will crumble and it will be necessary to add water and remix and retest until the material forms a cast. If the material shows any free water it is too wet to test and must be drained and air dried, mixing it frequently to insure uniformity. This overly wet material will form a good cast when checked initially, so the drying process should continue until a squeeze check on the drying material gives a cast which is more fragile and delicate to handle than the original. If the moisture content of the original sample prepared in Section 4.2 is within the limits described above, the test sample may be obtained immediately. If the moisture content is altered to meet these limits, the altered sample should be placed in a pan, covered with a lid or with a damp cloth which does not touch the material, and allowed to stand for a minimum of 15 minutes.

4.3.2.2 After the minimum 15-minute tempering period, place the sample on the splitting cloth and mix by alternately lifting each corner of the cloth and pulling it over the sample toward the diagonally opposite corner, causing the material to be rolled. When the material appears homogeneous, finish the mixing with the sample in a pile near the center of the cloth.

4.3.2.3 Fill the 3-oz (85-mL) tin measure by pushing it through the base of the pile while exerting pressure with the hand against the pile on the side opposite the measure. As the tin is moved though the pile, hold enough pressure with the hand to cause the material to fill the tin to overflowing. Press firmly with the palm of the hand, compacting the material and allowing the maximum amount to be placed in the tin. Strike off the tin measure level full with a spatula or straightedge. For the second determination, remix the sample and fill the tin again.

Note 6: Moist test specimens produce lower sand equivalent values than the corresponding over-dry specimens with almost no exceptions; therefore, if a dual specification encompassing both the wet and dry methods of sample preparation is utilized, it will be necessary to determine the appropriate correction for each material since a standard correction does not appear possible. Either method can be employed with equal confidence, however.

4.3.3 Reference Method (Mechanical Shaker) — Obtain the 3 oz (85 mL) tin measure of material by one of the alternate methods, Section 4.3.1 or 4.3.2, above; then dry the test sample to constant mass at 230 ± 9°F (110 ± 5°C), and cool to room temperature before testing.

5. PROCEDURE

5.1 Start the siphon by forcing air into the top of the solution bottle through the bend copper glass, or stainless steel blow tube while the pinch clamp is open. The apparatus is now ready for use.

5.2 Siphon 4.0 ± 0.1 in. (101.6 ± 2.5 mm) of working calcium chloride solution into the plastic cylinder. Pur the prepared test sample from the measuring tin into the plastic cylinder using the funnel to avoid spillage. (See Figure 3). Tap the bottom of the cylinder sharply on the heel of the hand several times to release air bubbles and to promote thorough wetting of the sample.
5.3 Allow the wetted sample to stand undisturbed for 10 ± 1 minute. At the end of the 10-minute soaking period, stopper the cylinder, then loosen the material from the bottom by partially inverting the cylinder and shaking it simultaneously.

5.4 After loosening the material from the bottom of the cylinder, shake the cylinder and contents by any one of the following methods:

5.4.1 Mechanical Shaker Method (Reference Method) — Place the stoppered cylinder in the mechanical sand equivalent shaker, set the timer, and allow the machine to shake the cylinder and contents for 45 ± 1 second.

5.4.2 Manual Shaker Method — Secure the stoppered cylinder in the three spring clamps on the carriage of the hand-operated sand equivalent shaker and reset the stroke counter to zero. Stand directly in front of the shaker and force the pointer to the stroke limit marker painted on the backboard by applying an abrupt horizontal thrust to the upper portion of the right hand spring steel strap. Then remove the hand from the strap and allow the spring action of the straps to move the carriage and cylinder in the opposite direction without assistance or hindrance. Apply enough force to the right hand spring steel strap during the thrust portion of each stroke to move the pointer to the stroke limit marker by pushing against the strap with the ends of the fingers to maintain a smooth oscillating motion. The center of the stroke limit marker is positioned to provide the proper stroke length and its width provides the maximum allowable limits of variation. The proper shaking action is accomplished only when the tip of the point reverses direction within the marker limits. Proper shaking action can best be maintained by using only the forearm and wrist action to propel the shaker. Continue the shaking action for 100 strokes.
5.4.3 Hand Method — Hold the cylinder in a horizontal position as illustrated in Figure 5 and shake it vigorously in a horizontal linear motion from end to end. Shake the cylinder 90 cycles in approximately 30 seconds using a throw of $9 \pm 1$ in. ($229 \pm 25$mm). A cycle is defined as a complete back and forth motion. To properly shake the cylinder at this speed, it will be necessary for the operator to shake with the forearms only, relaxing the body and shoulders.

5.5 Following the shaking operation, set the cylinder upright on the work table and remove the stopper.

5.6 Irrigation Procedure — Insert the irrigator tube in the cylinder and rinse material from the cylinder walls as the irrigator is allowed. Force the irrigator through the material to the bottom of the cylinder by applying a gentle stabbing and twisting action while the working solution flows from the irrigator tip. This flushes the fine material into suspension above the coarser sand particles. (See Figure 6.) Continue to apply the tabbing and twisting action while flushing the fines upward until the cylinder is filled to the 15-in. (381-mm) mark. Then raise the irrigator slowly without shutting off the flow so that the liquid level is maintained at above 15 in. (381 mm) while the irrigator is being withdrawn. Regulate the flow just before the irrigator is entirely withdrawn and adjust the final level to 15 in. (381 mm). Final level as judged by the bottom of the meniscus shall be between the top two gradations on the tube but shall not be above the 15-in. (381-mm) level.
Note 7: For certain soils, particularly on crushed materials, the stabbing action may not be possible. For these materials, the irrigation technique is as follows: Continue to apply a twisting action as the irrigation tube is slowly withdrawn. As the tube is withdrawn, it is essential that as many fines as flushed upward until the cylinder is filled to the 15-in (381-mm) mark.

5.7 Allow the cylinder and contents to stand undisturbed for 20 minutes ± 15 seconds. Start the timing immediately after withdrawing the irrigator tube.

5.8 At the end of the 20-minute sedimentation period, read and record the level of the top of the clay suspension. This is referred to as the “clay reading.” If no clear line of demarcation has formed at the end of the specified 20-minute sedimentation period, allow the sample to stand undisturbed until a clear reading can be obtained, then immediately read and record the level of the top of the clay suspension and the total sedimentation time. If the total sedimentation time exceeds 30 minutes, rerun the test using three individual samples of the same material. Read and record the clay column height of that sample requiring the shortest sedimentation period only.

5.9 After the clay reading has been taken, the “sand reading” shall be obtained by one of the following methods:

5.9.1 When using the weighted foot assembly having the sand indicator on the rod of the assembly, place the assembly over the cylinder and gently lower the assembly toward the sand. Do not allow the indicator to hit the mouth of the cylinder as the assembly is being lowered. As the weighted foot comes to rest on the sand, tip the assembly toward the graduations on the cylinder until the indicator touches the inside of the cylinder. Subtract 10 in. (254 mm) from the level indicated by the extreme top edge of the indicator and record this value as the “sand reading.” (See Figure 7.)
5.9.2 If an older model weighted foot assembly having centering screws is used, keep one of the centering screws in contact with the cylinder wall near the graduations so that it can be seen at all times while the assembly is being lowered. When the weighted foot has come to rest on the sand, read the level of the centering screw and record this value as the “sand reading.”

5.10 If clay or sand readings fall between 0.1-in. (2.5-mm) graduations, record the level of the higher graduation as the reading. For example, a clay reading of 7.95 would be recorded as 8.0, and a sand reading of 3.22 would be recorded as 3.3.

**Note 8:** Samples obtained from aggregate proposed for use in hot asphalt paving mixtures shall be prepared by oven-drying if acceptance of the material is based on tests on material that has passed through a hot plant drier.

6. **CALCULATIONS**

6.1 Calculate the sand equivalent (SE) to the nearest 0.1 using the following formula:

\[
SE = \frac{\text{Sand Reading \times 100}}{\text{Clay Reading}}
\]

6.2 If the calculated sand equivalent is not a whole number, report it as the next higher whole number, as in the following example:

\[
SE = \frac{3.3}{8} \times 100 = 41.25
\]

which is reported as 42.

6.3 If it is desired to average a series of sand equivalent values, average the whole number values determined as described above. If the average of these values is not a whole number, raise it to the next higher whole number, as in the following example:

Calculated SE values: 41.2, 43.8, 40.9

After raising each to the next higher whole number, they become: 42, 44, 41.

The average of these values is then determined:

\[
\frac{42 + 44 + 41}{3} = 42.3
\]

If the results from the same SE sample vary by more than 8 points, the test shall be invalid and a new test completed.

6.3.1 Since the average value is not a whole number, it is raised to the next higher whole number and the reported averages and equivalent value is reported as 43.

Report the results using WSDOT Form 350-161 EF, 422-020X, or other report approved by the State Materials Engineer.

7. **PRECAUTIONS**

7.1 Perform the test in a location free of vibrations; vibrations may cause the suspended material to settle at a rate greater than normal.

7.2 Do not expose the plastic cylinders to direct sunlight any more than is necessary.

7.3 Removal of Organic Growth: Occasionally it may be necessary to remove an organic growth from the working calcium chloride solution container and from the inside of the flexible tubing and irrigator tube. This organic material can easily be seen as a slimy substance in the
solution. To remove this growth, prepare a cleaning solvent by diluting sodium hypochlorite\(^1\) with an equal quantity of water. Fill the solution container with the prepared cleaning solvent, allow about a liter of cleaning solvent to flow through the siphon assembly and irrigator tube, then place the pinch clamp on the end of the tubing to cut off the flow of solvent and to hold the solvent in the tube. Refill the container and allow to stand overnight. After soaking, allow the cleaning solvent to flow out through the siphon assembly and irrigator tube. Remove the siphon assembly from the solution container and rinse both with clear water. The irrigator tube and siphon assembly can be rinsed easily by attaching a hose between the tip of the irrigator tube and water faucet and backwashing fresh water through the tube.

7.4 Occasionally the holes in the tip of the irrigator tube may become clogged by a particle of sand. If the obstruction cannot be freed by any other method, use a pin or other sharp object to force it out, using extreme care not to enlarge the size of the opening.

8. OPERATOR QUALIFICATIONS

WSDOT has deleted this section see Section 9-5.5 of the Construction Manual.
## Performance Exam Checklist

**Plastic Fines in Graded Aggregates and Soils by the Use of the Sand Equivalent Test FOP for AASHTO T 176**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample Preparation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>3. Sample passed through No. 4 (4.75 mm) sieve?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>4. Split or quarter proper amount of material?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>5. Material in clods broken up and re-screened?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>6. No fines lost?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>7. Temperature of working solution 72±5 F (22 ±3°C)?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>8. Working calcium chloride solution 36 ± 1 in. (915 mm ± 25 mm) above the work surface?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>9. 4 ± 0.1in (101.6 ± 2.5 mm) working calcium chloride solution siphoned into cylinder?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>10. Working solution dated?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td><strong>Method 2 — Pre-Wet</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Sample sprayed with water to dampen and prevent loss of fines?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>2. Material checked for moisture condition by tightly squeezing small portion in palm of hand and forming a cast?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>3. Sample at proper water content?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>a. If too dry, (cast crumbles easily), water added and re-mixed?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>b. If too wet (shows free water), sample drained, air dried and mixed frequently?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>4. If either 3(a) or 3(b) above occurred, sample placed in pan, covered with lid or damp cloth (not touching sample), and allowed to stand for at least 15 minutes?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>5. Sample placed on splitting cloth and mixed by alternately lifting each corner of the cloth and pulling it over the sample toward diagonally opposite corner, causing material to be rolled?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>6. Is material thoroughly mixed?</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Procedure Element</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>-----</td>
<td>----</td>
</tr>
<tr>
<td>7. When material appears to be homogeneous, mixing finished with sample in a pile near center of cloth?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Fill the 85 mL tin by pushing through base of pile with other hand on opposite side of pile?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Material fills tin to overflowing?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Material compacted into tin with palm of hand?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Tin struck off level full with spatula or straightedge?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Prepared sample funneled into cylinder with no loss of fines?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Bottom of cylinder tapped sharply on heel of hand several times to release air bubbles?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Wetted sample allowed to stand undisturbed for 10 min. ± 1 min.?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Cylinder stoppered and material loosened from bottom by shaking?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Properly performed shaking method?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Shaker Method (Reference Method)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual Shaker Method</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand Shaking Method</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Following shaking, cylinder set vertical on work surface and stopper removed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Irrigator tube inserted in cylinder and material rinsed from cylinder walls as irrigator is lowered?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Irrigator tube forced through material to bottom of cylinder by gently stabbing and twisting action?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Stabbing and twisting motion applied until cylinder filled to 15 in. (381 mm) mark?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Liquid raised and maintained at 15 in. (381 mm) mark while irrigator is being withdrawn?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22. No clear solution at top of column?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. Contents let stand 20 minutes ± 15 seconds?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24. Timing started immediately after withdrawal of irrigator?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25. No vibration or disturbance of the sample?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26. Readings taken at 20 minutes or up to 30 minutes, when a definite line appears?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27. Weighted foot assembly lowered into cylinder without hitting mouth of cylinder?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28. Calculations made to 0.1 and reported to the next higher whole number?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29. SE is based on the average results of two samples?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Procedure Element**

30. If the two SE values vary by more than 8 points additional tests run?  

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

31. All calculations performed correctly?  

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First attempt: Pass ☐ Fail ☐  

Second attempt: Pass ☐ Fail ☐

Signature of Examiner __________________________________________

**Comments:**

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
WSDOT FOP for AASHTO T 209

Method of Test for Maximum Specific Gravity of Bituminous Paving Mixtures — “Rice Density”

1. SCOPE

1.1 This method covers the determination of the maximum sp. gr. of uncompacted bituminous paving mixtures. This method is technically equivalent to AASHTO T 209.

2. APPARATUS

2.1 Balance, with ample capacity, and with sufficient sensitivity to enable maximum sp. gr. of samples of uncompacted paving mixtures to be calculated to at least four significant figures; that is, to at least three decimal places.

2.2 Container — A volumetric flask per AASHTO T 209 Section 6.1.

2.3 Vacuum pump or water aspirator, for evacuating air from the container.

2.4 Water Bath — A constant-temperature water bath (optional).

2.5 Thermometers — Calibrated liquid-in-glass, or electronic digital total immersion type, accurate to 0.1°C.

3. CALIBRATION OF FLASK

3.1 The volumetric flask will be calibrated periodically in conformance with established verification procedures, contact regional lab.

4. TEST SAMPLES

4.1 The sample shall be obtained and reduced in accordance with WSDOT Test Method No. 712, Sampling Bituminous Paving Mixtures.

4.2 The size of the sample shall conform to the requirements of Table 1. Samples larger than the capacity of the container may be tested a portion at a time.

<table>
<thead>
<tr>
<th>Nominal Max. Agg. Size</th>
<th>Sieve Size</th>
<th>Minimum Mass of Specimen, g</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4 (4.75)</td>
<td>No. 4</td>
<td>500</td>
</tr>
<tr>
<td>3/8 (9.5)</td>
<td>3/8 in.</td>
<td>1000</td>
</tr>
<tr>
<td>½ (12.5)</td>
<td>1/2 in.</td>
<td>1500</td>
</tr>
<tr>
<td>¾ (19.0)</td>
<td>3/4 in.</td>
<td>2000</td>
</tr>
<tr>
<td>1 (25.0)</td>
<td>1 in.</td>
<td>2500</td>
</tr>
<tr>
<td>1 ½ (37.5)</td>
<td>1 1/2 in.</td>
<td>4000</td>
</tr>
<tr>
<td>2 (50.0)</td>
<td>2 in.</td>
<td>6000</td>
</tr>
</tbody>
</table>
For aggregate, the nominal maximum size of particles is the largest sieve size listed in the applicable specification, upon which any material is permitted to be retained.

Note: For an aggregate specification having a generally unrestrictive gradation (i.e. wide range of permissible upper sizes), where the source consistently fully passes a screen substantially smaller than the maximum specified size, the nominal maximum size, for the purpose of defining sampling and test specimen size requirements may be adjusted to the screen, found by experience to retain no more than 5% of the materials.

5. PROCEDURE

5.1 Separate the particles of the sample, taking care not to fracture the mineral particles, so that the particles of the fine aggregate portion are not larger than 1/4 in. (6.3 mm). If the mixture is not sufficiently soft to be separated manually, place it in a large flat pan and warm in an oven only until it can be so handled.

5.2 Cool the sample to room temperature, place in the flask, and weigh. Designate the net mass (weight) of sample as a. Add sufficient water at approximately 77°F (25°C) to cover the sample.

5.3 Remove entrapped air by subjecting the contents to a partial vacuum of 30 mm Hg or less absolute pressure for a period of 15 ± 2 minutes. A partial vacuum of 30 mm Hg absolute pressure is approximately equivalent to 730 mm Hg reading on a vacuum gauge at sea level. Agitate the container and contents either continuously by mechanical device or manually by vigorous shaking at intervals of about two minutes.

A suitable wetting agent such as Aerosol OT in concentration of 0.01 percent or 1 ml of 10 percent solution in 1,000 ml of water shall be used to facilitate the release of entrapped air.

5.4 Fill the flask with water and bring the contents to a temperature of 77 ± 1°F (25 ± 0.5°C) in a constant-temperature water bath. Determine the weight of flask (filled) and contents 10 ± 1 minute after completing c. Care must be used when filling flask to avoid reintroducing air into water.

5.5 In lieu of a constant temperature water bath, determine the temperature of the water within the flask and determine the mass of the flask (filled) and the contents 10 ± 1 minutes after completing c. Make the appropriate density correction to 77°F (25°C) using Table 2.

6. CALCULATION

6.1 Calculate the Rice sp. gr. (calculate to three decimal places) of the sample as follows:

6.1.1 Determination at 77°F (25°C):

\[
\text{Rice Sp. Gr.} = \frac{A}{A + D - E} \times R
\]

where:

\[A = \text{Mass (weight) of dry sample in air, in grams,}\]
\[D = \text{Mass (weight) of flask filled with water at 77°F (25°C) in grams, and}\]
\[E = \text{Mass (weight) of flask filled with water and sample at 77°F (25°C) in grams.}\]
6.1.2 Determination using temperature correction:

Rice Sp. Gr. = \[ \frac{A}{A+D-E} \times R \]

where:

- **A** = Mass (weight) of dry sample in air, in grams,
- **D** = Mass (weight) of flask filled with water at 77°F (25°C) in grams,
- **E** = Mass (weight) of flask filled with water and sample at test temperature in grams, and
- **R** = Factor from Table 2 to correct density of water from the test temperature to 77°F (25°C).

**Note:** The flask calibration is done at 77°F (25°C).

6.1.3 Determination using weighted average:

\[ \text{Weighted Average Maximum Specific Gravity} = \frac{(\text{Sp. G}_1 \times A_1) + (\text{Sp. G}_2 \times A_2)}{(A_2 + A_2)} \]

where:

- **Sp. G**\(_1\) = Specific gravity of first test segment
- **Sp. G**\(_2\) = Specific gravity of second test segment
- **A**\(_1\) and **A**\(_2\) = Mass of dry sample in air of respective test segments

6.2 Calculate the rice density (calculate to one decimal place):

6.2.1 Rice density = Rice sp. gr. \( \approx 62.24 \text{ lb/ft.}^3 \) (997 kg/m\(^3\))
Table 2: Temperature Correction Factor

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<th>F°</th>
<th>“R”</th>
<th>C°</th>
<th>F°</th>
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*Note:* Water Temperatures should be maintained within the limits shown in bold face type.
7. FIELD DETERMINATION OF RICE DENSITY FOR PAVEMENT COMPACTION CONTROL

   This section has been moved to SOP 729 Standard Operating Procedure for determining the In-place densities of bituminous mixtures.

8. REPORT

   Report the maximum specific gravity (Rice Density) on WSDOT Form 350-157EF, or other report approved by the State Materials Engineer.
Performance Exam Checklist

Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
FOP for AASHTO T 209

Participant Name ________________________________________________ Exam Date __________

Procedure Element

1. The tester has a copy of the current procedure on hand? □ Yes □ No
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present? □ Yes □ No
3. Particles of sample separated? □ Yes □ No
4. Care used not to fracture mineral fragments? □ Yes □ No
5. After separation, fine aggregate particles not larger than 6.4 mm? □ Yes □ No
6. Sample at room temperature? □ Yes □ No
7. Mass of bowl or flask determined? □ Yes □ No
8. Mass of sample and bowl or flask determined? □ Yes □ No
9. Mass of sample determined? □ Yes □ No
10. Water at approximately 77°F (25°C) added to cover sample? □ Yes □ No
11. Entrapped air removed using partial vacuum for 15 ± 2 min? □ Yes □ No
12. Container and contents agitated continuously by mechanical device or manually by vigorous shaking at intervals of about 2 minutes? □ Yes □ No
13. Release of entrapped air facilitated by addition of suitable wetting agent (optional)? □ Yes □ No
14. Flask determination:
   a. Flask filled with water? □ Yes □ No
   b. Flask then placed in constant temperature water bath (optional)? □ Yes □ No
   c. Contents at 77 ± 1°C or Table 2 in FOP used? □ Yes □ No
   d. Mass of filled flask determined 10 ± 1 minutes after removal of entrapped air completed? □ Yes □ No
14. All calculations performed correctly? □ Yes □ No

First attempt: Pass □ Fail □ Second attempt: Pass □ Fail □

Signature of Examiner ________________________________________________
WSDOT FOP for AASHTO T 217

Determination of Moisture in Soils by Means of a Calcium Carbide Gas Pressure Moisture Tester

1. SCOPE

1.1 This method of test is intended to determine the moisture content of soils by means of a calcium carbide gas pressure moisture tester. The manufacturer’s instructions shall be followed for the proper use of the equipment.

1.2 The following applies to all specified limits in this standard: For the purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded off “to the nearest unit” in the last right-hand place of figures used in expressing the limiting value, in accordance with R 11, Recommended Practice for Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values.

Note 1: This method shall not be used on granular materials having particles large enough to affect the accuracy of the test – in general any appreciable amount retained on a No. 4 (4.75-mm) sieve. The super 200 D tester is intended to be used to test aggregate.

1.3 The values stated in English units are to be regarded as the standard.

1.4 Refer to R 16 for regulatory information for chemicals.

2. REFERENCED DOCUMENT

2.1 AASHTO Standards:

R 11, Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values

T 265, Laboratory Determination of Moisture Content of Soils

3. APPARATUS

3.1 Calcium carbide pressure moisture test – a chamber with attached pressure gage for the water content of specimens having a mass of at least 20 g. (Figure 1).

Those “Speed Moisture Testers” which use a 20 g sample may be used to test aggregates and soil-aggregate mixtures where the maximum particle size is $3/4$ in. (20 mm) or less.

3.2 Balance – shall conform to AASHTO M 231, Class G-2.

3.3 Two 1.25-in. (31.75-mm) steel balls

3.4 Cleaning brush and cloth.

3.5 Scoop for measuring calcium carbide reagent.

This FOP is based on AASHTO T 217-02
4. MATERIAL

4.1 Calcium carbide reagent.

*Note 2:* The calcium carbide must be finely pulverized and should be of a grade capable of producing acetylene gas in the amount of at least 2.25 ft³/lb (0.14 m³/kg) of carbide.

*Note 3:* The “shelf life” of the calcium carbide reagent is limited, so it should be used according to the manufacturer’s recommendations. When a can of calcium carbide is opened, it shall be dated. After 3 months of use, or if the can becomes contaminated, it shall be discarded.

5. PROCEDURE

5.1 When using the 20-g or 26-g tester, place three scoops (approximately 24g) of calcium carbide in the body of the moisture tester (or per the manufacturers recommendations). When using the super 200 D tester to test aggregate, place six scoops (approximately 48 g) of calcium carbide in the body of the moisture tester.

*Note 4:* Care must be exercised to prevent the calcium carbide from coming into direct contact with water.

5.2 Weigh a sample of the exact mass specified by the manufacturer of the instrument in the balance provided, and place the sample in the cap of the tester. When using the 20-g or 26-g size tester, place two 1.25-in. (31.75-mm) steel balls in the body of the tester with the calcium carbide (or per the manufacturers recommendations).

*Note 5:* Manufacturer’s instructions shall be followed for the use of steel balls, particularly when testing sand.

*Note 6:* If the moisture content of the sample exceeds the limit of the pressure gage (12 percent moisture for aggregate tester to 20-percent moisture for soil tester), a one-half size sample must be used and the dial reading must be multiplied by 2. This proportional method is not directly applicable to the dry mass percent scale on the super 200 D tester.

5.3 With the pressure vessel in an approximately horizontal position, insert the cap in the pressure vessel and seal the unit by tightening the clamp, taking care that no carbide comes in contact with the soil until a complete seal is achieved.

*FIGURE 1  Calcium Carbide Gas Pressure Moisture Meter*
5.4 Raise the moisture tester to a vertical position so that the soil in the cap will fall into the pressure vessel.

5.5 Shake the instrument vigorously so that all lumps will be broken up to permit the calcium carbide to react with all available free moisture. When steel balls are being used in the tester and when using the large tester to test aggregate, the instrument should be shaken with a rotating motion so the steel balls or aggregate will not damage the instrument or cause soil particles to become embedded in the orifice leading to the pressure diaphragm.

Note 7: Shaking should continue for at least 60 seconds with granular soils and for up to 180 seconds for other soils so as to permit complete reaction between the calcium carbide and the free moisture. Time should be permitted to allow dissipation of the heat generated by the chemical reaction.

5.6 When the needle stops moving, read the dial while holding the instrument in a horizontal position at eye level.

5.7 Record the sample mass and the dial reading.

5.8 With the cap of the instrument pointed away from the operator, slowly release the gas pressure. Empty the pressure vessel and examine the material for lumps. If the sample is not completely pulverized, the test should be repeated using a new sample. Clean the cap thoroughly of all carbide and soil before running another test.

Note 8: When removing the cap, care should be taken to point the instrument away from the operator to avoid breathing the fumes, and away from any potential source of ignition for the acetylene gas.

5.9 The dial reading is the percent of moisture by wet mass and must be converted to dry mass. With the super 200 D tester the dial reading is the percent of moisture by dry mass, and no further calculation is required.

6. CALCULATION

6.1 The percentage of moisture by dry mass of the soil may be determined from a correction curve similar to Figure 2.

6.2 A correction curve similar to Figure 2 is normally supplied with each moisture tester. Each moisture tester, however, should be checked for the accuracy of its gage, and for the accuracy of its correction curve.

5.2.1 The accuracy of the moisture tester gage should be checked by using a calibration kit (available from the manufacturer), equipped with a standard gage. In case of discrepancy, the gage on the tester should be adjusted to conform with the standard gage.

5.2.2 The accuracy of the correction curve should be checked by comparing curve-corrected moisture contents to moisture contents of locally prepared soils determined using T 265. In case of discrepancy, develop a new correction curve based on moisture contents determined from T 265.

5.2.3 The range of the factory-supplied or laboratory-determined curves may be extended by additional testing.
Figure 2—Correction Curve for Moisture Tester Reading

Note 9: It may be more convenient for field use of the apparatus to prepare a table of moisture tester readings versus oven-dry moisture content for the moisture tester.

6.3 Determine the percentage of moisture to the nearest whole percent.
Performance Exam Checklist

_Determination of Moisture in Soils by Means of Calcium Carbide Gas Pressure Moisture Tester_  
FOP for AASHTO T 217

Participant Name ___________________________ Exam Date _____________

### Procedure Element

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<td>2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?</td>
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<td>3. Shelf life of calcium carbide reagent checked?</td>
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First attempt: Pass ☐ Fail ☐  
Second attempt: Pass ☐ Fail ☐

Signature of Examiner __________________________________________

Comments:

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
WSDOT FOP for AASHTO T 224¹

Correction for Coarse Particles in the Soil

Compaction Test

1. SCOPE

1.1. This method describes a procedure for adjusting the densities of soil and soil aggregate mixtures to compensate for differing percentages of coarse particles retained on either the No.4 (4.75-mm) or 3/4 in. (19.0-mm) sieve. This is necessary to adjust either the field wet density to a dry density of the material passing these sieves or the reverse, by adjusting the lab density to the field density when doing compaction control testing. Comparisons are made by comparing the field densities with the maximum dry density as determined by T 99 or T 180.

The standard for the WSDOT is to use AASHTO T 99 Method A.

The Standard Specifications define non-granular material as 30% or less retained on the No. 4 (4.75-mm) sieve.

1.2. Two methods are available for correction, either, lab to field or field to lab density. The method specified in Section 4.1 adjusts the compacted lab density to the field density. The method specified in Section 4.2 adjust the field wet density to dry density of the fine fraction and compares its results with the compacted lab density.

WSDOT uses the calculation specified in section 4.1 for adjusting the compacted lab density to the field density. Appendix B contains a nomograph for this adjustment.

1.3. This test method applies to soil mixtures that have 30 percent or less retained on the No. 4 (4.75-mm) sieve, when Method A or B of T 99 or T 180 is used, or mixtures that have 30 percent or less retained on the 3/4 in. (19.0 mm) sieve, when Method C or D of T 99 or T 180 is used. The material retained on these sieves shall be defined as oversize particles (coarse particles).

1.4. This method applies to soils with any percentage of oversize particles as specified in Section 1.3. However, the correction may not be of practical significance for soils with only a small percentage of oversize particles. The person or agency specifying this method shall specify a minimum percentage of oversize particles below which the method need not be applied. If a minimum percentage is not specified, this method shall be applied to samples with more than 5 percent by weight of oversize particles.

1.5. The following applies to all specified limits in this standard: For the purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded off to the nearest 1 pcf (10 kg/m³), according to R 11.

1.6. The values stated in SI units are to be regarded as the standard.

¹This FOP is based on AASHTO T 224-01
2. REFERENCE DOCUMENTS

2.1. AASHTO Standards:

- R 11, Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values
- T 85, Specific Gravity and Absorption of Coarse Aggregate
- T 99, Moisture-Density Relations of Soils Using a 5.5-lb, (2.5-kg) Rammer and a 12-in. (305-mm) Drop
- T 180, Moisture-Density Relations of Soils Using a 10-lb (4.54-kg) Rammer and a 18-in. (457-mm) Drop
- T 217, Determination of Moisture in Soils by Means of a Calcium Carbide Gas Pressure Moisture Tester
- T 255, Total Evaporable Moisture Content of Aggregate by Drying
- T 272, Family of Curves-One Point Method

3. OUTLINE OF METHOD

3.1. When Method A or Method B of T 99 or T 180 is employed, the total field wet density is compared with the dry density of the soil particles passing the No. 4 (4.75-mm) sieve.

3.2. When Method C or Method D of T 99 or T 180 is employed, the total field wet density is compared with the dry density of the soil particles passing the 3/4 in. (19.0-mm) sieve.

3.3. Significant figures are as follows:

3.3.1. Adjusted wet density of the fine material passing the No. 4 (4.75-mm) sieve, Methods A and B; or 3/4 in. (19.0-mm) sieve, Method C and D; \(D_{f}\) 0.1 pcf (1 kg/m³).

3.3.2. Bulk specific gravity of the coarse material on the 4.75-mm (No. 4) sieve, Methods A and B; or 3/4 in. (19.0-mm) sieve, Methods C & D; \(G_{m}\) 0.01.

3.3.3. Percent by mass, of coarse and fine particles, of material retained and passing the No. 4 (4.75-mm) sieve, Methods A & B; or 3/4 in. (19.0-mm) sieve, Methods C and D; \(P_{c}\) and \(P_{f}\) 0.1 percent.

3.3.4. In-place (field) wet density of the total sample \(D\) 0.1 pcf (1 kg/m³).

4. ADJUSTMENT EQUATION

4.1. Compacted Laboratory Dry Density Corrected to Field Dry Density

4.1.1. This Section corrects the laboratory density obtained by either T 99 or T 180 for the moisture content and density of the material retained on the No. 4 (4.75-mm) sieve, Methods A & B; or the material retained on the 3/4 in. (19.0-mm) sieve, Methods C and D. The maximum lab dry density, adjusted for oversized particles and total moisture content are compared with the field dry density and field moisture content. This method is limited to field samples containing 40 percent or less for material retained on the No. 4 (4.75-mm) sieve, Methods A and B; or 30 percent or less of material retained on the 3/4 in. (19.0-mm) sieve, Methods C and D.

4.1.2. Determine the moisture content of the fine particles and oversize particles of the material used during compaction. The moisture contents can be determined by T 217 or T 255. The moisture content of the oversize material retained on the sieve can be assumed to be two (2) percent for most construction applications. If the moisture con-
tent of the oversized material is generally known, substitute that moisture content in the calculations. It is recommended if drying equipment is available, determine the actual moisture contents.

4.1.3. Calculate the dry mass of the coarse and fine particles as follows:

\[ M_D = \frac{M_M}{1 + MC} \]

where:

- \( M_D \) = mass of dry material (fine or oversize particles),
- \( M_M \) = mass of moist material (fine or oversize particles),
- \( MC \) = moisture content of respective fine or oversized particles, expressed as a decimal.

4.1.4 Calculate the percentage of the fine particles and oversized particles by dry weight of the total sample as follows:

\[ P_f = \left( \frac{100 M_{DF}}{M_{DF} + M_{DC}} \right) \]

and

\[ P_C = \left( \frac{100 M_{DC}}{M_{DF} + M_{DC}} \right) \]

where:

- \( P_f \) = percent of fine particles, of sieve used, by weight,
- \( P_C \) = percent of oversize particles, of sieve used, by weight,
- \( M_{DF} \) = mass of dry particles, and
- \( M_{DC} \) = mass of oversize particles.

4.1.5. Calculate the corrected moisture content and corrected dry density of the total sample (combined fine and oversized particles) as follows:

\[ M_{CT} = \left( \frac{MC_f P_f + MCC P_C}{100} \right) \]

where:

- \( M_{CT} \) = corrected moisture content of the combined fine and oversized particles, expressed as a decimal,
- \( MC_f \) = moisture content of the fine particles, expressed as a decimal,
- \( MCC \) = moisture content of the oversize particles, expressed as a decimal, and

\[
\text{Metric} = D_d = \frac{100 D_f \kappa}{(D_f P_C + k P_f)} \\
\text{English} = D_d = D_f \kappa / (D_f P_C + k P_f)
\]
where:

\[ D_d = \text{corrected total dry density (combined fine and oversized particles) kg/m}^3 \text{ (pcf)}, \]
\[ D_f = \text{dry density of the fine particles kg/m}^3 \text{ (pcf)}, \]
\[ P_C = \text{percent of oversize particles, of sieve used, by weight,} \]
\[ P_f = \text{percent of fine particles, of sieve used, by weight,} \]
\[ k = 1,000 \times \text{Bulk Specific Gravity (G_m) (oven dry basis) of coarse particles (kg/m}^3), \]
\[ \text{or } 62.4 \times \text{Bulk Specific Gravity (G_m) (oven dry basis) of coarse particles (pcf).} \]

**Note 1** – If the specific gravity has been determined, this value may be used in the calculations. Determine the Bulk Specific Gravity according to T 85, or determine the specific gravity for the coarse aggregate according the WSDOT Test Method T-606. For most construction activities the specific gravity can be assumed to be 2.60-2.67

4.2 Field Wet Density Corrected to Compacted Laboratory Density

WSDOT has Deleted this section

5. PRECISION

5.1. Since this correction for coarse particles involves no testing but instead utilizes the results of other tests and mathematically combines the results, determination of the precision and accuracy is not applicable.

APPENDIX A

A1. NOTES

A1.1. These methods, described for coarse particle correction, are applicable to one type of soil and soil aggregate material only. If the characteristic of the material changes, then a moisture density relationship (T 99 or T 180) test is performed to determine a new maximum density.

A1.2. T 272 describes the methods for determining different maximum densities of soil and soil-aggregate materials which reveal certain similarities and trends characteristic of the material type and source.

A1.2.1. Utilization of a Family of Curves-When using the One Point Method (T 272), Note 3 of T 272 does not apply. The percentage of oversized particles, when performing the density of soil and soil aggregate in-place, must be determined to adjust the T 99 or T 180 maximum density to compensate for this percentage.
APPENDIX B

WSDOT has added the following nomograph

B1. SOLUTION

B.1.1. The solution to this equation by nomograph is shown in Figure 1, wherein the maximum density of material passing the No. 4 (4.75 mm) sieve (Section 3.1) determined in the laboratory test is plotted and a line is drawn from this point to a point on the line representing the bulk specific gravity of the coarse particles. When the percentage of coarse particles contained in a field density of soil and soil-aggregate in-place has been determined and plotted on the above line as the abscissa on the chart (Figure 1), the ordinate will give the maximum laboratory dry density corrected to the new percentage of coarse particles.

B.1.2. Figures 2 and 3 illustrate a solution when Method C or Method D of T 99 or T 180 is utilized (Section 3.2).
**Example Method A or Method B**

Maximum laboratory dry density of 4.75 mm minus material, $D_i = 1826 \text{ kg/m}^3$ (114.0 lb/ft$^3$). Plot at A.

Specific gravity of coarse particles (4.75 mm plus) = 2.50. Plot at B.

Percent of coarse particles (4.75 mm plus) found when performing the density of soil and soil-aggregate in-place = 29.0. Plot at C.

Draw line AB.

Locate intersection of line extended vertically from C to line AB (point E).

Draw line horizontally from E, intersecting the ordinate at F.

Point F = 1949 kg/m$^3$ (121.7 lb/ft$^3$), the corrected maximum dry density of total material, D.

---

**Example Method C or Method D**

Maximum laboratory dry density of 19.0 mm minus material, $D_i = 1220 \text{ lb/ft}^3$. Plot at A.

Percent of coarse particles (4.75 mm plus), including any coarse particles replaced in the T99 or T180 Moisture Density Test, = 30.0. Plot at B.

Draw a line horizontally from A and a line vertically from B, meeting at point C.

Specific gravity of coarse particles (4.75 mm plus) = 2.50. Plot at E.

Draw a straight line, EC, and extend toward ordinate.

(Adjusting Maximum Density with Less Than 30 Percent Coarse Particles)

Percent of coarse particles (4.75 mm plus) found when performing the density of soil and soil-aggregate in-place = 15.0. Plot at F and draw line vertically from F to intersection with EC extended (point G).

Draw line horizontally from G, intersecting ordinate at H.

Point H = 1890 kg/m$^3$ (118.0 lb/ft$^3$), corrected maximum dry density of total material, D.

(Adjusting Maximum Density with More Than 30 Percent Coarse Particles)

Percent of coarse particles (4.75 mm plus) found when performing the density of soil and soil-aggregate in-place = 45.0. Plot at J and draw line vertically from J to intersection with EC (point K).

Draw line horizontally from K, intersecting the ordinate at L. Point L = 2018 kg/m$^3$ (126.0 lb/ft$^3$), the corrected maximum dry density of total material, D.
EXAMPLE

METHOD C OR METHOD D

Maximum laboratory dry density of 19.0 mm minus, \(D_t = 1938 \text{ kg/m}^3 (121.0 \text{ lb/ft}^3)\). Plot at A.
Specific gravity of coarse particles (19.0 mm plus) = 2.50. Plot at B.
Percent of coarse particles (19.0 mm plus) found when performing the density of soil and soil-aggregate in-place = 25.0. Plot at C.

Draw line AB.
Locate intersection of line extended vertically from C to line AB (point E).
Draw line horizontally from E, intersecting the ordinate at F.
Point F = 2015 kg/m^3 (125.8 lb/ft^3), the corrected maximum dry density of total material, D.

Figure 3. Density Correction Chart for Coarse Particles
B2. Report

Report the maximum density on DOT Form 350-074 and DOT Form 351-015.

If the specific gravity is unknown, then use 2.67.

Figure 1: Density Correction Chart for Coarse Particles

Maximum Dry Density - lb/ft³

Percent Coarse Particles
Performance Exam Checklist

Correction for Coarse Particles in the Soil
FOP for AASHTO T 224

Participant Name ________________________________ Exam Date ______________

Procedure Element
1. The tester has a copy of the current procedure on hand? Yes ☐ No ☐
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present? Yes ☐ No ☐

Gradation Analysis
1. WSDOT SOP 615 used to identify percent of oversize material? Yes ☐ No ☐
2. Sample Dried to a SSD condition (dried until no visible surface moisture present) and mass recorded? Yes ☐ No ☐
3. Sample allowed to cool sufficiently prior to sieving? Yes ☐ No ☐
4. Sample was shaken by hand through a No. 4 sieve for a sufficient period of time? Yes ☐ No ☐
5. Recorded mass of material retained on No. 4 sieve? Yes ☐ No ☐
6. Calculated and recorded percent of material retained and passing No 4 sieve? Yes ☐ No ☐

Correction for Coarse Particles
7. Maximum density of material passing No. 4 sieve, as determined by AASHTO T-99, correctly plotted onto nomograph? Yes ☐ No ☐
8. Line correctly drawn from maximum density plot to the correct specific gravity? Yes ☐ No ☐
9. Percent of material retained on the No. 4 screen correctly plotted onto nomograph? Yes ☐ No ☐
10. Corrected maximum density correctly identified from the nomograph? Yes ☐ No ☐
11. All calculations performed correctly? Yes ☐ No ☐

First attempt: Pass ☐ Fail ☐ Second attempt: Pass ☐ Fail ☐

Signature of Examiner __________________________________________
Comments:

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Reducing Samples of Aggregate to Testing Size

1. Scope
   1.1 This method covers for the reduction of large samples of aggregate to the appropriate size for testing employing techniques that are intended to minimize variations in measured characteristics between the test samples so selected and the large sample.
   1.2 The values stated in English units are to be regarded as the standard.
   1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents
   2.1 AASHTO Standards:
      T 2 Sampling of Aggregate
      T 84 Specific Gravity and Absorption of Coarse Aggregate
   2.2 ASTM Standards:
      C 125 Terminology Relating to Concrete and Concrete Aggregates

3. Terminology
   3.1 Definitions — The terms used in this practice are defined in ASTM C 125.

4. Significance and Use
   4.1 Specifications for aggregates require sampling portions of the material for testing. Other factors being equal, larger samples will tend to be more representative of the total supply. These methods provide for reducing the large sample obtained in the field or produced in the laboratory to a convenient size for conducting a number of tests to describe the material and measure its quality in a manner that the smaller test sample portion is most likely to be a representation of the larger sample, and thus of the total supply. The individual test methods provide for minimum amount of material to be tested.

   4.2 Under certain circumstances, reduction in size of the large sample prior to testing is not recommended. Substantial differences between the selected test samples sometimes cannot be avoided, as for example, in the case of an aggregate having relatively few large size particles in the sample. The laws of chance dictate that these few particles may be unequally distributed among the reduced size test samples. Similarly, if the test sample is being examined for certain contaminants occurring as a few discrete fragments in only small percentages, caution should be used in interpreting results from the reduced size test sample. Chance inclusion or exclusion of only one or two particles in the selected test sample may importantly influence interpretation of the characteristics of the original sample. In these cases, the entire original sample should be tested.

\(^1\)This FOP is based on AASHTO T 248-02.
4.3 Failure to carefully follow the procedures in this practice could result in providing a nonrepresentative sample to be used in subsequent testing.

5. SELECTION OF METHOD

5.1 Fine Aggregate — Samples of fine aggregate that are drier than the saturated-surface-dry condition (Note 1) using a mechanical splitter according to Method A. Samples having free moisture on the particle surfaces may be reduced in size by quartering according to Method B, or by treating as a miniature stockpile as described in Method C.

5.1.1 If the use of Method B or Method C is desired, and the sample does not have free moisture on the particle surfaces, the sample may be moistened to achieve this condition, thoroughly mixed, and then the sample reduction performed.

Note 1: The method of determining the saturated-surface-dry condition is described in Test Method T 84. As a quick approximation, if the fine aggregate will retain its shape when molded in the hand, it may be considered to be wetter than saturated-surface-dry.

5.1.2 If use of Method A is desired and the sample has free moisture on the particle surfaces, the entire sample may be dried to at least the saturated-surface-dry condition, using temperatures that do not exceed those specified for any of the tests contemplated, and then the sample reduction performed. Alternatively, if the moist sample is very large, a preliminary split may be made using a mechanical splitter having wide chute openings of 1 1/2 in. (38 mm) or more to reduce the sample to not less than 5000 g. The portion so obtained is then dried, and reduction to test sample size is completed using Method A.

5.2 Coarse Aggregates and Mixtures of Coarse and Fine Aggregates — Reduce the sample using a mechanical splitter in accordance with Method A (preferred method) or by quartering in accordance with Method B. The miniature stockpile Method C is not permitted for coarse aggregates or mixtures of coarse and fine aggregates.

5.3 Untreated materials shall be prepared for testing using this procedure. Treated materials (i.e., Hot Mix Asphalt or Asphalt Treated Base) shall be prepared for testing using WSDOT Test Method No. T 712 for reduction of size of samples of Asphalt treated materials.

6. SAMPLING

6.1 The samples of aggregate obtained in the field shall be taken in accordance with T 2, or as required by individual test methods. When tests for sieve analysis only are contemplated, the size of field sample listed in T 2 is usually adequate. When additional tests are to be conducted, the user shall determine that the initial size of the field sample is adequate to accomplish all intended tests. Similar procedures shall be used for aggregate production in the laboratory.
**Method A — Mechanical Splitter**

7. **APPARATUS**

7.1 Sample Splitter — Sample splitters shall have an even number of equal width chutes, but not less than a total of eight for coarse aggregate, or 12 for fine aggregate, which discharge alternately to each side of the splitter. For coarse aggregate and mixed aggregate, the minimum width of the individual chutes shall be approximately 50 percent larger than the largest particles in the sample to be split (Note 2). For dry fine aggregate in which the entire sample will pass the 3/8 in. (9.5 mm) sieve, the minimum width of the individual chutes shall be at least 50 percent larger than the largest particles in the sample and the maximum width shall be 3/4 in. (19 mm). The splitter shall be equipped with two receptacles to hold the two-halves of the sample following splitting. It shall also be equipped with a hopper or straight edge pan which has a width equal to or slightly less than the overall width of the assembly of chutes, by which the sample may be fed at a controlled rate to the chutes. The splitter and accessory equipment shall be so designed that the sample will flow smoothly without restriction or loss of material (Figure 1).

![Figure 1: Sample Dividers (Riffles)](image-url)
Note 2: Mechanical splitters are commonly available in sizes adequate for coarse aggregate having the largest particle not over 1 1/2 in. (37.5 mm).

8. PROCEDURE

8.1 Place the original sample in the hopper or pan and uniformly distribute it from edge to edge, so that when it is introduced into the chutes, approximately equal amounts will flow through each chute. The rate at which the sample is introduced shall be such as to allow free flowing through the chutes into the receptacles below. Reintroduce the portion of the sample in one of the receptacles into the splitter as many times as necessary to reduce the sample to the size specified for the intended test. The portion of the material collected in the other receptacle may be reserved for reduction in size for other tests.

(a) Small Sample Splitters for Fine Aggregate.

Figure 2: Quartering on a Hard, Clean Level Surface
Method B — Quartering

9. APPARATUS

9.1 Apparatus shall consist of a straightedge, scoop, shovel, or trowel; a broom or brush; and a canvas blanket approximately 6 by 8 ft. (2 by 2.5 m).

10. PROCEDURE

10.1 Use either the procedure described in 10.1.1 or 10.1.2 or a combination of both.

10.1.1 Place the original sample on a hard clean, level surface where there will be neither loss of material nor the accidental addition of foreign material. Mix the material thoroughly by turning the entire sample over three times. With the last turning, shovel the entire sample into a conical pile by depositing each shovelful on top of the preceding one. Carefully flatten the conical pile to a uniform thickness and diameter by pressing down the apex with a shovel so that each quarter sector of the resulting pile will contain the material originally in it. The diameter should be approximately four to eight times the thickness. Divide the flattened mass into four equal quarters with a shovel or trowel and remove two diagonally opposite quarters, including all fine material, and brush the cleared spaces clean. Successively mix and quarter the remaining material until the sample is reduced to the desired size (Figure 2).

10.1.2 As an alternative to the procedure in 10.1.1 when the floor surface is uneven, the field sample may be placed on a canvas blanket and mixed with a shovel as described in 10.1.1, or by alternatively lifting each corner of the canvas and pulling it over the sample toward the diagonally opposite corner causing the material to be rolled. Flatten the pile as described in 10.1.1. Divide the sample as described in 10.1.1 or if the surface beneath the blanket is uneven, insert a stick or pipe beneath the blanket and under the center of the pile, then lift both ends of the stick, dividing the sample into two equal parts. Remove the stick leaving a fold of the blanket between the divided portions. Insert the stick under the center of the pile at right angles to the first division and again lift both ends of the stick, dividing the sample into four equal parts. Remove two diagonally opposite quarters, being careful to clean the fines from the blanket. Successively mix and quarter the remaining material until the sample is reduced to the desired size (Figure 3).
Method C — Miniature Stockpile Sampling (Damp Fine Aggregate Only)

11. APPARATUS

11.1 Apparatus shall consist of a straight-edged scoop, shovel, or trowel for mixing the aggregate, and either a small sampling thief, small scoop, or spoon for sampling.

12. PROCEDURE

12.1 Place the original sample of damp fine aggregate on a hard clean, level surface where there will be neither loss of material nor the accidental addition of foreign material. Mix the material thoroughly by turning the entire sample over three times. With the last turning, shovel the entire sample into a conical pile by depositing each shovelful on top of the preceding one. If desired, the conical pile may be flattened to a uniform thickness and diameter by pressing the apex with a shovel so that each quarter sector of the resulting pile will contain the material originally in it. Obtain a sample for each test by selecting at least five increments of material at random locations from the miniature stockpile, using any of the sampling devices described in 11.1.
Performance Exam Checklist

Reducing Samples of Aggregates to Testing Size
FOP for AASHTO T 248

Participant Name ___________________________ Exam Date ______________

Procedure Element Yes No

1. The tester has a copy of the current procedure on hand? □ □

Selection of Method

1. Fine Aggregate
   A. Drier than saturated surface dry: Method A (Splitter) used? □ □
   B. Free moisture present: Method B (Quartering) used? □ □

2. Coarse Aggregate and Mixtures of Fine and Coarse Aggregates
   A. Method A used (preferred)? □ □
   B. Method B used? □ □

Method A — Splitting

1. Material spread uniformly on feeder? □ □
2. Rate of feed slow enough so that sample flows freely through chutes? □ □
3. Material in one pan re-split until desired mass is obtained? □ □

Method B — Quartering

1. Sample placed on clean, hard, and level surface? □ □
2. Mixed by turning over 3 times with shovel or by raising canvas and pulling over pile? □ □
3. Conical pile formed? □ □
4. Diameter equal to about 4 to 8 times thickness? □ □
5. Pile flattened to uniform thickness and diameter? □ □
6. Divided into 4 equal portions with shovel or trowel? □ □
7. Two diagonally opposite quarters, including all fine material, removed? □ □
8. Cleared space between quarters brushed clean? ☐ ☐
9. Process continued until desired sample size is obtained when two opposite quarters combined? ☐ ☐

The sample may be placed upon a blanket and a stick or pipe may be placed under the blanket to divide the pile into quarters.

First attempt: Pass ☐ Fail ☐ Second attempt: Pass ☐ Fail ☐

Signature of Examiner __________________________________________

Comments:
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WSDOT FOP for AASHTO T 255

Total Evaporable Moisture Content of Aggregate by Drying

1. SCOPE

1.1 This test method covers the determination of the percentage of evaporable moisture in a sample of aggregate by drying, both surface moisture and moisture in the pores of the aggregate. Some aggregate may contain water that is chemically combined with the minerals in the aggregate. Such water is not evaporable and is not included in the percentage determined by this test method.

1.2 The values stated in English units are to be regarded as the standard. The values stated in parentheses are provided for information only.

1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. For specific precautionary statements, see 5.3.1, 7.2.1, and 7.3.1.

2. REFERENCED DOCUMENTS

2.1 AASHTO Standards:

M 92 Wire-Cloth Sieves for Testing Purposes
M 231 Weighing Devices Used in Testing Materials
R 16 Regulatory Information for Chemicals Used in AASHTO Tests
T 2 Sampling of Aggregate
T 19/T 19M Bulk Density (“Unit Weight”) and Voids in Aggregate
T 84 Specific Gravity and Absorption of Coarse Aggregate
T 85 Specific Gravity and Absorption of Fine Aggregate

2.2 ASTM Standards:

C 125 Terminology Relating to Concrete and Concrete Aggregates
C 670 Practice for Preparing Precision Statements for Test Methods for Construction Materials

3. TERMINOLOGY

3.1 Definitions:

3.1.1 For definitions of terms used in this test method, refer to ASTM C 125.

4. Significance and Use

4.1 This test method is sufficiently accurate for usual purposes, such as adjusting batch quantities of ingredients for concrete. It will generally measure the moisture in the test sample more reliably than the sample can be made to represent the aggregate supply. In rare cases where the aggregate itself is altered by heat, or where more refined measurement is required, the test should be conducted using a ventilated, controlled temperature oven.

¹This FOP is based on AASHTO T 255-00.
4.2 Large particles of coarse aggregate, especially those larger than 2 in. (50 mm), will require greater time for the moisture to travel from the interior of the particle to the surface. The user of this test method should determine by trial if rapid drying methods provide sufficient accuracy for the intended use when drying large size particles.

5. **APPARATUS**

5.1 Balance — The balances shall have sufficient capacity, be readable to 0.1 percent of the sample mass, or better, and conform to the requirements of M 231.

5.2 Source of Heat — A ventilated oven capable of maintaining the temperature surrounding the sample at 110 ± 5°C (230 ± 9°F). Where close control of the temperature is not required (see Section 4.1), other suitable sources of heat may be used, such as an electric or gas hot plate, electric heat lamps, or a ventilated microwave oven.

5.3 Sample Container — A container not affected by the heat, and of sufficient volume to contain the sample without danger of spilling, and of such shape that the depth of sample will not exceed one fifth of the least lateral dimension.

5.3.1 Precaution — When a microwave oven is used, the container shall be nonmetallic.

*Note 1:* Except for testing large samples, an ordinary frying pan is suitable for use with a hot plate, or any shallow flat-bottomed metal pan is suitable with heat lamps or oven. Note Precaution in Section 5.3.1.

5.4 Stirrer — A metal spoon or spatula of convenient size.

6. **SAMPLING**

6.1 Sampling shall generally be accomplished in accordance with T 2, except for the sample size may be as stated in Table 1.

6.2 Secure a sample of the aggregate representative of the moisture content in the supply being tested and having a mass not less than the amount listed in Table 1. Protect the sample against loss of moisture prior to determining the mass.
Table 1
Sample Size for Aggregate

<table>
<thead>
<tr>
<th>Nominal Maximum Size of Aggregate, in. (mm)(^a)</th>
<th>Mass of Normal Weight Aggregate Sample, min, kg(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4 (4.75)</td>
<td>0.5</td>
</tr>
<tr>
<td>3/8 (9.5)</td>
<td>1.5</td>
</tr>
<tr>
<td>1/2 (12.5)</td>
<td>2</td>
</tr>
<tr>
<td>3/4 (19.0)</td>
<td>3</td>
</tr>
<tr>
<td>1 (25.0)</td>
<td>4</td>
</tr>
<tr>
<td>1 1/2 (37.5)</td>
<td>6</td>
</tr>
<tr>
<td>2 (50)</td>
<td>8</td>
</tr>
<tr>
<td>2 1/2 (63)</td>
<td>10</td>
</tr>
<tr>
<td>3 (75)</td>
<td>13</td>
</tr>
<tr>
<td>3 1/2 (90)</td>
<td>16</td>
</tr>
<tr>
<td>4 (100)</td>
<td>25</td>
</tr>
<tr>
<td>6 (150)</td>
<td>50</td>
</tr>
</tbody>
</table>

\(^a\)Based on sieves with square openings.

\(^b\)To determine the minimum sample weight for lightweight aggregate, multiply the value by the approximate dry-loose unit mass of the aggregate in kg/m\(^3\) and dividing by 1600.

**Note:** When determining moisture content for AASHTO T 310, the sample size will be approximately 9 lbs.

7.    PROCEDURE

7.1   Determine the mass of the sample to the nearest 0.1 percent or better of the total sample mass.

7.2   Dry the sample thoroughly in the sample container by means of the selected source of heat, exercising care to avoid loss of any particles. Very rapid heating may cause some particles to explode, resulting in loss of particles. Use a controlled temperature oven when excessive heat may alter the character of the aggregate, or where more precise measurement is required. If a source of heat other than the controlled temperature oven is used, stir the sample during drying to accelerate the operation and avoid localized overheating. When using a microwave oven, stirring of the sample is optional.

7.2.1   Caution — When using a microwave oven, occasionally minerals are present in aggregates that may cause the material to overheat and explode. If this occurs it can damage the microwave oven.

7.3   When a hot plate is used, drying can be expedited by the following procedure. Add sufficient anhydrous denatured alcohol to cover the moist sample. Stir and allow suspended material to settle. Decant as much of the alcohol as possible without losing any of the sample. Ignite the remaining alcohol and allow it to burn off during drying over the hot plate.

7.3.1   Warning — Exercise care to control the ignition operation to prevent injury or damage from the burning alcohol.

7.4   The sample is thoroughly dry when further heating causes, or would cause, less than 0.1 percent additional loss in mass.

7.5   Determine the mass of the dried sample to the nearest 0.1 percent or better of the total sample mass after it has cooled sufficiently not to damage the balance.
8. CALCULATION

8.1 Calculate total evaporable moisture content as follows:

\[ p = 100 \frac{(W - D)}{D} \]

where:

\( p \) = total evaporable moisture content of sample, percent;
\( W \) = mass of original sample, g; and
\( D \) = mass of dried sample, g

8.2 Surface moisture content is equal to the difference between the total evaporated moisture content and the absorption, with all values based on the mass of a dry sample. Absorption may be determined in accordance with T 85, Test for Specific Gravity and Absorption of Coarse Aggregates, or T 84, Test for Specific Gravity and Absorption of Fine Aggregates

9. PRECISION AND BIAS

9.1 Precision:

9.1.1 The within-laboratory single operator standard deviation for moisture content of aggregates has been found to be 0.28% (Note 2). Therefore, results of two properly conducted tests by the same operator in the same laboratory on the same type of aggregate sample should not differ by more than 0.79% (Note 2) from each other.

9.1.2 The between-laboratory standard deviation for moisture content of aggregates has been found to be 0.28% (Note 2). Therefore, results of properly conducted tests from two laboratories on the same aggregate sample should not differ by more than 0.79% (Note 2) from each other.

9.1.3 Test data used to derive the above precision indices were obtained from samples dried to a constant mass in a drying oven maintained at 230 ± 9 F (110 ± 5°C). When other drying procedures are used, the precision of the results may be significantly different than that indicated above.

Note 2: These numbers represent, respectively, the 1s and d2s limits as described in Practice C 670.

9.2 Bias:

9.2.1 When experimental results are compared with known values from accurately compounded specimens, the following has been derived.

9.2.1.1 The bias of moisture tests on one aggregate material has been found to have a mean of +0.06%. The bias of individual test values from the same aggregate material has been found with 95% confidence to lie between -0.07% and + 0.20%.

9.2.1.2 The bias of moisture tests on a second aggregate material has been found to have a mean of < +0.01%. The bias of individual test values from the same aggregate material has been found with 95% confidence to lie between -0.14% and +0.14%.

9.2.1.3 The bias of moisture tests overall on both aggregate materials has been found to have a mean of +0.03%. The bias of individual test values overall from both aggregate materials has been found with 95% confidence to lie between -0.12% and +0.18%.
9.2.2 Test data used to derive the above bias statements were obtained from samples dried to a constant mass in a drying oven maintained at 230 ± 9 F (110 ± 5°C). When other drying procedures are used, the bias of the results may be significantly different than that indicated above.

Note 3: These precision and bias statements were derived from aggregate moisture data provided by 17 laboratories participating in the SHRP Soil Moisture Proficiency Sample Program which is fully described in the National Research Council Report SHRP-P-619. The samples tested which relate to these statements were well graded mixtures of fine and coarse aggregate with moisture contents ranging from air dry to saturated surface dry.

10. REPORT

Report results using WSDOT Form 422-020, or other report approved by the State Materials Engineer.
Performance Exam Checklist

**Total Moisture Content of Aggregate by Drying**
**FOP for AASHTO T 255**

<table>
<thead>
<tr>
<th>Procedure Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?</td>
</tr>
<tr>
<td>3. Representative sample of appropriate mass obtained?</td>
</tr>
<tr>
<td>4. Mass of clean, dry container determined?</td>
</tr>
<tr>
<td>5. Sample placed in container and mass determined?</td>
</tr>
<tr>
<td>6. Test sample mass conforms to the required mass?</td>
</tr>
<tr>
<td>7. Sample mass determined to 0.1 percent?</td>
</tr>
<tr>
<td>8. Loss of moisture avoided prior to mass determination?</td>
</tr>
<tr>
<td>9. Sample dried by a suitable heat source?</td>
</tr>
<tr>
<td>10. Sample cooled prior to mass determination?</td>
</tr>
<tr>
<td>11. If aggregate heated by means other than a controlled oven, is sample stirred to avoid localized overheating?</td>
</tr>
<tr>
<td>12. Mass determined and compared to previous mass – showing less than 0.1 percent loss?</td>
</tr>
<tr>
<td>13. Calculations performed properly and results reported to the nearest 0.1 percent?</td>
</tr>
</tbody>
</table>

First attempt: Pass [ ] Fail [ ]
Second attempt: Pass [ ] Fail [ ]

Signature of Examiner ________________________________

Comments:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
WSDOT FOP for AASHTO T 272

Family of Curves — One-point Method

1. SCOPE

1.1 These methods of tests are for the rapid determination of the maximum density and optimum moisture content of a soil sample utilizing a family of curves and a one-point determination.

1.2 One-point determinations are made by compacting the soil in a mold of a given size with a 5.5-lb (2.5-kg) rammer dropped from a height of 12 in. (305 mm). Four alternate procedures are provided as follows:

   Method A — A 4-in. (101.6 mm) mold; soil material passing a No. 4 (4.75-mm) sieve. Sections 4 and 5.
   Method B — A 6-in. (152.4-mm) mold; soil material passing a No. 4 (4.75-mm) sieve. Sections 6 and 7.
   Method C — A 4-in. (101.6 mm) mold; soil material passing a 3/4 in. (19.0-mm) sieve. Sections 8 and 9.
   Method D — A 6-in. (152.4-mm) mold; soil material passing a 3/4 in. (19.0-mm) sieve. Sections 10 and 11.

   The preferred method of WSDOT is to use method A.

1.3 The methods described herein correspond to the methods in T 99 and must be chosen accordingly; i.e., when moisture-density relationships as determined by T 99 Method C are used to form the family of curves, then Method C described in this procedure must be used for the one-point determination (Note 1).

   Note 1: Direct reference to T 99 is made throughout these test methods and most terminology, apparatus and procedures are the same.

1.4 In addition, the concepts described herein are applicable to one-point determinations and moisture-density relationships as specified in T 180 with appropriate apparatus and method used as required.

1.5 The following applies to all specified limits in this standard: For the purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded off “to the nearest unit” in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding-off method of R 11, Recommended Practice for Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values.

1.6 The values stated in English units are to be regarded as the standard.

2. DEFINITION

2.1 A family of curves is a group of typical soil moisture-density relationships determined using T 99, which reveal certain similarities and trends characteristic of the soil type and source. Soils sampled from one source will have many different moisture-density curves, but if a group
FIGURE 1  Example of Curves
of these curves are plotted together certain relationships usually become apparent. In general it will be found that higher unit mass soils assume steeper slopes with maximum dry densities at lower optimum moisture contents, while the lower unit mass soils assume flatter more gently sloped curves with higher optimum moisture contents (Figure 1).

3. APPARATUS

3.1 See T 99, Section 2.

METHOD A

4. SAMPLE

4.1 See T 99, Section 3.

5. PROCEDURE

5.1 Thoroughly mix the selected representative sample with sufficient water to dampen approximately 4 percentage points below optimum moisture content. Greater accuracy in the determination of the maximum density will result as the moisture content used approaches optimum moisture content. Moisture content of the sample should never exceed the optimum water content.

5.2 Form a specimen by compacting the prepared soil in the 4-in. (101.6-mm) mold (with collar attached) in three approximately equal layers to give a total compacted depth of about 5 in. (125 mm). Compact each layer by 25 uniformly distributed blows from the rammer dropping free from a height of 12 in. (305 mm) above the elevation of the soil when a sleeve-type rammer is used, or from 12 in. (305 mm) above the approximate elevation of compacted soil when a stationary mounted type of rammer is used. During compaction, the mold shall rest firmly on a dense uniform, rigid and stable foundation (Note 2).

Note 2: Each of the following has been found to be a satisfactory base on which to rest the mold during compaction of the soil: A block of concrete, with a mass not less than 200 lb (91 kg) supported by a relatively stable foundation; a sound concrete floor; and for field application, such surfaces as are found in concrete box culverts, bridges, and pavements.

5.2.1 Following compaction, remove the extension collar, carefully trim the compacted soil even with the top of the mold by means of the straightedge, and determine the mass of the mold and moist soil in kilograms to the nearest 5 grams, or determine the mass in pounds to the nearest 0.01 pounds. For molds conforming to tolerances given in Section 3 and masses recorded in kilograms, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 1060, and record the result as the wet density, \( W_1 \), in kilograms per cubic meter, of compacted soil. For molds conforming to tolerances given in Section 3 and masses recorded in pounds, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 30, and record the result as the wet density, \( W_1 \), in pounds per cubic foot, of compacted soil. For used molds out of tolerance by not more than 50 percent (Section 3), use the factor for the mold as determined in accordance with Section 8 (Calibration of Measure), AASHTO T 19.

5.3 Remove the material from the mold and slice vertically through the center. Take a representative sample of the material from one of the cut faces, determine the mass immediately, and dry in an oven at 110 ± 5°C (230 ± 9°F), for at least 12 hours, or to a constant mass to determine the moisture content in accordance with AASHTO T 255 or T 217. The moisture sample shall have a mass not less than 100 g.
**Note** — When developing a compaction curve for free draining soils, such as uniform sands and gravels, where seepage occurs at the bottom of the mold and base plate, taking a representative moisture content sample from the mixing bowl may be preferred in order to determine the amount of moisture available for compaction.

**METHOD B**

6. **SAMPLE**

6.1 Select the representative sample in accordance with Section 4, except that it shall have a mass of approximately 16 lb (7 kg).

7 **PROCEDURE**

7.1 Follow the same procedure as described for Method A in Section 5, except for the following: Form a specimen by compacting the prepared soil in the 6-in. (152.4-mm) mold (with collar attached) in three approximately equal layers to give a total compacted depth of about 5-in. (125 mm), each layer being compacted by 56 uniformly distributed blows from the rammer. For molds conforming to tolerances given in Section 3, and masses recorded in kilograms, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 471, and record the result as the wet density, W1, in kilograms per cubic meter of compacted soil. For molds conforming to tolerances given in Section 3, and masses recorded in pounds, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 13.33, and record the result as the wet density, W1, in pounds per cubic foot, of the compacted soil. For used molds out of tolerance by not more than 50 percent (Section 3), use the factor for the mold as determined in accordance with Section 8 (Calibration of Measure), AASHTO T 19.

**METHOD C**

8. **SAMPLE**

8.1 If the soil sample is damp when received from the field, dry it until it becomes friable under a trowel. Drying may be in air or by use of drying apparatus such that the temperature does not exceed 140°F (60°C). Then thoroughly break up the aggregations in such a manner as to avoid reducing the natural size of individual particles.

8.2 Sieve an adequate quantity of the representative pulverized soil over the 3/4 in. (19.0-mm) sieve. Discard the coarse material, if any, retained on the 3/4 in. (19.0-mm) sieve (Note 3).

**Note 3:** If it is advisable to maintain the same percentage of coarse material (passing a 2 in. (50-mm) sieve and retained on a No. 4 (4.75-mm) sieve) in the moisture-density sample as in the original field sample, the material retained on the 3/4 in. (19.0-mm) sieve shall be replaced as follows: Sieve an adequate quantity of the representative pulverized soil over the 2 in. (50-mm) and 3/4 in. (19.0-mm) sieves. Determine the mass of the material passing the 2 in. (50-mm) sieve and retained on the 3/4 in. (19.0-mm) sieve and replace it with an equal mass of material passing the 3/4 in. (19.0-mm) sieve and retained on the No. 4 (4.75-mm) sieve. Take the material for replacement from the remaining portion of the sample.

8.3 Select a representative sample having a mass of approximately 12 lb (5 kg) or more of the soil prepared as described in Sections 8.1 and 8.2.

9. **PROCEDURE**

9.1 Thoroughly mix the selected representative sample with sufficient water to dampen it to approximately 4 percentage points below optimum moisture content. Greater accuracy in the determination of the maximum density will result as the moisture content used approaches the optimum moisture content.
9.2 Form a specimen by compacting the prepared soil in the 4-in. (101.6-mm) mold (with collar attached) in three approximately equal layers to give total compacted depth of about 5 in. (125 mm). Compact each layer by 25 uniformly distributed blows from the rammer dropping free from a height of 12 in. (305 mm) above the elevation of the soil when a sleeve-type rammer is used or from 12 in. (305 mm) above the approximate elevation of each finely compacted layer when a stationary mounted type rammer is used. During compaction, the mold shall rest firmly on a dense, uniform, rigid and stable foundation (Note 2).

9.2.1 Following compaction, remove the extension collar and carefully trim the compacted soil even with the top of the mold by means of the straightedge. Holes developed in the surface by removal of coarse material shall be patched with smaller size material. Determine the mass of the mold and moist soil in kilograms to the nearest 5 grams, or determine the mass in pounds to the nearest 0.01 pounds. For molds conforming to tolerances given in Section 3 and masses recorded in kilograms, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 1060, and record the result as the wet density, \( W_1 \), in kilograms per cubic meter of compacted soil. For molds conforming to tolerances given in Section 3 and masses recorded in pounds, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 30, and record the result as the wet density, \( W_1 \), in pounds per cubic foot, of compacted soil. For used molds out of tolerance by not more than 50 percent (Section 3), use the factor for the mold as determined in accordance with Calibration of Measure in AASHTO T-19.

9.3 Remove the material from the mold and slice vertically through the center. Take a representative sample of the material from one of the cut faces, determine the mass immediately and dry to a constant mass using a drying apparatus described in Section 3 to determine the moisture content. The moisture sample shall have a mass not less than 500 g.

**METHOD D**

10. SAMPLE

10.1 Select the representative sample in accordance with Section 8.3 except that it shall have a mass of approximately 25 lb (11 kg).

11. PROCEDURE

11.1 Follow the same procedure as described for Method C in Section 9, except for the following: Form a specimen by compacting the prepared soil in the 6-in. (152.4-mm) mold (with collar attached) in three approximately equal layers to give a total compacted depth of about 5 in. (125 mm), each layer being compacted by 56 uniformly distributed blows from the rammer. For molds conforming to tolerances given in Section 3, and masses recorded in kilograms, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 471, and record the result as the wet density, \( W_1 \), in kilograms per cubic meter, of compacted soil. For molds conforming to tolerances given in Section 3, and masses recorded in pounds, multiply the mass of the compacted specimen and the mold, minus the mass of the mold, by 13.33, and record the result as the wet density, \( W_1 \), in pounds per cubic foot, of the compacted soil. For used molds out of tolerance by not more than 50 percent (Section 3), use the factor for the mold as determined in accordance with Section 8 (Calibration of Measure), AASHTO T-19.
CALCULATIONS AND REPORT

12.  CALCULATIONS

12.1 See T 99, Section 11.

13.  MAXIMUM DENSITY AND OPTIMUM MOISTURE CONTENT DETERMINATION

13.1 The calculations in Section 12.1 shall be made to determine the moisture content and corresponding over-dry density (mass) in pounds per cubic foot (kilograms per cubic meter) of the compacted specimen. The dry density (unit mass) of the soil shall be plotted as ordinate and the corresponding moisture content as the abscissa to define one-point within or on the family of curves (Figure 1).

13.2 If the one-point falls on one of the curves in the family of curves the maximum dry density and optimum moisture content defined by that curve shall be used (Note 4).

13.3 If the one-point falls within the family but not on a curve, a new curve shall be drawn through the plotted one-point parallel and in character with the nearest existing curve in the family of curves. The maximum dry density and optimum moisture content as defined by the new curve shall be used (Note 4).

**Note 4:** If the one-point plotted within or on the family of curves does not fall in the 80 to 100 percent of optimum moisture range, compact another specimen, using the same material, at an adjusted moisture content that will place the one-point within this range.

13.3.1 If the family of curves is such that the profile of a new curve to be drawn through a one-point is not well defined or in any way questionable, then a full moisture-density relationship shall be made for the soil in question to correctly define the new curve and verify the applicability of the family of curves (Note 5).

**Note 5:** New curves drawn through plotted one-point determinations shall not become a permanent part of the family of curves until verified by a full moisture-density relationship.

14.  REPORT

14.1 The report shall include the following:

14.1.1 The method used (Method A, B, C, or D).

14.1.2 The optimum moisture content as a percentage to the nearest whole number.

14.1.3 The maximum density to the nearest 1.0 lb/ft³ (0.5 kg/m³).

14.1.4 In Methods C and D indicate if the material retained on the 3/4-in. (19.0-mm) sieve was removed or replaced.

14.1.5 Type of face if other than 2-in. (50.8-mm) circular.

**Note 6:** Inherent variability of soils places limitations on this method of test. The person using this test method must realize this and become thoroughly familiar with the material being tested. Knowledge of the AASHTO Soil Classification System and ability to recognize the gradation of soils are requirements for this work.
APPENDIX

DEVELOPING A MOISTURE-DENSITY FAMILY OF CURVES

The purpose of the family of curves is to represent the average moisture-density characteristics of the material. The family must, therefore, be based on moisture-density relationships which adequately represent the entire mass range and all types of material for which the family is to be used. It may be that particular soil types have moisture-density relationships that differ considerably and cannot be represented on one general family of curves; in this case a separate family may be developed. Also, moisture-density relationships for material of widely varying geologic origins should be carefully examined to determine if separate families are required.

When a small number of moisture-density relationships are being used to develop a family of curves, plot the point representing the maximum density and optimum moisture content for each relationship on a single sheet of graph paper. Draw a smooth curve which as closely as possible connects all these points. This line will define the maximum density and optimum moisture content of the material represented by this family of curves. At 2-lb (1-kg) increments draw moisture-density curves with slopes similar to the slopes of the original moisture-density relationships. Slopes should gradually steepen going from low to high maximum density material.

When a great number of moisture-density relationships are available, the above procedure can be modified by using average values. Tabulate the maximum density, optimum moisture content, and slope for all moisture-density relationships in each 2-lb (1-kg) increment of density. Average the maximum densities and optimum moisture contents for each increment and plot these values. As before, draw a smooth curve which as closely as possible connects all these points. Determine the average slope for each increment, and at each 2-lb (1-kg) increment draw a moisture-density curve using this average slope value. A computer, if available, may be used to accomplish this work.

The accuracy of a family of curves can be checked by comparing the maximum density and optimum moisture content from an individual moisture-density relationship with that obtained using the One-Point Method and family of curves. A point representing 80 percent of optimum moisture content is taken from the individual moisture-density relationship and used as described in the One-Point Method to determine the maximum density and optimum moisture content from the family of curves. These values are compared with the values from the individual moisture-density relationship. The difference represents the maximum variance expected when the One-Point Method and family of curves are used for material represented by that individual moisture-density relationship. This comparison should be made for all types of material over the mass range of the family. Based on these results some adjustments may be necessary to the family and/or it may be recognized that the family is not applicable to some types of material. Families based on relatively few moisture-density relationships will generally require the closest scrutiny since it can be expected that a larger number of relationships will give better average conditions.
Performance Exam Checklist

Family of Curves — One-point Method
FOP for AASHTO T 272

Participant Name ___________________________________________ Exam Date ________________

Procedure Element Yes No

1. The tester has a copy of the current procedure on hand? ☐ ☐

2. One-point determination of dry density and corresponding moisture content made in accordance with the FOP for AASHTO T 99, AASHTO T 180, or WAQTC TM 9? ☐ ☐
   a. Correct size No 4 or 3/4 in. (4.75 mm or 19.0 mm) material used? ☐ ☐
   b. Correct number of blows per layer used (25 or 56)? ☐ ☐
   c. Correct number of layers used (3, 4, or 5)? ☐ ☐
   d. Moisture content determined in accordance with FOP for AASHTO T255/T265 or AASHTO T 217? ☐ ☐

3. One-point plotted on family of curves supplied? ☐ ☐

4. One-point falls within 80 to 100 percent of optimum moisture content in order to be valid? ☐ ☐

5. If one-point does not fall within 80 to 100 percent of optimum moisture content, another one-point determination with an adjusted water content is made? ☐ ☐

6. Maximum dry density and corresponding optimum moisture content correctly estimated? ☐ ☐

First attempt: Pass ☐ Fail ☐ Second attempt: Pass ☐ Fail ☐

Signature of Examiner ___________________________________________

Comments:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
WSDOT Test Method for AASHTO T 304

Uncompacted Void Content of Fine Aggregate

1. SCOPE

1.1. This method describes the determination of the loose uncompacted void content of a sample of fine aggregate. When measured on any aggregate of a known grading, void content provides an indication of that aggregate’s angularity, sphericity, and surface texture compared with other fine aggregates tested in the same grading. When void content is measured on an as-received fine aggregate grading, it can be an indicator of the effect of the fine aggregate on the workability of a mixture in which it may be used.

1.2. Three procedures are included for the measurement of void content. Two use graded fine aggregate (standard grading or as-received grading), and the other uses several individual size fractions for void content determinations:

1.2.1. Standard Graded Sample (Method A) – This method uses a standard fine aggregate grading that is obtained by combining individual sieve fractions from a typical fine aggregate sieve analysis. See the section on Preparation of Test Samples for the Grading.

Note WSDOT Specifications require Method A

1.2.2. Individual Size Fractions (Method B) – This method uses each of three fine aggregate size fractions: (a) 2.36-mm (No. 8) to 1.18-mm (No. 16); (b) 1.18-mm (No. 16) to 600-um (No. 30); and (c) 600-um (No. 30) to 300 um (No. 50). For this method, each size is tested separately.

1.2.3. As-Received Grading (Method C) – This method uses that portion of the fine aggregate finer than a 4.75-mm (No. 4) sieve.

1.2.4. See the section on Significance and Use for guidance on the method to be used.

1.3. The values stated in SI units shall be regarded as the standard.

1.4. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCES DOCUMENTS

AASHTO Standards

T 2, WSDOT FOP for AASHTO for the Sampling of Aggregates

T 248, WSDOT FOP for AASHTO for Reducing Field Samples of Aggregate to Testing Size

T 27/11, WAQTC FOP for AASHTO for the Sieve Analysis of Fine & Coarse Aggregates & Materials Finer Than 75 mm (No. 200) in Mineral Aggregates by Washing

T 84 Specific Gravity and Absorption of Fine Aggregate

This test method is based on AASHTO T304-96 (2000).
2.1. **ASTM Standards:**

- B 88, Specification for Seamless Copper Water Tube
- B 88M, Specification for Seamless Copper Water Tube (Metric)
- C 29/29M, Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
- C 117, Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
- C 125, Terminology Relating to Concrete and Concrete Aggregates
- C 128, Test Method for Specific Gravity and Absorption of Fine Aggregate
- C 136, Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C 702, Practice for Reducing Samples of Aggregate to Testing Size
- C 778, Specification for Standard Sand
- D 75, Practice for Sampling Aggregates

2.2. **ACI Document:**

- ACI 116R, Cement and Concrete Terminology

3. **TERMINOLOGY**

3.1. Terms used in this standard are defined in ASTM C 125 or ACI 116R.

4. **SUMMARY OF TEST METHOD**

4.1. A nominal 100-mL calibrated cylindrical measure is filled with fine aggregate of prescribed grading by allowing the sample to flow through a funnel from a fixed height into the measure. The fine aggregate is struck off, and its mass is determined by weighing. Uncompacted void content is calculated as the difference between the volume of the cylindrical measure and the absolute volume of the fine aggregate collected in the measure. Uncompacted void content is calculated using the bulk dry specific gravity of the fine aggregate. Two runs are made on each sample and the results are averaged.

4.1.1. For a graded sample (Method A or Method C) the percent void content is determined directly, and the average value from two runs is reported.

4.1.2. For the individual size fractions (Method B), the mean percent void content is calculated using the results from tests of each of the three individual size fractions.

5. **SIGNIFICANCE AND USE**

5.1. Methods A and B provide percent void content determined under standardized conditions which depend on the particle shape and texture of a fine aggregate. An increase in void content by these procedures indicates greater angularity, less sphericity, or rougher surface texture, or some combination of the three factors. A decrease in void content results is associated with more rounded, spherical, smooth surfaced fine aggregate, or a combination of these factors.

5.2. Method C measures the uncompacted void content of the minus No. 4 (4.75-mm) portion of the as-received material. This void content depends on grading as well as particle shape and texture.
5.3. The void content determined on the standard graded sample (Method A) is not directly comparable with the average void content of the three individual size fractions from the same sample tested separately (Method B). A sample consisting of single size particles will have a higher void content than a graded sample. Therefore, use either one method or the other as a comparative measure of shape and texture, and identify which method has been used to obtain the reported data. Method C does not provide an indication of shape and texture directly if the grading from sample to sample changes.

5.3.1. The standard graded sample (Method A) is most useful as a quick test which indicates the particle shape properties of a graded fine aggregate. Typically, the material used to make up the standard graded sample can be obtained from the remaining size fractions after performing a single sieve analysis of the fine aggregate.

5.3.2. Obtaining and testing individual size fractions (Method B) is more time consuming and requires a larger initial sample than using the graded sample. However, Method B provides additional information concerning the shape and texture characteristics of individual sizes.

5.3.3. Testing samples in the as-received grading (Method C) may be useful in selecting proportions of components used in a variety of mixtures. In general, high void content suggests that the material could be improved by providing additional fines in the fine aggregate or more cementitious material may be needed to fill voids between particles.

5.3.4. The bulk dry specific gravity of the fine aggregate is used in calculating the void content. The effectiveness of these methods of determining void content and its relationship to particle shape and texture depends on the bulk specific gravity of the various size fractions being equal, or nearly so. The void content is actually a function of the volume of each size fraction. If the type of rock or minerals, or its porosity, in any of the size fractions varies markedly it may be necessary to determine the specific gravity of the size fractions used in the test.

5.4. Void content information from Methods A, B, or C will be useful as an indicator of properties such as: the mixing water demand of hydraulic cement concrete; flowability, pumpability, or workability factors when formulating grouts or mortars; or, in bituminous concrete, the effect of the fine aggregate on stability and voids in the mineral aggregate; or the stability of the fine aggregate portion of a base course aggregate.

6. APPARATUS

6.1. Cylindrical Measure – A right cylinder of approximately 100 mL capacity having an inside diameter of approximately 39 mm and an inside height of approximately 86 mm made of drawn copper water tube meeting ASTM Specification B 88 Type M, or B 88 M Type C. The bottom of the measure shall be metal at least 6 mm thick, shall be firmly sealed to the tubing, and shall be provided with means for aligning the axis of the cylinder with that of the funnel. (See Figure 1.)

6.2. Funnel – The lateral surface of the right frustum of a cone sloped 60 ± 4° from the horizontal with an opening of 12.7 ± 0.6 mm diameter. The funnel section shall be a piece of metal, smooth on the inside and at least 38 mm high. It shall have a volume of at least 200 mL or shall be provided with a supplemental glass or metal container to provide the required volume. (See Figure 2.)
Figure 1 – Nominal 100-ml Cylindrical Measure

Figure 2 – Suitable Funnel Stand Apparatus with Cylindrical Measure in Place
Note 1 – Pycnometer top C9455 sold by Hogentogler and Co., Inc., 9515 Gerwig, Columbia, MD 21045, 410-381-2390 is satisfactory for the funnel section, except that the size of the opening has to be enlarged and any burrs or lips that are apparent should be removed by light filing or sanding before use. This pycnometer top must be used with suitable glass jar with the bottom removed (Figure 2).

6.3. *Funnel stand* – A three or four legged support capable of holding the funnel firmly in position with the axis of the funnel colinear (within a 4° angle and a displacement of 2 mm) with the axis of the cylindrical measure. The funnel opening shall be 115 ± 2 mm above the top of the cylinder. A suitable arrangement is shown in Figure 2.

6.4. *Glass Plate* – A square glass plate approximately 60 mm by 60 mm with a minimum 4-mm thickness used to calibrate the cylindrical measure.

6.5. *Pan* – A metal or plastic pan of sufficient size to contain the funnel stand and to prevent loss of material. The purpose of the pan is to catch and retain fine aggregate particles that overflow the measure during filling and strike off.

6.6. Metal spatula with a blade approximately 100 mm long, and at least 20 mm wide, with straight edges. The end shall be cut at a right angle to the edges. The straight edges. The straight edge of the spatula blade is used to strike off the fine aggregate.

6.7. Scale or balance accurate and readable to ±0.1 g within the range of use, capable of weighing the cylindrical measure and its contents.

7. SAMPLING

7.1. The sample(s) used for this test shall be obtained using FOP for AASHTO T 2 ASTM D 75 and FOP for AASHTO T 248 ASTM C 702, or from sieve analysis samples used for FOP for AASHTO T 27/11 ASTM C 136, or from aggregate extracted from a bituminous concrete specimen. For Methods A and B, the sample is washed over a 150-um (No. 100) or 75-um (No. 200) sieve in accordance with FOP for AASHTO T 27/11 ASTM C 136 and then dried and sieved into separate size fractions according to FOP for AASHTO T 27/11 ASTM C 136 procedures. Maintain the necessary size fractions obtained from one (or more) sieve analysis in a dry condition in separate containers for each size. For Method C, dry a split of the as-received sample in accordance with the drying procedure in FOP for AASHTO T 27/11 ASTM C 136.

8. CALIBRATION OF CYLINDRICAL MEASURE

8.1. Apply a light coat of grease to the top edge of the dry, empty cylindrical measure. Weigh the measure, grease, and glass plate. Fill the measure freshly boiled, deionized water at a temperature of 18 to 24°C. Record the temperature of the water. Place the glass plate on the measure, being sure that no air bubbles remain. Dry the outer surfaces of the measure and determine the combined mass of measure, glass plate, grease, and water by weighing. Following the final weighing, remove the grease, and determine the mass of the clean, dry, empty measure for subsequent test.
8.2. Calculate the volume of the measure as follows:

\[ V = 1000 \]

where: \( \frac{M}{D} \)

\( V \) = volume of cylinder, mL,
\( M \) = net mass of water, g, and
\( D \) = density of water (see table in ASTM C 29/C 29M for density at the

temperature used), Kg/m³.

Determine the volume to the nearest 0.1 mL.

**Note 2** – If the volume of the measure is greater than 100.0 mL, it may be desirable to grind
the upper edge of the cylinder until the volume is exactly 100.0 mL, to simplify
subsequent calculations.

9. **PREPARATION OF TEST SAMPLES**

9.1. **Method A – Standard Graded Sample** – Weigh out and combine the following quantities of
fine aggregate which has been dried and sieved in accordance with FOP for AASHTO
T 27/11 ASTM C 136

<table>
<thead>
<tr>
<th>Individual Size Fraction</th>
<th>Mass, g</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 8 (2.36mm) to No. 16 (1.18 mm)</td>
<td>44</td>
</tr>
<tr>
<td>No. 16 (1.18 mm) to No. 30 (600 um)</td>
<td>57</td>
</tr>
<tr>
<td>No. 30 (600 um) to No. 50 (300 um)</td>
<td>72</td>
</tr>
<tr>
<td>No. 50 (300 um) to No. 100 (150 um)</td>
<td>17</td>
</tr>
</tbody>
</table>

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The tolerance on each of these amounts is ±0.2 g.

9.2. **Method B – Individual Size Fractions:**

WSDOT has deleted this section they use Method A

9.3. **Method C – As Received Grading:**

WSDOT has deleted this section they use Method A
9.4. Specific Gravity of Fine Aggregate—If the bulk dry specific gravity of fine aggregate from the source is unknown, determine it on the minus No. 4 (4.75 mm) material according to FOP for AASHTO T 84 ASTM C 128. Use this value in subsequent calculations unless some size fractions differ by more than 0.05 from the specific gravity typical of the complete sample, in which case the specific gravity of the fraction (or fractions) being tested must be determined. An indicator of differences in specific gravity of various particle sizes is a comparison of specific gravities run on the fine aggregate in different gradings. Specific gravity can be run on gradings with and without specific size fractions of interest. If specific gravity differences exceed 0.05, determine the specific gravity of the individual 2.36 mm (No. 8) to 150 um (No. 100) sizes for use with Method A or the individual size fractions for use with Method B either by direct measurement or by calculation using the specific gravity data on gradings with and without the size fraction of interest. A difference in specific gravity of 0.05 will change the calculated void content about one percent.

10. Procedure

10.1. Mix each test sample with the spatula until it appears to be homogeneous. Position the jar and funnel section in the stand and center the cylindrical measure as shown in Figure 2. Use a finger to block the opening of the funnel. Pour the test sample into the funnel. Level the material in the funnel with the spatula. Remove the finger and allow the sample to fall freely into the cylindrical measure.

10.2. After the funnel empties, strike-off excess heaped fine aggregate from the cylindrical measure by a single pass of the spatula with the width of the blade vertical using the straight part of its edge in light contact with the top of the measure. Until this operation is complete, exercise care to avoid vibration or any disturbance that could cause compaction of the fine aggregate in the cylindrical measure. (Note 3) Brush adhering grains from the outside of the container and determine the mass of the cylindrical measure and contents to the nearest 0.1 g. Retain all fine aggregate particles for a second test run.

Note 3 – After strike-off, the cylindrical measure may be tapped lightly to compact the sample to make it easier to transfer the container to scale or balance without spilling any of the sample.

10.3. Recombine the sample from the retaining pan and cylindrical measure and repeat the procedure. The results of two runs are averaged. See the Calculation section.

10.4. Record the mass of the empty measure. Also, for each run, record the mass of the measure and fine aggregate.

11. Calculation

11.1. Calculate the uncompacted voids for each determination as follows:

\[ U = \left( \frac{V - (F/G)}{100} \right) \times 100 \]

where:

- \( V \) = volume of cylindrical measure, mL;
- \( F \) = net mass, g, of fine aggregate in measure (gross mass minus the mass of the empty measure);
- \( G \) = Bulk dry specific gravity of fine aggregate; and
- \( U \) = uncompacted voids, percent, in the material.

11.2. For the standard Graded Sample (Method A) calculate the average uncompacted voids for the two determinations and report the result as \( U_s \).
11.3. For the Individual Size Fractions (Method B) calculate:

11.3.1. First, the average uncompacted voids for the determination made on each of the three size-fraction samples:

\[ U_1 = \text{Uncompacted Voids, No. 8 (2.36 mm) to No. 16 (1.18 mm), percent;} \]

\[ U_2 = \text{Uncompacted Voids, No. 16 (1.18 mm) to No. 30 (600 um), percent; and} \]

\[ U_3 = \text{Uncompacted Voids, No. 30 (600 um) to No. 50 (300 um), percent.} \]

11.3.2. Second, the mean uncompacted voids \((U_m)\) including the results for all three sizes:

\[ U_m = \frac{(U_1 + U_2 + U_3)}{3} \]

11.4. For the As-Received grading (Method C) calculate the average uncompacted voids for the two determinations and report the result as \(U_R\).

12. REPORT

12.1 For the Standard Graded Sample (Method A) report:

12.1.1. The Uncompacted Voids \((U)\) in percent to the nearest one-tenth of a percent (0.1%).

12.1.2. The specific gravity value used in the calculations.

12.2. For the Individual Size Fractions (Method B) report the following percent voids to the nearest one-tenth of a percent (0.1%):

12.2.1. Uncompacted Voids for size fractions: (a) No. 8 (2.36 mm) to No. 16 (1.18 mm) \((U_1)\); (b) No. 16 (1.18 mm) to No. 30 (600 um) \((U_2)\); and (c) No. 30 (600 um) to No. 50 (300 um) \((U_3)\).

12.2.2. Mean Uncompacted Voids \((U_m)\).

12.2.3. Specific gravity value(s) used in the calculations, and whether the specific gravity value(s) were determined on a graded sample or the individual size fractions used in the test.

12.3. For the As-Received Sample (Method C) report:

12.3.1. The uncompacted voids \((U_R)\) in percent to the nearest one-tenth of a percent (0.1%).

12.3.2. The specific gravity value used in the calculation.

12.4 Report Results using WSDOT Form 350-161, or other report approved by the State Materials Engineer.

13. PRECISION AND BIAS

13.1. Precision:

13.1.1. The single-operator standard deviation has been found to be 0.13 percent voids (1S), using the graded standard silica sand as described in ASTM C 778. Therefore, results of two properly conducted tests by the same operator on similar samples should not differ by more than 0.37 percent (D2S).

13.1.2. The multilaboratory standard deviation has been found to be 0.33 percent (1S) using the standard fine aggregate as described in ASTM C 778. Therefore, results of two properly conducted tests by different laboratories on similar samples should not differ by more than 0.93 percent (D2S).
13.1.3. The above statements pertain to void contents determined on “graded standard sand” as described in Specification C 778, which is considered rounded, and is graded from No. 30 (600 um) to No. 100 (150 um) and may not by typical of other fine aggregates. Additional precision data are needed for test of fine aggregates having different levels of angularity and texture tested in accordance with this Test Method.

13.2. *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedures in this Test Method, bias has not been determined.

14. KEYWORDS
   Angularity; fine aggregate; particle shape; sand; surface texture; void content.

*Copies may be obtained from the American Concrete Institute, Box 19150, Detroit, MI 48219.*
Performance Exam Checklist

UNCOMPACTED VOID CONTENTOF FINE AGGREGATE

*FOP AASHTO T-304-96*

<table>
<thead>
<tr>
<th>Participant Name</th>
<th>Exam Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Procedure Element**

1. The tester has a copy of the current procedure on hand? | Yes | No |
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present? | Yes | No |

**CALIBRATION OF CYLINDRICAL MEASURE**

1. Light coat of grease applied to top edge of the dry, empty cylindrical measure? | Yes | No |
2. Cylindrical measure, grease and glass plate weighed to the nearest 0.1 gram? | Yes | No |
3. Measure filled with freshly boiled, de-ionized water and temperature recorded? | Yes | No |
4. Glass plate placed on the measure and all air bubbles eliminated? | Yes | No |
5. Outer surface of the measure dried? | Yes | No |
6. Combined mass of measure, glass plate, grease and water weighed to the nearest 0.1 gram? | Yes | No |
7. Grease and water removed and the combined mass of the clean, dry, empty measure weighed? | Yes | No |
8. Volume of the cylindrical measure determined as per Section 8, AASHTO T-304? | Yes | No |

**SAMPLE PREPARATION**  (Method A)

Note: If Bulk Dry Specific Gravity is unknown, determine it on the minus 4.75 mm (No. 4-) material according to *AASHTO T-84*.

1. Field sample obtained per AASHTO T-2? | Yes | No |
2. Sample reduced to testing size per AASHTO T-248? | Yes | No |
3. Sample washed over No. 100 or No. 200 sieve in accordance with AASHTO T-27/11? | Yes | No |
4. Sample dried to constant weight? | Yes | No |
5. Standard Graded sample achieved per AASHTO T-27/11? | Yes | No |
6. Necessary size fractions obtained, maintained in a dry condition in separate containers for Each size? | Yes | No |
7. Standard Graded sample-weighed out and combined per Section 9.1, AASHTO T-304? | Yes | No |
PROCEDURE (Method A)

Note: If Bulk Dry Specific Gravity is unknown, determine it on the minus No. 4- (4.75 mm) material according to AASHTO T-84.

1. Test sample mixed until it appears to be homogeneous?  
2. Jar and funnel section positioned in stand and cylindrical measure centered on stand?  
3. Finger used to block the opening of the funnel?  
4. Test sample poured into the funnel and leveled?  
5. Finger removed and sample allowed to fall freely into cylindrical measure?  
6. After funnel empties, is excess material struck off w/single pass of upright spatula?  
7. Was care taken to avoid any vibration or disturbance that could cause compaction of material?  
8. All adhering grains brushed off before weighing the cylindrical measure?  
9. Mass of the cylindrical measure and contents weighed to nearest 0.1 gram?  
10. All fine aggregate particles retained and re-homogenized for a second test run?  
11. Percent (%) of Uncompacted Voids calculated for each run, as per AASHTO T-304, Method A?  
12. Were the results for each run averaged for a final result?  
13. Was the (%) percent of Uncompacted voids reported to the nearest one-tenth of a percent (0.1%)?  
14. All calculations performed correctly?

First attempt:  Pass ☐  Fail ☐  
Second attempt:  Pass ☐  Fail ☐

Signature of Examiner __________________________________________

Comments:

________________________________________________________________
________________________________________________________________
________________________________________________________________

________________________________________________________________

________________________________________________________________
Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method

1. SCOPE

1.1 This test method covers the determination of asphalt binder content of HMA mixtures by ignition at temperatures that reach the flashpoint of the binder in a furnace. The means of sample heating may be the convection method or the direct irradiation method. The aggregate remaining after burning can be used for sieve analysis using FOP for AASHTO T 30. 
1.2 The values in English units are to be regarded as the standard. 
1.3 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1 AASHTO Standards

M 231 Weighing Devices Used in the Testing of Materials 
T 2 Sampling of Aggregates 
T 30 Mechanical Analysis of Extracted Aggregate 
T 40 Sampling Bituminous Materials 
T 110 Moisture or Volatile Distillates in Bituminous Paving Mixtures 
T 168 Sampling Bituminous Paving Mixtures 
T 248 Reducing Samples of Aggregate to Testing Size 

2.2 Manufacturer’s Instruction Manual 

2.3 WSDOT Standards 

FOP for WAQTC TM 6 Moisture Content of Bituminous Mixes by Oven 
FOP for AASHTO T 168 Sampling Bituminous Paving Materials 
WSDOT 712 Reducing Samples of Hot Mix Asphalt to Testing Size 

3. SUMMARY OF TEST METHOD

3.1 The asphalt binder in the paving mixture is ignited using the furnace equipment applicable to the particular method. The asphalt binder content is calculated as the difference between the initial mass of the asphalt mixture and the mass of the residual aggregate, the calibration factor, and moisture content. The asphalt content is expressed as mass percent of moisture-free mixture.

4. SIGNIFICANCE AND USE

4.1 This method can be used for quantitative determinations of asphalt binder content and gradation in HMA mixtures and pavement samples for quality control, specification acceptance, and mixture evaluation studies. This method does not require the use of solvents. Aggregate obtained by this test method may be used for gradation analysis according to T 30.

¹This procedure is based on AASHTO T 308-01
5. SAMPLING

5.1 Obtain samples of aggregate in accordance with T 2.

5.2 Obtain samples of asphalt binder in accordance with T 40.

5.3 Obtain samples of freshly produced hot-mix asphalt in accordance with T 168.

5.4 The test specimen shall be the end result of quartering a larger sample taken in accordance with T 248. The test specimen for asphalt content determination shall be the end result of a larger sample taken in accordance with FOP for AASHTO T 168.

5.5 If the mixture is not sufficiently soft to separate with a spatula or trowel, place it in a large flat pan in an oven at 12°C + 5°C (25°F + 9°F). If the mixture is not sufficiently soft to separate for testing, carefully heat the mixture in an oven until sufficiently soft, not to exceed 325°F (163°C).

5.6 The size of the test sample shall be governed by the nominal maximum aggregate size of the mixture and shall conform to the mass requirement shown in Table 1. When the mass of the test specimen exceeds the capacity of the equipment used, the test specimen may be divided into suitable increments, tested, and the results appropriately combined for calculation of the asphalt binder content (weighted average). Specimen sizes shall not be more than 400 g greater than the minimum recommended specimen mass. The size of the test sample shall be governed by the nominal maximum aggregate size of the mixture and shall conform to the mass requirement shown in Table 1. The maximum sample size shall not exceed 4000 g.

Note 1: Large samples of fine mixes tend to result in incomplete ignition of asphalt.

Table 1

<table>
<thead>
<tr>
<th>Nominal Max. Agg. Size</th>
<th>Sieve Size</th>
<th>Minimum Mass of Specimen, g</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>No. 4</td>
<td>1200</td>
</tr>
<tr>
<td>3/8 in.</td>
<td>3/8</td>
<td>1200</td>
</tr>
<tr>
<td>1/2 in.</td>
<td>1/2</td>
<td>1500</td>
</tr>
<tr>
<td>3/4 in.</td>
<td>3/4</td>
<td>2000</td>
</tr>
<tr>
<td>1 in.</td>
<td>1</td>
<td>3000</td>
</tr>
<tr>
<td>1 1/2 in.</td>
<td>1 1/2</td>
<td>4000</td>
</tr>
</tbody>
</table>

For aggregate, the nominal maximum size of particles is the largest sieve size listed in the applicable specification, upon which any material is permitted to be retained.

Note: For an aggregate specification having a generally unrestrictive gradation (i.e. wide range of permissible upper sizes), where the source consistently fully passes a screen substantially smaller than the maximum specified size, the nominal maximum size, for the purpose of defining sampling and test specimen size requirements may be adjusted to the screen, found by experience to retain no more than 5% of the materials.

6. CALIBRATION

6.1 This section has been replaced with the following:

The Calibration is to be performed according to WSDOT Standard Operating Procedure SOP 728.
Test Method A

7. APPARATUS

7.1 Ignition Furnace — A forced air ignition furnace that heats the samples by either convection method or direct irradiation method. The convection-type furnace must be capable of maintaining the temperature at 1072°F (578°C). The furnace shall have an internal balance thermally isolated from the furnace chamber accurate to 0.1 g. The balance shall be capable of weighing a 3500 gram sample in addition to the sample baskets. A data collection system will be included so that the weight can be automatically determined and displayed during the test. The furnace shall have a built-in computer program to calculate change in mass of the sample baskets and provide for the input of a correction factor for aggregate loss. The furnace shall provide a printed ticket with the initial specimen mass, specimen mass loss, temperature compensation, correction factor, corrected asphalt content (percent), test time, and test temperature. The furnace chamber dimensions shall be adequate to accommodate a sample size of 3500 grams. The furnace shall provide an audible alarm and indicator light when the sample mass loss does not exceed 0.01 percent of the total sample mass for three consecutive minutes. The furnace door shall be equipped so that the door cannot be opened during the ignition test. A method for reducing furnace emissions shall be provided. The furnace shall be vented into a hood or to the outside and, when set up properly, shall have no noticeable odors escaping into the laboratory. The furnace shall have a fan with capability to pull air through the furnace to expedite the test and to reduce the escape of smoke into the laboratory.

Note 2: The furnace shall also allow the operator to change the ending mass loss percentage to 0.02 percent.

7.2 Sample Basket(s) — of appropriate size that allows the samples to be thinly spread and allows air to flow through and around the sample particles. Sets with two or more baskets shall be nested. The sample shall be completely enclosed with screen mesh, perforated stainless steel plate, or other suitable material.

7.2.1 Sample Basket Assembly — consisting of sample basket(s) (7.2), catch pan (7.3), and an assembly guard to secure sample basket(s) to catch pan.

Note 3: Screen mesh or other suitable material with maximum ad minimum opening of No. 8 (2.36 mm) and No. 30 (600 microns) respectively has been found to perform well.

7.3 Catch Pan — of sufficient size to hold the sample basket(s) so that aggregate particles and melting asphalt binder falling through the screen mesh are caught.

7.4 Oven or suitable devise — Capable of maintaining 325 ± 25°F (163 ± 14°C).

7.5 Balance — of sufficient capacity and conforming to the requirements of M231, Class G2, for weighting specimen in basket(s).

7.6 Safety Equipment — safety glasses or face shield, high temperature gloves, long sleeve jacket, a heat resistant surface capable of withstanding 1202°F (650°C) and a protective cage capable of surrounding the sample baskets during the cooling period.

7.7 Miscellaneous Equipment — a pan larger than the sample basket(s) for transferring sample after ignition, spatulas, bowls, and wire brushes.
8. TEST PROCEDURES

8.1 Test Initiation

8.1.1 For the convection-type furnace, preheat the ignition furnace to 538°C (1000°F) or as determined in Section 6.9.1. Manually record the furnace temperature (set point) prior to the initiation of the test if the furnace does not record automatically. Preheat the ignition furnace to 1000°F (538°C). Manually record the furnace temperature (set point) prior to the initiation of the test if the furnace does not record automatically.

8.1.2 For the direct irradiation-type furnace, use the same burn profile as used during the calibration.

8.2 Oven dry the HMA sample to a constant mass at a temperature of 105 ± 5°C (221 ± 9°F) or determine the moisture content of the samples according to T 110. Oven dry the HMA sample to a constant mass at a temperature of 325 ± 25°F (163 ± 14°C), not to exceed mixing temperature, or determine the moisture content of the samples according to FOP for WAQTC TM 6.

8.3 Enter the calibration factor for the specific mix to be tested as determined in Section 6 in the ignition furnace.

8.4 Weigh and record the mass of the sample basket(s) and catch pan (with guards in place).

8.5 Prepare the sample as described in Section 5. Evenly distribute this sample in the sample basket(s) that have been placed in the catch plan, taking care to keep the material away from the edges of the basket. Use a spatula or trowel to level the specimen.

8.6 Weigh and record the total mass of the sample, basket(s), catch pan, and basket guards. Calculate and record the initial mass of the specimen (total mass minus the mass of the specimen basket assembly).

8.7 Input the initial mass of the specimen in whole grams into the ignition furnace controller. Verify that the correct mass has been entered.

8.8 Tare or zero furnace balance, open the chamber door, and place the sample baskets in the furnace. Close the chamber door, and verify that the sample mass (including the basket(s)) displayed on the furnace scale equals the total mass recorded in Section 8.6 within ± 5 g ± 6 g. Differences greater than 5 g ± 6 g or failure of the furnace scale to stabilize may indicate that the sample basket(s) are contacting the furnace wall. Initiate the test by pressing the start/stop button. This will lock the sample chamber and start the combustion blower.

Note 4: The furnace temperature will drop below the setpoint when the door is opened, but will recover with the door closed and when ignition occurs. Sample ignition typically increases the temperature well above the setpoint, depending on sample size and asphalt content.

Note: Operator should wear safety equipment – high temperature gloves, face shield, fire-retardant shop coat – when opening the door to load or unload the sample.

Safety Note: Do not attempt to open the furnace door until the binder has been completed burned off.

8.9 Allow the test to continue until the stable light and audible stable indicator indicate the test is complete (the change in mass does not exceed 0.01 percent for three consecutive minutes). Press the start/stop button. This will unlock the sample chamber and cause the printer to print out the test results.
Note 5: An ending mass loss percentage of 0.02 may be substituted when aggregate that exhibits an excessive amount of loss during ignition testing is used. The precision and bias statement was developed using 0.01 percent. Both precision and accuracy may be adversely affected by using 0.02.

8.10 Use the corrected asphalt binder content (percent) from the printed ticket. If a moisture content has been determined, subtract the moisture content from the printed ticket corrected asphalt content, and report the difference as the corrected asphalt binder content.

8.11 Open the chamber door, remove the sample basket assembly and place on heat resistance surface and cover with the protective cage. Allow sample to cool to room temperature (approximately 30 minutes).

Test Method B

WSDOT has deleted Method B.

11. GRADATION

11.1 Allows the specimen to cool to room temperature in the sample baskets.

11.2 Empty the contents of the baskets into a flat pan. Use a small wire sieve brush to ensure that any residual fines are removed from the baskets.

11.3 Perform the gradation analysis according to FOP for AASHTO T 27/T11.

12. REPORT

12.1 Report the test method (A or B), corrected asphalt binder content, calibration factor, temperature compensation factor (if applicable), total percent loss, sample mass, moisture content (if determined) and the test temperature. Attach the original printed tickets to the report for units with internal balances.

12.2 The asphalt percentage and aggregate gradation shall be reported on WSDOT Form 350-560 or other report approved by the State Materials Engineer.

13. PRECISION AND BIAS

13.1 Precision — Precision was determined in an NCAT round-robin study for surface mixes using Test Method A. Precision has not yet been determined for Test Method 2.

Table 2 Precision

<table>
<thead>
<tr>
<th>Asphalt Content</th>
<th>Acceptable Range of Standard Deviation, Percent</th>
<th>Two Test Results, Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Operator Precision</td>
<td>0.04</td>
<td>0.11</td>
</tr>
<tr>
<td>Multi Lab Precision</td>
<td>0.06</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Note 9: The precision estimates are based on 4 aggregate type, 4 replicates, and 12 laboratories participating with 0 laboratory results deleted as outlying observations. All 4 aggregates were tested in surface mixes and had relatively low absorption values.

13.2 Bias — The bias for Test Methods A and B has not been determined.
Performance Exam Checklist

Determining the Asphalt Cement Content of Hot Mix Asphalt (HMA) by the Ignition Method for AASHTO T 308

Participant Name ___________________________________________ Exam Date ________________

Procedure Element

1. The tester has a copy of the current procedure on hand?  Yes ☐  No ☐
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?  Yes ☐  No ☐

Procedure

1. Oven at correct temperature 1000°F?  Yes ☐  No ☐
2. Mass of sample baskets and catch pan recorded?  Yes ☐  No ☐
3. Samples evenly distributed in basket?  Yes ☐  No ☐
4. Mass of sample recorded?  Yes ☐  No ☐

Method A

5. Enter calibration factor for specific mix design?  Yes ☐  No ☐
6. Initial mass entered into furnace controller?  Yes ☐  No ☐
7. Sample correctly placed into furnace?  Yes ☐  No ☐
8. Test continued until stable indicator signals?  Yes ☐  No ☐
9. Binder content obtained on printed ticket?  Yes ☐  No ☐
10. Binder content corrected for moisture?  Yes ☐  No ☐
11. All calculations performed correctly?  Yes ☐  No ☐

First attempt:  Pass ☐  Fail ☐  Second attempt:  Pass ☐  Fail ☐

Signature of Examiner ___________________________________________

Comments:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

T 308  November 2002  T 308
Page 7 of 8
1. SCOPE

1.1 This test method covers the determination of temperature of freshly mixed portland cement concrete.

1.2 The values stated in English units are to be regarded separately as standard.

1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1 AASHTO Standards:

T 141 Sampling Freshly Mixed Concrete

2.2 ASTM Standards:

C 172 Practice for Sampling Freshly Mixed Concrete

3. SIGNIFICANCE AND USE

3.1 This test method provides a means for measuring the temperature of freshly mixed concrete. It may be used to verify conformance to a specified requirement for temperature of concrete.

3.2 Concrete containing aggregate of a nominal maximum size greater than 3 in. [75 mm] may require up to 20 min for the transfer of heat from aggregate to mortar. (See ACI Committee 207.1R Report.3)

4. APPARATUS

4.1 Container, shall be made of nonabsorptive material and large enough to provide at least 3 in. [75 mm] of concrete in all directions around the sensor of the temperature measuring device; concrete cover must also be at least three times the nominal maximum size of the coarse aggregate.

4.2 Temperature Measuring Device — The temperature measuring device shall be capable of measuring the temperature of the freshly mixed concrete to ±1°F (± 0.5°C) throughout the entire temperature range likely to be encountered in the fresh concrete. Liquid-in-glass thermometers having a range of 0 to 120°F (-18 to 49°C) are satisfactory. Other thermometers of the required accuracy, including the metal immersion type, are acceptable.

4.3 Partial immersion liquid-in-glass thermometers (and possibly other types) shall have a permanent mark to which the device must be immersed without applying a correction factor.

4.4 Reference Temperature Measuring Device — The reference temperature measuring device shall be a liquid-in-glass thermometer readable to 0.5°F (0.2°C) that has been verified and calibrated. The calibration certificate or report indicating conformance to the requirements of ASTM E 77 shall be available for inspection.

1 This FOP is based on AASHTO T 309-99.
5. CALIBRATION OF TEMPERATURE MEASURING DEVICE

5.1 Each temperature measuring device used for determining temperature of freshly mixed concrete shall be calibrated annually, or whenever there is a question of accuracy. This calibration shall be performed by comparing the readings of the temperature measuring device at two temperatures at least 27°F (15°C) apart.

5.2 Calibration of the temperature measuring devices may be made in oil or other suitable baths having uniform density if provision is made to:

- Maintain the bath temperature constant within 0.5°F (0.2°C) during the period of the test.
- Have both the temperature and reference temperature measuring devices maintained in the bath for a minimum of 5 min before reading temperatures.
- Continuously circulate the bath liquid to provide a uniform temperature.
- Slightly tap thermometers containing liquid to avoid adhesion of the liquid to the glass if the temperature exposure is being reduced.

6. SAMPLING CONCRETE

6.1 The temperature of freshly mixed concrete may be measured in the transporting equipment provided the sensor of the temperature measuring device has at least 3 in. [75 mm] of concrete cover in all directions around it.

6.2 Temperature of the freshly mixed concrete may be obtained following concrete placement using the forms as the container.

6.3 If the transporting equipment or placement forms are not used as the container, a sample shall be prepared as follows:

- Immediately, prior to sampling the freshly mixed concrete, dampen (with water) the sample container.
- Sample the freshly mixed concrete in accordance with Practice C 172, except that composite samples are not required if the only purpose for obtaining the sample is to determine temperature.
- Place the freshly mixed concrete into the container.
- When concrete contains a nominal maximum size of aggregate greater than 3 in. (75 mm), it may require 20 min before the temperature is stabilized after mixing.

7. PROCEDURE

7.1 Place the temperature measuring device in the freshly mixed concrete so that the temperature sensing portion is submerged a minimum of 3 in. (75 mm). Gently press the concrete around the temperature measuring device at the surface of the concrete so that ambient air temperature does not affect the reading.

7.2 Leave the temperature measuring device in the freshly mixed concrete for a minimum period of 2 min or until the temperature reading stabilizes, then read and record the temperature.

7.3 Complete the temperature measurement of the freshly mixed concrete within 5 min after obtaining the sample.
8. REPORT
   8.1 Record the measured temperature of the freshly mixed concrete to the nearest 1°F (0.5°C).

9. PRECISION AND BIAS
   9.1 The precision and bias of this test method have not been determined. A precision and bias statement will be included when sufficient test data have been obtained and analyzed.
Performance Exam Checklist

Temperature of Freshly Mixed Concrete
FOP for AASHTO T-309

Participant Name ________________________________ Exam Date ________________

Procedure Element

1. The tester has a copy of the current procedure on hand? ☐ Yes ☐ No

2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present? ☐ Yes ☐ No

3. Obtain sample of concrete large enough to provide a minimum of 3 in. (75 mm) of concrete cover around sensor in all directions? ☐ Yes ☐ No

4. Use calibrated thermometer approved for concrete: ☐ Yes ☐ No

5. Place thermometer in sample with a minimum of 3 in. (75 mm) cover around sensor? ☐ Yes ☐ No

6. Gently press concrete around thermometer? ☐ Yes ☐ No

7. Read temperature after a minimum of 2 minutes or when temperature reading stabilizes? ☐ Yes ☐ No

8. Complete temperature measurement within 5 minutes of obtaining sample? ☐ Yes ☐ No

9. Record temperature to nearest 1°F (0.5°C)? ☐ Yes ☐ No

First attempt: Pass ☐ Fail ☐ Second attempt: Pass ☐ Fail ☐

Signature of Examiner __________________________________________

Comments:

______________________________________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________
WSDOT FOP for AASHTO T 310
In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1. SCOPE

1.1 This test method describes the procedure for determining the in-place density and moisture of soil and soil-aggregate by use of nuclear equipment. The density of the material may be determined by either direct transmission, backscatter, or backscatter/air-gap ratio method. The preferred method for determining density is by direct transmission. The moisture of the material is determined only from measurements taken at the surface of the soil (i.e., Backscatter).

1.2 Density — The total or wet density of soil and soil-rock mixtures is determined by the attenuation of gamma radiation where the source or detector is placed at a known depth up to 300 mm (12 in.) while the detector(s) or source remains on the surface (Direct Transmission Method) or the source and detector(s) remain on the surface (Backscatter Method).

1.2.1 The density in mass per unit volume of the material under test is determined by comparing the detected rate of gamma radiation with previously established calibration data.

1.3 Moisture — The moisture content of the soil and soil-rock mixtures is determined by thermalization or slowing of fast neutrons where the neutron source and the thermal neutron detector both remain at the surface.

1.3.1 The water content in mass per unit volume of the material under test is determined by comparing the detection rate of thermalized or slow neutrons with previously established calibration data.

1.4 SI Units — The values stated in SI units are to be regarded as the standard. The inch-pound equivalents may be approximate. It is common practice in the engineering profession to concurrently use pounds to represent both a unit of mass (lbf) and of force (lbm). This implicitly combines two systems of units, that is, the absolute system and the gravitational system.

1.4.1 This standard has been written using the absolute system for water content (kilograms per cubic meter) in SI units. Conversion to the gravitational system of unit weight in lbf/ft.³ may be made. The recording of water content in pound-force per cubic foot should not be regarded as non-conformance with this standard although the use is scientifically incorrect.

1.4.2 In the English SI system, the pound (lbf) represents a unit of force (weight). However, the use of balances or scales recording pounds of mass (lbm), or recording of density (lbm/ft.³) should not be regarded as non-conformance with this standard.

1.5 This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. See Section 6. Hazards.

1This FOP is based on AASHTO T 310-02.
2. REFERENCED DOCUMENTS

2.1 AASHTO Standards:

- T 99 Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
- T 180 Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- T 191 Density of Soil In-Place by the Sand-Cone Method
- T 217 Determination of Moisture in Soils by Means of a Calcium Carbide Gas Pressure Moisture Tester
- T 224 Correction for Coarse Particles in the Soil Compaction Test
- T 255 Total Evaporable Moisture Content of Aggregate by Drying
- T 265 Laboratory Determination of Moisture Content of Soils
- T 272 Family of Curves – One-Point Method

2.2 ASTM Test Method:

- D 2216, Laboratory Determination of Moisture Content of Soil
- D 2487, Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D 2488, Description and Identification for Soils (Visual-Manual Procedure)
- D 4253, Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
- D 4254, Maximum Index Density and Unit Weight of Soils and Calculation of Relative Density

3. SIGNIFICANCE

3.1 The test method described is useful as a rapid, nondestructive technique for the in-place determination of the wet density and water content of soil and soil-aggregate.

3.2 The test method is used for quality control and acceptance testing of compacted soil and rock for construction and for research and development. The non-destructive nature allows repetitive measurements at a single test location and statistical analysis of the results.

3.3 Density — The fundamental assumptions inherent in the methods are that Compton scattering is the dominant interaction and that the material under test is homogeneous.

3.4 Moisture — The fundamental assumptions inherent in the test method are that the hydrogen present is in the form of water as defined by ASTM D 2216, and that the material under test is homogeneous.

3.5 Test results may be affected by chemical composition, sample heterogeneity, and, to a lesser degree, material density and the surface texture of the material being tested. The technique also exhibits spatial bias in that the apparatus is more sensitive to water contained in the material in close proximity to the surface and less sensitive to water at deeper levels.
4. INTERFERENCES

4.1 In-Place Density Interferences

4.1.1 The chemical composition of the sample may affect the measurement, and adjustments may be necessary.

4.1.2 The instrument is more sensitive to the density of the material in close proximity to the surface in the Backscatter Method.

Note 1: The nuclear gauge density measurements are somewhat biased to the surface layers of the soil being tested. This bias has largely been corrected out of the Direct Transmission Method and any remaining bias is insignificant. The Backscatter Method is still more sensitive to the material within the first several inches from the surface.

4.1.3 Oversize rocks or large voids in the source-detector path may cause higher or lower density determination. Where lack of uniformity in the soil due to layering, rock or voids is suspected, the test site should be excavated and visually examined to determine if the test material is representative of the full material in general and if rock correction is required.

4.1.4 The sample volume is approximately 0.10 ft.\(^3\) (0.0028 m\(^3\)) for the Backscatter Method and 0.20 ft.\(^3\) (0.0057 m\(^3\)) for the Direct Transmission Method when the test depth is 6 in. (150 mm). The actual sample volume is indeterminate and varies with the apparatus and the density of the material. In general, the higher the density the smaller the volume.

4.1.5 Other radioactive sources must not be within 30 ft. (10 m) of equipment in operation.

4.2 In-Place Moisture Content Interferences

4.2.1 The chemical composition of the sample may dramatically affect the measurement and adjustments may be necessary. Hydrogen in forms other than water, as defined by ASTM D 2216, and carbon will cause measurements in excess of the true value. Some chemical elements such as boron, chlorine, and minute quantities of cadmium will cause measurements lower than the true value.

4.2.2 The water content determined by this test method is not necessarily the average water within the volume of the sample involved in the measurement. The measurement is heavily influenced by the water content of the material closest to the surface. The volume of soil and rock represented in the measurement is indeterminate and will vary with the water content of the material. In general, the greater the water content of the material, the smaller the volume involved in the measurement. At 10 lbs/ft.\(^3\) (160 kg/m\(^3\)), approximately 50 percent of the typical measurement results from the water content of the upper 2 to 3 in. (50 to 75 mm).

4.2.3 Other neutron sources must not be within 10 m (30 ft.) of equipment in operation.

5. APPARATUS

5.1 Nuclear Density/Moisture Gauge — While exact details of construction of the apparatus may vary, the system shall consist of:

5.1.1 A sealed source of high energy gamma radiation such as cesium or radium.

5.1.2 Gamma Detector — Any type of gamma detector such as a Geiger-Mueller tube(s).
5.2 **Fast Neutron Source** — A sealed mixture of a radioactive material such as americium, radium, or californium-252 and a target material such as beryllium.

5.3 **Slow Neutron Detector** — Any type of slow neutron detector such as boron trifluoride or helium-3 proportional counter.

5.4 **Reference Standard** — A block of material used for checking instrument operation, correction of source decay, and to establish conditions for a reproducible reference count rate.

5.5 **Site Preparation Device** — A plate, straightedge, or other suitable leveling tool which may be used for planning the test site to the required smoothness, and in the Direct Transmission Method, guiding the drive pin to prepare a perpendicular hole.

5.6 **Drive Pin** — A pin not to exceed the diameter of the rod in the Direct Transmission Instrument by more than ¼ in (6mm) used to prepare a hole in the material under test for inserting the rod.

5.6.1 A slide hammer, with a drive pin attached, may also be used both to prepare a hole in the material to be tested and to extract the pin without distortion to the hole. In place of a slide hammer a hammer of significant size and weight for preparing a hole in the material to be tested using the drive pin along with an extraction tool.

5.7 **Drive Pin Extractor** — A tool that may be used to remove the drive pin in a vertical direction so that the pin will not distort the hole in the extraction process.

6. **HAZARDS**

6.1 This equipment utilizes radioactive materials that may be hazardous to the health of the users unless proper precautions are taken. Users of this equipment must become familiar with applicable safety procedures and government regulations.

6.2 Effective user instructions together with routine safety procedures, such as source leak tests, recording and evaluation of film badge data, etc., are a recommended part of the operation and storage of this gauge.

7. **CALIBRATION**

7.1 Calibration of the instrument will be in accordance with Appendices A1 and A2.

8. **STANDARDIZATION**

8.1 All nuclear density/moisture gauges are subject to long-term aging of the radioactive sources, detectors, and electronic systems, which may change the relationship between count rates and the material density and water content. To offset this aging, instruments are calibrated as a ratio of the measurement count rate to a count rate made on a reference standard or to an air-gap count (for the backscatter/air-gap ratio method). The reference count rate should be in the same or higher order of magnitude than the range of measurement count rates over the useful range of the gauge.

8.2 Standardization of equipment on the reference standard is required at the start of each day’s use and a permanent record of these data shall be retained. The standardization shall be performed with the equipment at least 10 m (30 ft.) away from other nuclear density/moisture gauges and clear of large masses of water or other items which may affect the reference count rates. The standardization shall be performed with the equipment away from other radioactivity devices, large masses of water and large vertical surfaces at the manufacturer’s recommended distance. Standard counts should be taken in the same environment as the actual measurement counts.
8.2.1 Turn on the instrument and allow for stabilization according to the manufacturer’s recommendations. If the instrument is to be used either continuously or intermittently during the day, it is best to leave it in the “power on” condition to prevent having to repeat the stabilization (refer to manufacturer recommendations). This will provide more stable, consistent results.

8.2.2 Using the reference standard take at least four repetitive readings at the normal measurement period and obtain the mean. If available on the instrument, one measurement of four or more times the normal period is acceptable. This constitutes one standardization check. Using the reference standard block supplied with the density/moisture gauge perform standardization using manufacturer’s recommendations.

Use the procedure recommended by the gauge manufacturer for determining compliance with the gauge calibration curves. Without specific recommendations for the gauge manufacturer, use the procedure in 8.2.3.

8.2.3 If the mean of the four repetitive readings is outside the limits set by Equation 1, repeat the standardization check. If the second standardization check satisfies Equation 1, the equipment is considered in satisfactory operating condition. If the second standardization check does not satisfy Equation 1, the instrument should be checked and verified according to Appendices A1 and A2, sections A1.8 and A2.5. If the verification shows that there is no significant change in the calibration curve, a new reference standard count, \( N_o \), should be established. If the calibration check shows that there is a significant difference in the calibration curve, repair and recalibrate the instrument.

\[
N_s = N_o \pm 1.96 \sqrt{\frac{N_o}{F}} \quad \text{Eq. 1}
\]

where:

\( N_s \) = value of current standardization count,

\( N_o \) = Average of the past four values of \( N_s \) taken for prior usage,

\( F \) = factory pre-scale factor (contact gauge manufacturer for the factor).

9. **PROCEDURE**

9.1 Turn on and allow the equipment to stabilize (warm up) according to the manufacturer’s recommendations (see 8.2.1). Prior to performing density test verify that today’s Standardization Count has been preformed. Select a test location where the gauge will be at least 6 in. (150 mm) away from any vertical mass. If closer than 24 in. (600 mm) to a vertical mass, such as in a trench, follow gauge manufacturer correction procedures.

9.2 Prepare the test site in the following manner:

9.2.1 Remove all loose and disturbed material and additional material as necessary to expose the top of the material to be tested.

**Note 2:** The spatial bias should be considered in determining the depth at which the gauge is to be seated.

9.2.2 Prepare a horizontal area sufficient in size to accommodate four gauge readings that will be 90° to each other due to the gauge, by planning the area to a smooth condition so as to obtain maximum contact between the gauge and material being tested.

9.2.3 The maximum void beneath the gauge shall not exceed \( \frac{1}{8} \) in. (3 mm). Use native fines or fine sand to fill the voids and smooth the surface with a rigid plate or
other suitable tool. The depth of the filler should not exceed approximately \( \frac{1}{8} \) in. (3 mm).

*Note 3:* The placement of the gauge on the surface of the material to be tested is critical to the successful determination of density. The optimum condition is total contact between the bottom surface of the gauge and the surface of the material being tested. When optimal conditions are not present, correct surface irregularities by the use of native fines or similar filler material. The total area filled should not exceed 10 percent of the bottom area of the gauge. Several trial seatings may be required to achieve these conditions.

9.3 Turn on and allow the equipment to stabilize (warm up) according to the manufacturer’s recommendations (see 8.2.1).

9.4 Backscatter or Backscatter/Air-Gap Ratio Method of In-Place Nuclear Density & Moisture Content

This Section has been deleted because WSDOT does not use this method

9.5 *Direct Transmission Method of In-Place Nuclear Density & Moisture Content*

9.5.1 Select a test location where the gauge in test position will be at least the minimum distance recommended by the manufacture 150 mm (6 in.) away from any vertical projection. If gauge will be within the minimum distance recommended by the manufacture follow instructions outlined by manufactures instruction manual.

9.5.2 Make a hole perpendicular to the prepared surface using the guide and the hole-forming device (Section 5). The hole shall be a minimum of 2 in. (50 mm) deeper than the desired measurement depth and of an alignment that insertion of the probe will not cause the gauge to tilt from the plane of the prepared area.

9.5.3 Mark the test area to allow the placement of the instrument over the test site and to allow the alignment of the source rod to the hole. Follow manufacturer recommendations if applicable.

9.5.4 Remove the hole forming device carefully to prevent the distortion of the hole, damage to the surface, or loose material to fall into the hole.

9.5.5 Place the instrument on the material to be tested, making sure of maximum surface contact as described above.

9.5.6 Lower the source rod into the hole to the desired test depth. Pull gently on the gauge in the direction that will bring the side of the probe to face the center of the gauge so that the probe is in intimate contact with the side of the hole in the gamma measurement path.

*Note 4:* As a safety precaution, do not extend a rod containing radioactive sources out of its shielded position prior to placing on the test site. Always align the instrument so as to allow placing the rod directly into the test hole from the shielded position.

9.5.7 Keep all other radioactive sources at least the minimum distance recommended by the manufacture 30 ft. (10 m) away from the gauge to avoid affecting the measurement.

9.5.8 If the gauge is so equipped, set the depth selector to the same depth as the probe before recording the automated (gauge computed densities, moisture contents, and weights) values.
9.5.9 **Secure and record one or more 1-minute readings (see Note 5).** Secure and record one, one minute dry density and moisture content readings, then turn the gauge 90° and perform another set of readings. If the two dry density readings are not within 3 lbs/cf (50 kg/m³) of each other see note 5.

9.5.10 Determine the in-place wet density by use of the calibration curve previously established or read the gauge directly if so equipped.

*Note 5:* The gauge may be rotated about the axis of the probe to obtain additional readings. If two readings are not within tolerances stated, rotate gauge 90° and retest. Again compare both readings. If these readings are still not within tolerances stated move to another location to perform test.

10. **CALCULATION OF RESULTS**

10.1 If dry density is required, the in-place water content may be determined by using the nuclear methods described herein; gravimetric samples and laboratory determination; or other approved instrumentation.

10.1.1 If the water content is determined by nuclear methods, use the gauge readings directly, or subtract the kg/m³ (lbm/ft.³) of moisture from the kg/m³ (lbm/ft.³) of wet density, and obtain dry density in kg/m³ (lbm/ft.³).

10.1.2 If the water content is determined by other methods, and is in the form of percent, proceed as follows:

\[
\text{d} = \frac{100}{100 + W} \text{ (m)} \quad \text{(Eq. 2)}
\]

where:

\[d = \text{dry density in lb/ft.}^3 \text{ (kg/m}^3\text{)},\]
\[m = \text{wet density in lb/ft.}^3 \text{ (kg/m}^3\text{)},\]
and
\[W = \text{water as a percent of dry mass.}\]

10.2. **Percent Compaction**

WSDOT has deleted this section refer to WSDOT SOP 615 for determining the percent compaction.

11. **REPORT**

WSDOT has deleted this section refer to WSDOT SOP 615 for reporting.

11.1 The report shall include the following:

11.1.1 Standardization and adjustment data for the date of the tests.

11.1.2 Make, model and serial number of the test instrument.

11.1.3 Name of the operator(s).

11.1.4 Date of last instrument calibration or calibration verification.

11.1.5 Test site identification.

11.1.6 Visual description of material tested.

11.1.7 Test mode (backscatter or direct transmission) and test depth (if applicable).
11.1.8. Wet and dry densities in kg/m$^3$ or unit weights in lb/ft$^3$.

11.1.9. Water content in percent of dry mass or dry unit weight.

11.1.10. Any adjustments made in the reported values and reasons for adjustments (i.e., offset, oversize particle).

11.1.11. Percent Compaction

11.1.12. Name and Signature of Operator

12. Precision and Bias

12.1. Precision:

12.1.1. Wet Density – Criteria for judging the acceptability of wet density test results obtained by this test method are given in Table 1. The figure in column three represents the standard deviations that have been found to be appropriate for the materials tested in column one. The figures given in column four are the limits that should not be exceeded by the difference between the results of two properly conducted tests. The figures given are based upon an inter-laboratory study in which five test sites containing soils, with wet densities as shown in column two were tested by eight different devices and operators. The wet density of each test site was determined three times by each device.

Table 1 – Results of Statistical Analysis (Wet Density)

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Average Standard Deviation</th>
<th>Deviation</th>
<th>Acceptable Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Type</td>
<td>lb/ft$^3$ (kg/m$^3$)</td>
<td></td>
<td>lb/ft$^3$ (kg/m$^3$)</td>
</tr>
<tr>
<td>Single Operator Precision</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Transmission:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL</td>
<td>114.7(1837.3)</td>
<td>0.34(5.45)</td>
<td>0.94 (15.06)</td>
</tr>
<tr>
<td>SP</td>
<td>120.9(1936.6)</td>
<td>0.27(4.32)</td>
<td>0.74(11.85)</td>
</tr>
<tr>
<td>ML</td>
<td>130.1(2084.0)</td>
<td>0.46(7.37)</td>
<td>1.28(20.50)</td>
</tr>
<tr>
<td>Backscatter:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ML</td>
<td>124.6(1995.9)</td>
<td>1.21(19.38)</td>
<td>3.39(54.30)</td>
</tr>
<tr>
<td>Multilaboratory Precision</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Transmission:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL</td>
<td>114.7(1837.3)</td>
<td>0.66(10.57)</td>
<td>1.86(29.79)</td>
</tr>
<tr>
<td>SP</td>
<td>120.9(1936.6)</td>
<td>0.68(10.89)</td>
<td>1.91(30.59)</td>
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<tr>
<td>ML</td>
<td>130.1(2084.0)</td>
<td>0.77(12.23)</td>
<td>2.15(34.44)</td>
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<tr>
<td>Backscatter:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ML</td>
<td>124.6(1995.9)</td>
<td>2.38(38.12)</td>
<td>6.67(106.84)</td>
</tr>
</tbody>
</table>

The data used to establish the density and moisture content precision statements are contained in ASTM Research Report RR:D18-1004. Other Soil Types should reflect similar precision values.

$^b$ Two separate readings at a singular site with constant gate orientation and settings.
12.1.2. Moisture Content – Criteria for judging the acceptability of the moisture content results obtained by this test method are given in Table 2. The value in column two is in the units actually measured by the nuclear gauge. The figures in column three represent the standard deviations that have been found to be appropriate for the materials tests in column one. The figures given in column four are the limits that should not be exceeded by the difference between the results of two properly conducted tests. The figures given are based upon an inter-laboratory study in which five test sites containing soils, with moisture content as shown in column two were tested by eight different devices and operators. The moisture content of each test site was determined three times by each device.

Table 2 – Results of Statistical Analysis (Moisture Content)

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Average Standard Deviation lb/ft³ (kg/m³)</th>
<th>of Two Results Deviation lb/ft³ (kg/m³)</th>
<th>Acceptable Range lb/ft³ (kg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL</td>
<td>12.1(193.8)</td>
<td>0.35(5.6)</td>
<td>0.97(15.5)</td>
</tr>
<tr>
<td>SP</td>
<td>18.7(299.5)</td>
<td>0.46(7.4)</td>
<td>1.29(20.7)</td>
</tr>
<tr>
<td>ML</td>
<td>19.6(314.0)</td>
<td>0.35(5.6)</td>
<td>0.99(15.8)</td>
</tr>
<tr>
<td>CL</td>
<td>12.1(193.8)</td>
<td>0.52(8.3)</td>
<td>1.44(23.1)</td>
</tr>
<tr>
<td>SP</td>
<td>18.7(299.5)</td>
<td>0.75(12.0)</td>
<td>2.10(33.6)</td>
</tr>
<tr>
<td>ML</td>
<td>19.6(314.0)</td>
<td>0.58(9.3)</td>
<td>1.63(26.1)</td>
</tr>
</tbody>
</table>

Two separate readings at a singular site with constant gate orientation and settings.

12.2. Bias:

12.2.1. There are no accepted reference values for these test methods, therefore, bias cannot be determined.

13. KEYWORDS

13.1 Compaction test; density; moisture content; nuclear methods; quality control; water content.

APPENDIX

A1. WET DENSITY CALIBRATION AND VERIFICATION
A2. WATER CONTENT CALIBRATION AND VERIFICATION
A3. GAUGE COUNT PRECISION

WSDOT has removed these section as WSDOT used manufacturer’s software to calibrate
Performance Exam Checklist

In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

FOP FOR AASHTO T 310

Participant Name __________________________________________ Exam Date _____________

Procedure Element Yes No

1. The tester has a copy of the current procedure on hand? □ □
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present? □ □
3. Gauge turned on and allowed to stabilize per manufacturer’s recommendations? □ □
4. Gauge calibrated and standard count recorded in accordance with manufacturer’s instructions? □ □
5. Test location selected away from other radioactive sources, large objects, vertical projections per manufacturer’s recommendations? □ □
6. Loose, disturbed material removed? □ □
7. Flat, smooth area prepared? □ □
8. Surface voids filled with native fines (¼ in. (3 mm) maximum thickness)? □ □
9. Hole driven 2 in. (50 mm) deeper than material to be tested? □ □
10. Gauge placed, probe placed, and source rod lowered without disturbing loose material? □ □
11. Method B:
   a. Gauge firmly seated, and gently pulled back so that source rod is against hole? □ □
   b. A one minute count taken; dry density and moisture data recorded? □ □
   c. Gauge turned 90° (180° in trench)? □ □
   d. Gauge firmly seated, and gently pulled back so that source rod is against hole? □ □
   e. A second one-minute count taken; dry density and moisture data recorded? □ □
   f. Density counts within 3 lb/ft³ (50 kg/m³)? □ □
   g. Average of two tests? □ □
12. A minimum 9 lbs (4 kg) sample obtained from below gauge? □ □
13. Oversize determined following WSDOT SOP 615? □ □
14. All calculations performed correctly? □ □

First attempt: Pass □ Fail □ Second attempt: Pass □ Fail □

Signature of Examiner________________________________________
WSDOT FOP for AASHTO T 312

Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

1. SCOPE

1.1. This standard covers the compaction of cylindrical specimens of hot-mix asphalt (HMA) using the Superpave gyratory compactor.

1.2. This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1. AASHTO Standards:

- M 231, Weighing Devices Used in Testing of Materials
- R 30, Mixture Conditioning of Hot-Mix Asphalt (HMA)
- T 166, Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
- T 168, Sampling Bituminous Paving Mixtures
- T 209, Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
- T 275, Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens

2.2. ASTM Standard:

- D 4402, Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus

2.3. Other Standards:

- WSDOT SOP 731, Method for determining volumetric properties of asphalt concrete pavement class superpave
- WSDOT SOP 732, Superpave Volumetric Design for Hot-Mix Asphalt (HMA)

3. SIGNIFICANCE AND USE

3.1. This standard is used to prepare specimens for determining the mechanical and volumetric properties of HMA. The specimens simulate the density, aggregate orientation, and structural characteristics obtained in the actual roadway when proper construction procedure is used in the placement of the paving mix.

3.2. This test method may be used to monitor the density of test specimens during their preparation. It may also be used for field control of an HMA production process.

†This Test Method is based on AASHTO T 312-01.
4. APPARATUS

4.1. Superpave Gyratory Compactor-An electrohydraulic or electromechanical compactor with a ram and ram heads as described in Section 4.3. The axis of the ram shall be perpendicular to the platen of the compactor. The ram shall apply and maintain a pressure of 600 ± 18 kPa perpendicular to the cylindrical axis of the specimen during compaction (Note 1). The compactor shall tilt the specimen molds at an angle of 1.25 ± 0.02º (22 ± 0.35 mrad) and gyrate the specimen molds at a rate of 30.0 ± 0.5 gyrations per minute throughout compaction.

Note 1 – This stress calculates to 10,600 ± 310 N total force for 6 inches (150 mm) specimens.

4.1.1 Specimen Height Measurement and Recording Device – When specimen density is to be monitored during compaction, a means shall be provided to continuously measure and record the height of the specimen to the nearest 0.1 mm during compaction once per gyration.

4.1.2 The system may include a printer connected to an RS232C port capable of printing test information, such as specimen height per gyration. In addition to a printer, the system may include a computer and suitable software for data acquisition and reporting.

4.2. Specimen Molds – Specimen molds shall have steel walls that are at least 0.3 inches (7.5 mm) thick and are hardened to at least a Rockwell hardness of C48. The initial inside finish of the molds shall have a root mean square (rms) of 1.60 um or smoother (Note 2). Molds shall have an inside diameter of 5.9 to 6.0 inches (149.90 to 150.00 mm) and be at least 9.8 inches (250 mm) high at room temperature.

Note 2 – Smoothness measurement is in accordance with ANSI B 46.1. One source of supply for a surface comparator, which is used to verify the rms value of 1.60 um, is GAR Electroforming, Danbury, Connecticut.

4.3. Ram Heads and Mold Bottoms – Ram heads and mold bottoms shall be fabricated from steel with a minimum Rockwell hardness of C48. The ram heads shall stay perpendicular to its axis. The platen side of each mold bottom shall be flat and parallel to its face. All ram and base plate faces (the sides presented to the specimen) shall be flat to meet the smoothness requirement in Section 4.2 and shall have a diameter of 5.88 to 5.90 inches (149.50 to 149.75 mm).

4.4. Thermometers – Armored, glass, or dial-type thermometers with metal stems for determining the temperature of aggregates, binder, and HMA between 18 to 418°F (10 and 232°C).

4.5. Balance – A balance meeting the requirements of M 231, Class G5, for determining the mass of aggregates, binder, and HMA.

4.6. Oven – An oven, thermostatically controlled to ±5.4°F (±3°C), for heating aggregates, binder, HMA, and equipment as required. The oven shall be capable of maintaining the temperature required for mixture conditioning in accordance with R 30.

4.7. Miscellaneous – flat-bottom metal pans for heating aggregates, scoop for batching aggregates, containers (grill-type tins, beakers, containers for heating asphalt), large mixing spoon or small trowel, large spatula, gloves for handling hot equipment, paper disks, mechanical mixer (optional), lubricating materials recommended by the compactor manufacturer.
5. HAZARDS
   5.1. Use standard safety precautions and protective clothing when handling hot materials and preparing test specimens.

6. STANDARDIZATION
   6.1. Items requiring periodic verification of calibration include the ram pressure, angle of gyration, gyration frequency, LVDT (or other means used to continuously record the specimen height), and oven temperature. Verification of the mold and platen dimensions and the inside finish of the mold are also required. When the computer and software options are used, periodically verify the data processing system output using a procedure designed for such purposes. Verification of calibration, system standardization, and quality checks may be performed by the manufacturer, other agencies providing such services, or in-house personnel. Frequency of verification shall follow the manufacturer’s recommendations.

7. PREPARATION OF APPARATUS
   7.1. Immediately prior to the time when the HMA is ready for placement in the mold, turn on the main power for the compactor for the manufacturer’s required warm-up period.
   7.2. Verify the machine settings are correct for angle, pressure, and number of gyrations.
   7.3. Lubricate any bearing surfaces as needed per the manufacturer’s instructions.
   7.4. When specimen height is to be monitored, the following additional item of preparation is required. Immediately prior to the time when the HMA is ready for placement in the mold, turn on the device for measuring and recording the height of the specimen, and verify the readout is in the proper units, mm, and the recording device is ready. Prepare the computer, if used, to record the height data, and enter the header information for the specimen.

8. HMA MIXTURE PREPARATION
   8.1. Weigh the appropriate aggregate fractions into a separate pan, and combine them to the desired batch weight. The batch weight will vary based on the ultimate disposition of the test specimens. If a target air void level is desired, as would be the case for Superpave mix analysis and performance specimens, batch weights will be adjusted to create a given density in a known volume. If the specimens are to be used for the determination of volumetric properties, the batch weights will be adjusted to result in a compacted specimen having dimensions of 6 inches (150 mm) in diameter and 4.53 ± 0.12 inches (115 ± 5 mm) in height at the desired number of gyrations.

   Note 3 – It may be necessary to produce a trial specimen to achieve this height requirement. Generally, 4500 – 4700 g of aggregate are required to achieve this height for aggregates with combined bulk specific gravities of 2.55—2.70, respectively.

   8.2. Place the aggregate and binder container in the oven, and heat them to the required mixing temperature.

   8.2.1. The mixing temperature range is defined as the range of temperatures where the un-aged binder has a kinematic viscosity of 170 ± 20 mm²/s (approximately 0.17 ± 0.02 Pa·s for a binder density of 1.00 g/cm³) measured in accordance with ASTM D 4402.

   Note 4—Modified asphalts may not adhere to the equi-viscosity requirements noted, and the manufacturer’s recommendations should be used to determine mixing and compaction temperatures.
Note 5—The SI unit kinematic viscosity is m²/s; for practical use, the submultiple mm²/s is recommended. The more familiar centistokes is a cgs unit of kinematic viscosity; it is equal to 1 mm²/s. The kinematic viscosity is the ratio of the viscosity of the binder to its density. For a binder with a density equal to 1.000 g/cm³, a kinematic viscosity of 170 mm²/s is equivalent to a viscosity of 0.17 Pa·s measured in accordance with ASTM D 4402.

8.3. Charge the mixing bowl with the heated aggregate from one pan, and dry-mix thoroughly. Form a crater in the dry blended aggregate, and weigh the required amount of binder into the mix. Immediately initiate mixing.

8.4. Mix the aggregate and binder as quickly and thoroughly as possible to yield HMA having a uniform distribution of binder. As an option, mechanical mixing may be used.

8.5. After completing the mixture preparation perform the required mixture conditioning in accordance with R 30.

8.6. Place a compaction mold and base plate in an oven at no more than 25° F (13.9° C) above the required compaction temperature for a minimum of 30 to 60 minutes prior to the estimated beginning of compaction (during the time the mixture is being conditioned in accordance with R 30).

8.7. Following the mixture conditioning period specified in R 30, if the mixture is at the compaction temperature, proceed immediately with the compaction procedure as outlined in Section 9. If the compaction temperature is different from the mixture conditioning temperature used in accordance with R 30, place the mix in another oven at the compaction temperature for a brief time (maximum of 30 minutes) to achieve the required temperature.

8.7.1. The compaction temperature is the mid-point of the range of temperatures where the unaged binder has a kinematic viscosity of 280 ± 30 mm²/s (approximately 0.28 ± 0.03 Pa·s) measured in accordance with ASTM D 4402 (Note 4).

8.8. If loose HMA plant mix is used, the sample should be obtained in accordance with T 168. The mixture shall be brought to the compaction temperature range by careful, uniform heating in an oven immediately prior to molding.

9. COMPACTION PROCEDURE

9.1. When the compaction temperature is achieved, remove the heated mold, base plate, and upper plate (if required) from the oven. Place the base plate and a paper disk in the bottom of the mold.

9.2. Place the mixture into the mold in one lift. Care should be taken to avoid segregation in the mold. After all the mix is in the mold, level the mix, and place another paper disk and upper plate (if required) on top of the leveled materials.

9.3. Load the charged mold into the compactor, and center the loading ram.

9.4. Apply a pressure of 600 ± 18 kPa on the specimen.

9.5. Apply a 1.25 ± 0.02° (22.0 ± 0.35 mrad) angle to the mold assembly, and begin the gyratory compaction.

9.6. Allow the compaction to proceed until the desired number of gyrations specified in the contract documents is reached and the gyratory mechanism shuts off.
9.7. Remove the angle from the mold assembly; retract the loading ram; remove the mold from the compactor (if required); and extrude the specimen from the mold.

**Note 6**—No additional gyrations with the angle removed are required unless specifically called for in another standard referencing T 312 (as in R 30 Section 7.3.2.1.2). The extruded specimen may not be a right angle cylinder. Specimen ends may need to be sawed to conform to the requirements of specific performance tests.

**Note 7**—The specimens can be extruded from the mold immediately after compaction for most HMA. However, a cooling period of 5 to 10 minutes in front of a fan may be necessary before extruding some specimens to insure the specimens are not damaged.

9.8. Remove the paper disks from the top and bottom of the specimens.

**Note 8**—Before reusing the mold, place it in an oven for at least 5 minutes. The use of multiple molds will speed up the compaction process.

10. DENSITY PROCEDURE

10.1 Determine the maximum specific gravity (G_{mm}) of the loose mix in accordance with T 209 using a companion sample. The companion sample shall be conditioned to the same extent as the compaction sample.

10.2. Determine the bulk specific gravity (G_{mb}) of the specimen in accordance with T 166 or T 275 as appropriate.

10.3. When the specimen height is to be monitored, record the specimen height to the nearest 0.1 mm after each revolution in addition to those specified in Section 8.

11. DENSITY CALCULATIONS

11.1 Calculate the uncorrected relative density (G_{mmux}) at any point in the compaction process using the following equation:

\[
\%G_{mmux} = \frac{W_m}{\frac{V_{mx} G_{mm} G_m}{m_{G_{mm}}}} \times 100
\]

where:

- \( \%G_{mmux} \) = uncorrected relative density at any point during compaction expressed as a percent of the maximum theoretical specific gravity;
- \( W_m \) = mass of the specimen in g;
- \( G_{mm} \) = theoretical maximum specific gravity of the mix;
- \( G_m \) = unit weight of water, 1 g/cm³;
- \( x \) = number of gyrations; and
- \( V_{mx} \) = volume of the specimen, in cm³, at any point based on the diameter (d) and height (h) of the specimen at that point (use “mm” for height and diameter measurements).

It can be expressed as:

\[
V_{mx} = \frac{\pi d^2 h}{4 \times 1000}
\]

**Note 9**—This formula gives the volume in cm³ to allow a direct comparison with the specific gravity.
11.2. At the completion of the bulk specific gravity test, determine the relative density (%G\text{\text{max}}) at any point in the compaction process as follows:

\[
\%G_{\text{max}} = \frac{G_{\text{mb}}h_{\text{m}}}{G_{\text{mb}}h_{\text{x}}} \times 100
\]

where:

- \%G_{\text{max}} = corrected relative density expressed as a percent of the maximum theoretical specific gravity;
- G_{\text{mb}} = bulk specific gravity of the extruded specimen;
- h_{\text{m}} = height in millimeters of the extruded specimen; and
- h_{\text{x}} = height in millimeters of the specimen after x gyrations.

12. REPORT

12.1. Report the following information in the compaction report, if applicable:

12.1.1. Project name
12.1.2. Date of the test;
12.1.3. Start time of the test;
12.1.4. Specimen identification;
12.1.5. Percent binder in specimen, nearest 0.1 percent;
12.1.6. Average diameter of the mold used (d), nearest 1.0 mm;
12.1.7. Mass of the specimen (W_{\text{m}}), nearest 0.1 g;
12.1.8. Maximum specific gravity (G_{\text{max}}) of the specimen by T 209, nearest 0.001;
12.1.9. Bulk specific gravity (G_{\text{mb}}) of the specimen by T 166, nearest 0.001;
12.1.10. Height of the specimen after each gyration (h_{\text{x}}), nearest 0.1 mm; and
12.1.11. Relative density (%G_{\text{max}}) expressed as a percent of the theoretical maximum specific gravity, nearest 0.1 percent.

12.2. Report results on WSDOT form 350-162 or other report approved by the State Materials Engineer.

13. PRECISION AND BIAS

13.1. Precision—The research required to determine the precision of this procedure has not been conducted.

13.2. Bias—The research required to determine the bias of this procedure has not been conducted.

14. KEYWORDS

14.1. Gyratory; compaction; density
Performance Exam Checklist

Determining Density of Hot Mix Asphalt (HMA)
Specimens by Means of the SHRP
Gyratory Compactor
FOP For AASHTO T 312

<table>
<thead>
<tr>
<th>Participant Name</th>
<th>Exam Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

**Procedure Element**

1. The tester has a copy of the current procedure on hand? ☐ ☐
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present? ☐ ☐
3. Main power for compactor turned on for manufacturer’s required warm-up period? ☐ ☐
4. Angle, pressure and number of gyrations set? ☐ ☐
5. Bearing surfaces, rotating base surface, and rollers lubricated? ☐ ☐

**Preparation of Mixtures**

1. Is mixture at compaction temperature? If not, was mixture placed in an oven and brought up to compaction temperature? ☐ ☐
2. Mold and base plate heated for 30 to 60 minutes in an oven at the required compaction temperature? ☐ ☐

**Plant mix – Loose mix brought to compaction temperature by uniform heating immediately prior to molding.**

1. Mold, base plate and upper plate (if required) removed from oven and paper disk placed on bottom of mold? ☐ ☐
2. Mixture placed into mold in one lift, mix leveled, and paper disk and upper plate (if required) placed on top of material? ☐ ☐
3. Mold loaded into compactor and a pressure of 600 ± 18 kPa applied? ☐ ☐
4. Angle of 1.25 ± 0.02° (22 ± 0.35 mrad) applied to the mold assembly and gyratory compaction started? ☐ ☐
5. Compactor shuts off when appropriate gyration level is reached? ☐ ☐
6. No leveling off load applied (dwell gyrations or square load)? ☐ ☐
7. Mold removed and specimen extruded? ☐ ☐
8. Paper disks removed? ☐ ☐
<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. If specimens are used for determination of volumetric properties, are the heights of the specimens 115 ± 5mm?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10. All calculations performed correctly?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>First attempt: Pass ☐ Fail ☐</td>
<td></td>
<td></td>
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<tr>
<td>Second attempt: Pass ☐ Fail ☐</td>
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Signature of Examiner ____________________________________________________________________________________________________________________________

Comments:
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T 312                                                                                   November 2002                                                                                      T 312
WSDOT Test Method T 420

Test Method for Determining the Maturity of Compost (Solvita Test)

1. SCOPE

   The Solvita test is used for evaluating compost conditions.

2. REFERENCE DOCUMENTS

   AASHTO T-2

3. TERMINOLOGY

   3.1 Definitions

   3.1.1 Compost shall be stable, mature, decomposed organic solid waste that is the result of the accelerated, aerobic biodegradation and stabilization under controlled conditions. The result is a uniform dark, soil-like appearance.

   3.1.2 Maturity of any compost sample may be judged using both color test results from paddle A and C. Paddle A is a styrene paddle with a gel component that measures the ammonia content of the compost. Paddle C is a styrene paddle with a gel component that measures the carbon dioxide emitted by the compost sample.

4. SUMMARY OF TEST METHOD

   There are three easy steps involved in using the Solvita test kit to evaluate compost.

   4.1 Obtain and prepare the sample.
   4.2 Perform the test by placing both Solvita gel-paddles in the jar.
   4.2 Determine compost maturity using the color keys provided in the kit.

5. SIGNIFICANT AND USE

   This test is used to determine the maturity of compost materials delivered in the field for use. This test measures the amount of ammonia and carbon dioxide in the compost.

6. APPARATUS

   6.1 Solvita Kit containing the following:
      a testing jar with lid
      a carbon-dioxide paddle (marked with “C”) is purple
      an ammonia paddle (marked with “A”) is yellow
      color determination charts

   6.2 Shovel

   6.3 Small trowel or spoon

   6.4 A clean container large enough to combine the sample (approximately 5 gallons)

   6.5 A clean surface for mixing the sample such as a tarp or plywood
7. SAMPLE PREPARATION

7.1 A composite sample (approximately 1 cubic foot) representing the lot to be tested should be sampled in accordance with AASHTO T-2 “Sampling from Stockpiles” or “Sampling from Transport Units”.

7.2 Place the sample on a hard, clean, level surface where there will be neither loss of material nor the accidental addition of foreign material.

7.3 Particles such as wood chips which are too large for the jar (over 1/2 inch) should be removed or screened from the compost sample.

7.4 Checking for optimal moisture is absolutely necessary for accurate maturity testing. Samples which are either too wet or too dry are not likely to produce accurate results. The moisture level should be judged by the squeeze test before proceeding. Perform the Squeeze test by squeezing a small handful of compost. When squeezed tightly the compost should feel wet without producing any free water. Compost that is too dry is dusty and will not clump with hard squeezing.

7.5 Mix the material thoroughly by turning the entire sample over three times. With the last turning, the entire sample shall be placed into a conical pile.

7.6 Using a small trowel, or other device, remove a portion from the center of the pile.

7.7 Fill the jar to the fill line and obtain proper density by sharply tapping the bottom of the jar on a counter. Fluffy or coarse composts should be compacted by pressing firmly into the jar.

7.8 If compost to be tested is not in an optimal state, then the following should be performed:
   1. If the sample is hot, it should be covered and allowed to cool to room temperature before testing.
   2. If the sample is too wet, it should be dried until it passes the squeeze test.
   3. If the sample is too dry, add clean water until it passes the squeeze test. This sample shall be covered and allowed to stand at room temperature for 24 hours before performing the test.

8. PROCEDURE

8.1 Open each package by tearing along the top strip and carefully remove the paddle by grasping the handle. Do not touch the special gel surface, and don’t allow compost to touch it. Once the gel pack is opened, the test should be started within 30 minutes. The gel is not harmful to touch, but should be kept out of the mouth and eyes.

8.2 Insert the paddles into the sample at right angles to each other so that they can be seen through the viewing side. The edges of the paddles can be touching in the middle. Position the two paddles as indicated by the color squares on the jar label. Push the paddle tips into the compost to the bottom of the jar. Be careful not to jostle or tip the jar. Do not use a paddle if the gel is dried out or if the color is not the “Control Color” indicated on the respective color charts.

8.3 Screw the lid on tight, and keep the jar at room temperature 68-77 F (20-25 C) out of direct sunlight for 4 hours ± 10 minutes.
9. EVALUATING THE RESULTS

9.1 Read the Solvita paddle colors 4 hours after the test is started. To read the colors, observe the paddles through the viewing side of the jar with the lid in place and illuminated from the front. Color rendition is best in moderate-intensity, fluorescent room light. Compare to the color charts provided with the kit, and record the color numbers that most closely match. Since the Solvita colors may continue to change after 4-hours, the proper interpretation for this test is based on a 4-hour ± 10 minute reading.

10. REPORTS

10.1 Report both the readings for the “A” paddle and the “C” paddle in the Inspector’s Daily Report.
# Performance Exam Checklist

**Determining the Maturity of Compost (Solvita Test)**

**WSDOT Test Method T 420**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td>☐</td>
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</tbody>
</table>

**Sample Preparation**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Representative sample obtained per AASHTO T-2?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. Sample placed on clean hard surface?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. Check for optimal moisture?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. Sampled mixed thoroughly?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>5. Small sample taken from the center of the pile?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>6. Sample filled in jar to the proper line and compacted?</td>
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<td>☐</td>
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</table>

**Procedure**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Open the gel packs without touching the gel sticks?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>2. Is the test started within 30 minutes of opening the gel pack?</td>
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</tr>
<tr>
<td>3. Are the paddles inserted in the compost at right angles to each other?</td>
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<tr>
<td>4. Are the paddles positioned to be seen through the viewing window?</td>
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<tr>
<td>5. Are the paddles pushed to the bottom of the jar?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>6. Is the lid screwed on tight?</td>
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<tr>
<td>7. Is the jar at room temperature 68-77 F?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>8. Is the test run for 4 hours + 10 minutes?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>9. Are the color charts read?</td>
<td>☐</td>
<td>☐</td>
</tr>
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</table>

First attempt: Pass ☐ Fail ☐  
Second attempt: Pass ☐ Fail ☐

Signature of Examiner ________________________________

Comments:
WSDOT Standard Operating Procedure SOP 615

Determination of the % Compaction for Embankment & Untreated Surfacing Materials using the Nuclear Moisture-Density Gauge

1. SCOPE

This procedure covers the procedures for determining the in-place density, moisture content, gradation analysis, oversize correction, and determination of maximum density of compacted soils and untreated surfacing materials using a nuclear density device in the direct transmission mode.

2. REFERENCES

a. AASHTO T 99 FOP for AASHTO T 99 for Method of Test for Moisture-Density Relations of Soils
b. AASHTO T 224 FOP for AASHTO T 224 for Correction for Coarse Particles in Soil Compaction Test
c. AASHTO T 255 FOP for AASHTO T 255 for Total Moisture Content of Aggregate by Drying
d. AASHTO T 272 FOP for AASHTO T 272 for Family of Curves — One Point Method
e. AASHTO T 310 FOP for AASHTO T 310 for In-Place Densities and Moisture Content of Soils and Soil-Aggregate by Nuclear Methods (Shallow Depth)
f. WSDOT T 606 Method of Test for Compaction Control of Granular Materials

3. TEST LOCATION

When selecting a test location, the tester shall visually select a site where the least compactive effort has been applied.

4. NUCLEAR DENSITY TEST

Determine the dry density and moisture content of soils and untreated surfacing materials using the nuclear moisture-density gauge in accordance with WSDOT FOP for AASHTO T 310, and record on DOT Form 350-074 “Field Density Test”

5. OVERSIZE DETERMINATION

a. A sample weighing a minimum of 9 lbs. will be taken from beneath the gauge. Care shall be taken to select material that is truly representative of where the moisture density gauge determined the dry density and moisture content.

b. There are two methods for determining the amount of oversized aggregate, Method 1, dries the sample to an SSD condition before sieving, and Method 2, a rapid test that washes the No. 4 minus material out of the sample before sieving. Method 2 is only recommended for crushed surfacing materials, materials with high clay content, or other granular materials that are at or near the optimum moisture content for compaction.

   Method 1:

   1. Dry the sample to SSD conditions, (i.e. dried until no visible surface moisture present, material may still appear damp). Allow the sample to cool sufficiently and record mass to the nearest 0.1 percent of the total mass or better.
2. Shake sample by hand over the No. 4 (4.75 mm) sieve. Limit the quantity of material on the sieve so that all particles have opportunity to reach the sieve openings a number of times during the sieving operation. The mass retained on the No. 4 (4.75 mm) sieve at the completion of the sieving operation shall not exceed 800 grams, 1.8 pounds, for a 12" sieve, or 340 grams, 0.75 pounds; for a 8" sieve.

3. Remove and weigh the material on the No. 4 (4.75 mm) sieve to the nearest 0.1% of the total mass or better and record.

Method 2:
1. Determine the mass of the sample to the nearest 0.1% of the total mass or better and record.

2. Charge the material in a suitable container with water, agitate the material to suspend the fines, then slowly decant and screen the material over a verified No. 4 sieve. Repeat as necessary to remove as much of the No. 4 minus material as possible. DO NOT overload the sieve.

3. Place the washed sample retained on the No. 4 sieve into a tared container. Blot the material to a SSD condition (i.e. no visible surface moisture present, material may still appear damp) during this step.

4. Weigh the mass of the material on the No. 4 sieve to the nearest 0.1% of the total mass or better and record.

c. Calculate the percentage retained and the percent passing the No. 4 (4.75 mm) sieve to the nearest percent and record on DOT Form 350-074 by the following formula:

   English:
   \[
   \% \text{ Retained No. 4} = \frac{\text{Mass Retained on the No. 4 sieve}}{\text{Initial Dry Mass}}
   \]
   \[
   \% \text{ Passing} = 100 - \% \text{ Retained}
   \]

   Metric:
   \[
   \% \text{ Retained 4.75 mm} = \frac{\text{Mass Retained on the 4.75 mm sieve}}{\text{Initial Dry Mass}}
   \]
   \[
   \% \text{ Passing} = 100 - \% \text{ Retained}
   \]

6. % COMPACTION DETERMINATION BASED ON AASHTO T 99
   a. This process is applicable to nongranular, silty materials with less than 30 percent retained on the No. 4 (4.75 mm) sieve. AASHTO Test Method T-99 and WSDOT FOP for AASHTO T-272 are used to determine the maximum density of the material passing the No. 4 (4.75 mm) sieve. Record the maximum density on DOT Form 350-074 line “Maximum Density”

   b. The maximum density from AASHTO T-99 and T-272 must be corrected for material larger than the No. 4 (4.75 mm) sieve. To correct for the oversize, use WSDOT FOP for AASHTO T224, and enter this value on DOT Form 350-074 line “Corrected Maximum Density”. When 0% is retained on the No. 4 (4.75 mm) sieve, no correction is necessary.

   c. Percent Compaction is calculated by the following formula and entered on DOT Form 350-074:
7. % COMPACtion DETERMINATION BASED ON WSDOT TEST METHOD No. 606.
   a. This process is applicable to granular, free-draining materials and to materials with 30 percent or more retained on the No. 4 (4.75 mm) sieve. Test Method 606 requires specialized equipment and is run only by the Region or State Materials Laboratory.
   b. Using the appropriate computer-generated chart, determine the maximum density, based on the percent passing the No. 4 (4.75 mm) sieve. This value should be entered on DOT Form 350-074 on line “Maximum Density”.
   c. Percent of compaction is then calculated by the formula and entered on DOT Form 350-074:

   English:
   \[
   \frac{\text{% Compaction lbs.}/\text{ft.}^3}{\text{Corrected Maximum Density lbs./ft.}^3} = \frac{\text{Dry Density lbs.}/\text{ft.}^3}{(100)}
   \]

   Metric:
   \[
   \frac{\text{% Compaction kg/m}^3}{\text{Corrected Maximum Density kg/m}^3} = \frac{\text{Dry Density kg/m}^3}{(100)}
   \]

8. OPTIMUM MOISTURE DETERMINATION
   Record the Optimum Moisture content from the appropriate density curve on DOT Form 350-074.
   For non-granular materials, the optimum moisture content will have to be corrected with the following formula:
   \[
   \text{Corrected Optimum Moisture} = (\text{Optimum Moisture}) \times \left(\frac{\text{% Passing No. 4}}{100}\right)
   \]

9. REPORT
   Report compaction data of DOT Form 350-074, “Field Density Test” and on DOT Form 351-015 “Daily Compaction Test, or other report approved by the State Materials Engineer.
WSDOT Test Method T 712

Standard Method of Reducing Bituminous Paving Mixtures

Significance

Samples of bituminous paving mixes taken in accordance with FOP AASHTO T 168 are composites and are large to increase the likelihood that they are representative of the product being tested. Materials sampled in the field need to be reduced to appropriate sizes for testing. It is extremely important that the procedure used to reduce the field sample not modify the material properties.

1. SCOPE

This method covers the procedure for reducing samples of Hot Mixed Asphalt (HMA). The samples are to be acquired in accordance with FOP AASHTO T 168. The sample is to be representative of the average of the HMA being produced.

2. APPARATUS

- Flat-bottom scoop,
- Broom or brush,
- Non-stick splitting surface such as metal, paper, canvas blanket or heat-resistant plastic,
- Large spatulas, trowels, metal straight edge or 12 in. dry wall taping knife, sheet metal quartering splitter,
- Oven — An oven of appropriate size, capable of maintaining a uniform temperature within the allowable tolerance for the grade of asphalt.
- Miscellaneous equipment including trowel(s), spatula(s), hot plate, non-asbestos heat-resistant gloves or mittens, pans, buckets, cans.

3. SAMPLE PREPARATION

The sample must be warm enough to separate. If not, warm in an oven until it is sufficiently soft to mix and separate easily.

4. PROCEDURE

Initial Reduction of Field Sample

A. Place the sample on a hard, clean, non-stick, level surface where there will be neither loss of material nor the accidental addition of foreign material. The surface may be covered with a canvas blanket, heavy paper or other suitable material. Remove the sample from the agency approved containers by dumping into a conical pile.
B. Divide the into four approximately equal quarters with a spatula, trowel, flat metal plate, or sheet metal quartering splitter.

C. With the quartering devise in place remove all the material from each quarter. If needed for additional testing the material should be placed in agency approved containers for storage or shipment.

**Note 1:** When testing lean mixes or mixes with aggregate larger than 3/4 in. (19 mm), sampling as described in Method B, with no remixing and no removal of a similar amount of material from the opposite quarter, is recommended at this point to obtain samples for each acceptance test.

D. Pay particular attention that excessive amounts of materials is not left on the splitting surface or splitting equipment.

F. When the further reduction of the HMA is to be done, proceed according to step 2 of methods A, B, or C.

**Note 2:** Identify the opposite quarter as the “Challenge Sample.”

**Reducing to Test Size — Method A**

1. On a hard, clean, non-stick, level surface where there will be neither loss of material nor the accidental addition of foreign material. Remove the sample from the agency approved containers by dumping into a conical pile. The surface shall be covered with either a canvas blanket, heavy paper or other suitable material.

2. With the material on the canvas or paper. Mix the sample thoroughly by turning the entire sample over four times. Alternately lift each corner of the canvas or paper and pull it over the sample diagonally toward the opposite corner causing the material to be rolled. With the last turning, lift both opposite corners to form a conical pile.

3. Grasp the canvas or paper, roll the material into a loaf and flatten the top.
4. Pull the canvas or paper so approximately $\frac{1}{4}$ of the length of the loaf is off the edge of the counter. Allow this material to drop into a container to be saved. As an alternate using a straight edge slice off approximately $\frac{1}{4}$ of the length of the loaf and place in a container to be saved.

![Figure 4](image)

5. Pull additional material (loaf) off the edge of the counter and drop the appropriate size sample into a sample pan or container. As an alternate using a straight edge slice off appropriate size sample from the length of the loaf and place in a sample pan or container.

6. Repeat step 5 until the proper size sample has be acquired. Step 5 is to be repeated until all the samples for testing have been obtained.

**Note 3:** When reducing the sample to test size it is advisable to take several small increments determining the mass each time until the proper minimum size is achieved. Unless the sample size is grossly in excess of the minimum or exceeds the maximum test size use the sample as reduced for the test.

**Reducing to Test Size — Method B**

1. On a hard, clean, non-stick, level surface where there will be neither loss of material nor the accidental addition of foreign material. Remove the sample from the agency approved containers by dumping into a conical pile. The surface shall be covered with either a canvas blanket, heavy paper or other suitable material. (See Note 1.)

2. With the material on the canvas or paper. Mix the sample thoroughly by turning the entire sample over four times. Alternately lift each corner of the canvas or paper and pull it over the sample diagonally toward the opposite corner causing the material to be rolled. With the last turning, lift both opposite corners to form a conical pile.

3. Quarter the conical pile using a quartering device or straightedge.

![Figure 5](image)
4. With the quartering device in place using a suitable straight edge slice through the quarter of the HMA from the apex of the quarter to the outer edge. Pull or drag the material from the quarter holding one edge of the straight edge in contact with the quartering device. Two straight edges may be used in lieu of the quartering device.

5. Slide or scoop the material into a sample pan. Repeat step 4 removing a similar amount of material from the opposite quarter. Step 4 is to be repeated until all the samples for testing have been obtained.

Note 4: When reducing the sample to test size it is advisable to take several small increments determining the mass each time until the proper minimum size is achieved. Unless the sample size is grossly in excess of the minimum or exceeds the maximum test size use the sample as reduced for the test.

Reducing to Test Size — Method C

1. On a hard, clean, non-stick, level surface where there will be neither loss of material nor the accidental addition of foreign material. Remove the sample from the agency approved containers by dumping into a conical pile. The surface shall be covered with either a canvas blanket, heavy paper or other suitable material.

2. With the material on the canvas or paper. Mix the sample thoroughly by turning the entire sample over four times. Alternately lift each corner of the canvas or paper and pull it over the sample diagonally toward the opposite corner causing the material to be rolled. With the last turning, lift both opposite corners to form a conical pile.

3. Quarter the conical pile using a quartering device or straightedge.

4. Remove the opposite quarters saving the material for future use.

5. Repeat step 2 through 4 until the proper size sample has be achieved.

6. When additional test specimens are required, dump the removed material into a conical pile as in step 1 and repeat steps 2 through 5. This process may be repeated until sample have been reduced to testing size for all tests.

5. SAMPLE IDENTIFICATION

(1) Each sample submitted for testing shall be accompanied by a transmittal letter completed in detail. Include the contract number, acceptance and mix design verification numbers, mix ID.

(2) Samples shall be submitted in standard sample boxes, secured to prevent contamination and spillage.

(3) Sample boxes shall have the following information inscribed with indelible-type marker: Contract number, acceptance and mix design verification numbers, mix ID.

(4) The exact disposition of each quarter of the original field sample shall be determined by the agency.
Performance Exam Checklist

Reducing Samples of Hot Mix Asphalt to Testing Size
WSDOT Test Method T 712

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<th>Procedure Element</th>
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<th>No</th>
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<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
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<td>☐</td>
</tr>
<tr>
<td>2. Sample warmed if not sufficiently soft?</td>
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**Method A**

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<th>Procedure Element</th>
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<tbody>
<tr>
<td>3. Sample placed on paper on clean, hard, and level surface?</td>
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<td>☐</td>
</tr>
<tr>
<td>4. Sample mixed thoroughly?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. Rolled into loaf and then flattened?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. At least ¼ of loaf removed by slicing off or dropping off edge of counter?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7. Proper sample size quantity of material sliced off or dropped off edge of counter onto sample container?</td>
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<td>☐</td>
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</table>

**Method B**

<table>
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<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Sample thoroughly mixed and conical pile formed?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9. Divided into 4 equal portions with quartering device or straightedge?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10. With two straight edges or a splitting device and one straight edge. Was a sample sliced from apex to outer edge of the quarter?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11. Cleared spaces scraped clean?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12. Process continued until proper test size is obtained?</td>
<td>☐</td>
<td>☐</td>
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</table>

**Method C**

<table>
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<tr>
<th>Procedure Element</th>
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<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Sample thoroughly mixed and conical pile formed?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14. Divided into 4 equal portions with quartering device or straightedge?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15. Two diagonally opposite quarters removed and saved?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16. Cleared spaces scraped clean?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>17. Process repeated until proper test size is obtained?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>18. Were opposite quarters and combined to make sample?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

First attempt:  Pass ☐  Fail ☐  
Second attempt:  Pass ☐  Fail ☐  

Signature of Examinerr __________________________________________
WSDOT Test Method No. 716

Method of Random Sampling for Locations of Testing and Sampling Sites

1. SCOPE
   a. This method outlines the procedure for selecting sampling and testing sites in accordance with accepted random sampling techniques. It is intended that all testing and sampling locations be selected in an unbiased manner based entirely on chance.
   b. Testing and sampling locations and procedures are as important as testing. For test results or measurements to be meaningful, it is necessary that the sampling locations be selected at random, typically by use of a table of random numbers. Other techniques yielding a system of randomly selected locations are also acceptable.
   c. This procedure is divided into several sections:
      • Applications for Asphalt Paving Density, Section 5
      • Applications for Asphalt Mixture Sampling, Section 6
      • Applications for Portland Cement Concrete, Section 7
      • Applications for Aggregate and other materials, Section 8

2. STRAIGHT RANDOM SAMPLING VS. STRATIFIED RANDOM SAMPLING:
   Straight random sampling considers an entire lot as a single unit and determines each sample location based on the entire lot size. Stratified random sampling divides the lot into a specified number of sublots or units and then determines each sample location within a distinct sublot. Both methods result in random distribution of samples to be tested for compliance with the agency’s specification.

3. PROCEDURE
   a. Determine the lot, or sublot size and number of tests per LOT or sublot.
   b. Determine the “X” and/or “Y” random number by using values from the random number table.
   c. Multiply the lot or sublot size by the random number. This will give you the test location within the lot or sublot to do the testing.

4. STRATIFIED RANDOM SAMPLING
   a. Following determination of the LOT length in Example 1, determine the length increment for individual sublots by dividing by the number of such desired sublots. In the case of Asphalt Concrete Pavement this would be five sublots
   b. Determine random location factors “X” and/or “Y” values by random entry to the table.
   c. To determine the location of test No. 1 in sublot No. 1 multiply the sublot increment by the selected “X” or “Y” factor from the Random Number table, then add this amount to the beginning location. Test locations within each of the subsequent sublots are determined by calculating the fractional location within the sublot interval then adding the increment of the preceding sublot.
   d. For irregular lot or sublot sizes at the end of production, determine the location by dividing the final increment into 5 equal parts and define a test location within each.
5. APPLICATIONS FOR ASPHALT PAVING DENSITY

a. Determine the LOT size and number of tests per LOT. The Standard specifications set the size of a density test lot for Asphalt Concrete Pavement to no greater than a single day’s production or approximately 400 tons, whichever is less, and require five tests per LOT. At the end of a day’s production and the final lot is greater than 400 tons, it should be broken up into two lots.

b. Convert this LOT size to an area segment of the roadway based on the roadway section and depth being constructed for the course being tested. The calculations in Example 1 show how this is performed. Table 1 has been provided to give you recommend lot lengths for standard lane widths at various depths. Lot length needs to be determined to the nearest 100 feet.

Example 1
Sample Computation for Lot Length

Using nominal compacted density of 2.05 tons/cy, and a 400 ton lot:

\[ \text{Tons per lineal foot} = \frac{\text{1.0 (foot)} \times \text{width (feet)} \times \text{depth (feet)}}{27} \times 2.05 \text{ Tons/cy} \]

\[ \text{Tons per lineal Foot} = \frac{1.0 \text{ ft} \times 12 \text{ ft} \times 0.15 \text{ ft} \times 2.05 \text{ tons}}{2} = 0.137 \text{ Tons per lineal Foot.} \]

\[ \text{Lot length} = \frac{400 \text{ Tons}}{0.137 \text{ Tons per lineal Foot}} = 2900 \text{ lineal Feet} \]

Table 1:
Asphalt Paving Density Test Lot Length
400 Ton lot at 2.05 tons/cubic yard

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>Compacted Depth</th>
<th>Computed Lot Length</th>
<th>Recommended Lot Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 feet</td>
<td>0.12</td>
<td>3655</td>
<td>3700</td>
</tr>
<tr>
<td></td>
<td>0.15</td>
<td>2924</td>
<td>2900</td>
</tr>
<tr>
<td></td>
<td>0.20</td>
<td>2193</td>
<td>2200</td>
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<tr>
<td></td>
<td>0.25</td>
<td>1754</td>
<td>1800</td>
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<tr>
<td>11 feet</td>
<td>0.12</td>
<td>3987</td>
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<td>0.15</td>
<td>3189</td>
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<td></td>
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</tr>
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</table>

LOT length may also be determined based on Nominal Designated LOT sizes. To utilize this concept, compacted mix volumes equivalent to the designated mix quantity per LOT have been determined using the nominal compacted unit weight of asphalt concrete pavement. These volumes are then converted into Density LOT lengths using the typical lane width and specified compacted depth. The included tables present the values for LOT Lengths based on English units.

c. Determine the locations of the test (or sampling) sites by using values from the random number table (Table 2) to determine the coordinate location on the roadway. In the table, use the “X” values as decimal fractions of the total length of the lot; use the “Y” values as fractions of the width, customarily measured from the right edge of the pavement. The values in the table have been set so that no measurements are taken within 1.5 LF (0.45 m) of the edge of the pavement. Whenever a test location is determined to fall within such an area (i.e., bridge end, track crossing, or night joint) the test location should be moved ahead or back on stationing, as appropriate, by 25 LF (8 m).
Table 2
Random Numbers with X and Y values

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<th>X</th>
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<td>0.78</td>
</tr>
</tbody>
</table>
e. In order to determine which “X” and “Y” values should be used, enter the table on a line
chosen by chance. Recommended procedure is selection of a line based on the last two digits
from the most recent standard count on the nuclear density gage. Subsequent “X” and “Y”
values are then taken from the lines that follow. Based on the specified sampling frequency, 20
lots can be accommodated by one cycle through the table. Start each shift with a set of values
determined by chance in order to obtain random selection.

f. Example 2 shows the calculations for determining the testing location for asphalt pavement
density. The test record, DOT Form 350-092, has an area for determining the testing location
see Figure 1.

Example 2
Test Location Within the LOT
for Asphalt Pavement Density

For the lot: (12 ft. wide, 0.15 ft. deep, starting at station 168 + 75 with paving progressing
ahead on station), Lot length was previously determined as 2,900 LF. Using the last two digits
of the standard count, as in the example, 2951, assume “X” and “Y” values from line (51) in
table 2: X = 0.762, Y = 0.65.

For the first test:
   Beginning station: 168 + 75
   Sublot length increment: 580 * 0.762 = 442
   Width offset: 12 * 0.65 = 7.8 ft. (from right edge)
   Location is: station: (168+75) + 442 = 173 + 17, 7.8 ft. from right edge

For the Second test:
   Beginning station: (168 + 75) + (580) = 174 + 60
   Sublot length increment: 580 * 0.285 = 165
   Width offset: 12 * 0.28 = 3.4 ft. (from right edge)
   Location is: station: (174 + 60) + 165 = (176 + 25), 3.4 ft. from right edge

For the Third test:
   Beginning station: (168 + 75) + 580 + 580 = 180 + 35
   Sublot length increment: 580 * 0.347 = 201
   Width offset: 12 * 0.87 = 10.4 ft. (from right edge)
   Location is: station: (180 + 35) + 201 = (182 + 36), 10.4 ft. from right edge

6. APPLICATIONS FOR ASPHALT PAVEMENT MIXTURE
   a. Determine the sublot size. The Standard Specifications define a lot as the total quantity of
      material or work produced for each job mix formula (JMF). The sublot size for asphalt mix-
      ture gradation, asphalt content, and /or volumetrics is a maximum of 800 tons, and shall be
determined to the nearest 100 tons. Sampling of liquid asphalt shall be every other mixture
sample. At the end of production, if the tonnage produced since the last sublot is less than 100
tons, you do not have to take a sample. If the tonnage exceeds 100 tons and is less than 800
tons, a sample must be taken regardless of the random sample tonnage.
b. Determine the locations of the test (or sampling) sites as defined in Section 3 using random numbers from Table 3, or from another Random Number Generator. Do not sample from the first or last 25 tons.

Table 3
Random Numbers

<table>
<thead>
<tr>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) 0.186</td>
<td>(21) 0.256</td>
<td>(41) 0.201</td>
<td>(61) 0.508</td>
<td>(81) 0.431</td>
</tr>
<tr>
<td>(2) 0.584</td>
<td>(22) 0.753</td>
<td>(42) 0.699</td>
<td>(62) 0.884</td>
<td>(82) 0.509</td>
</tr>
<tr>
<td>(3) 0.965</td>
<td>(23) 0.108</td>
<td>(43) 0.785</td>
<td>(63) 0.648</td>
<td>(83) 0.962</td>
</tr>
<tr>
<td>(4) 0.044</td>
<td>(24) 0.626</td>
<td>(44) 0.874</td>
<td>(64) 0.398</td>
<td>(84) 0.315</td>
</tr>
<tr>
<td>(5) 0.840</td>
<td>(25) 0.885</td>
<td>(45) 0.604</td>
<td>(65) 0.142</td>
<td>(85) 0.721</td>
</tr>
<tr>
<td>(6) 0.381</td>
<td>(26) 0.418</td>
<td>(46) 0.087</td>
<td>(66) 0.962</td>
<td>(86) 0.637</td>
</tr>
<tr>
<td>(7) 0.756</td>
<td>(27) 0.320</td>
<td>(47) 0.334</td>
<td>(67) 0.516</td>
<td>(87) 0.056</td>
</tr>
<tr>
<td>(8) 0.586</td>
<td>(28) 0.098</td>
<td>(48) 0.189</td>
<td>(68) 0.615</td>
<td>(88) 0.905</td>
</tr>
<tr>
<td>(9) 0.480</td>
<td>(29) 0.791</td>
<td>(49) 0.777</td>
<td>(69) 0.226</td>
<td>(89) 0.195</td>
</tr>
<tr>
<td>(10) 0.101</td>
<td>(30) 0.717</td>
<td>(50) 0.704</td>
<td>(70) 0.881</td>
<td>(90) 0.981</td>
</tr>
<tr>
<td>(11) 0.282</td>
<td>(31) 0.868</td>
<td>(51) 0.946</td>
<td>(71) 0.369</td>
<td>(91) 0.600</td>
</tr>
<tr>
<td>(12) 0.957</td>
<td>(32) 0.583</td>
<td>(52) 0.426</td>
<td>(72) 0.001</td>
<td>(92) 0.044</td>
</tr>
<tr>
<td>(13) 0.377</td>
<td>(33) 0.385</td>
<td>(53) 0.266</td>
<td>(73) 0.744</td>
<td>(93) 0.433</td>
</tr>
<tr>
<td>(14) 0.456</td>
<td>(34) 0.465</td>
<td>(54) 0.791</td>
<td>(74) 0.229</td>
<td>(94) 0.762</td>
</tr>
<tr>
<td>(15) 0.778</td>
<td>(35) 0.101</td>
<td>(55) 0.711</td>
<td>(75) 0.906</td>
<td>(95) 0.678</td>
</tr>
<tr>
<td>(16) 0.243</td>
<td>(36) 0.285</td>
<td>(56) 0.122</td>
<td>(76) 0.413</td>
<td>(96) 0.347</td>
</tr>
<tr>
<td>(17) 0.578</td>
<td>(37) 0.829</td>
<td>(57) 0.895</td>
<td>(77) 0.827</td>
<td>(97) 0.274</td>
</tr>
<tr>
<td>(18) 0.966</td>
<td>(38) 0.998</td>
<td>(58) 0.371</td>
<td>(78) 0.984</td>
<td>(98) 0.114</td>
</tr>
<tr>
<td>(19) 0.373</td>
<td>(39) 0.539</td>
<td>(59) 0.221</td>
<td>(79) 0.641</td>
<td>(99) 0.480</td>
</tr>
<tr>
<td>(20) 0.834</td>
<td>(40) 0.060</td>
<td>(60) 0.011</td>
<td>(80) 0.068</td>
<td>(100) 0.685</td>
</tr>
</tbody>
</table>

Once the two-digit number is selected the corresponding four-digit number becomes the factor for determining the selection of the next sample.

c. In order to determine which random values should be used, enter the table on a line chosen by chance. Recommended procedure is selection of a line based on the last two digits of the ignition furnace calibration.

d. Example 3 shows the calculations for determining the testing location for asphalt concrete mixture. The File Maker Pro Form DOT 350-160 will calculate the testing location for you.

Example 3
Test Location for a Sublot of Asphalt Concrete Mixture

The Ignition Furnace calibration is 0.45%. Use 45 as the starting point to enter the random number table 3. The starting random number is 0.604.

For the First test point:

Beginning tonnage: 0

Sublot increment: 800 * 0.604 = 483

Testing tonnage is at: 483 tones
For the Second test point:
  
  Beginning tonnage: 800  
  Sublot increment: 800 * 0.087 = 70  
  Testing tonnage is at: 800 + 70 = 870 tones

For the Third test point:
  
  Beginning Tonnage: 800 + 800 = 1600  
  Sublot increment: 800 * 0.334 = 267  
  Testing tonnage is at: 1600 + 267 = 1867 tones

For the Fourth test point:
  
  Beginning Tonnage: 1600 + 800 = 2400  
  Sublot increment: 800 * 0.189 = 151  
  Testing tonnage is at: 2400 + 151 = 2551 tones

7. APPLICATIONS FOR PORTLAND CEMENT CONCRETE

a. Determine the sublot size. The Standard Specifications states after two successive tests indicate that the concrete is within specified limits; the sampling and testing frequency may decrease to one for every five truck load. Concrete samples other than initial load samples or samples for questioned acceptance will be taken from each sublot by a random selection. Random selection will be accomplished by using the random number table 3. For each day of concrete delivery and placement a new random number will be selected and the process repeated.

b. Determine the locations of the test (or sampling) sites as defined in Section 3 using random numbers from table 3, or from another Random Number Generator. Do not sample concrete from the first ½ cubic yard of the truck.

c. In order to determine which random values should be used, enter the table on a line chosen by chance. As a suggestion, select a line corresponding to the last two numbers on the first civilian license plate you see or other acceptable random means. Subsequent “X” values for following sublots on the same day are taken from the lines, which follow. Start each day with an “X” value determined by chance in order to obtain a random selection.

d. Example 4 shows the calculations for determining the testing location for Portland Cement Concrete.

Example 4
Test Location for a Sublot of Portland Cement Concrete

For this example the random number selected is “37.” Enter the random number table 3 at (37) and the corresponding four-digit number is 0.829, this is the factor.

Based on the delivery of 10 cubic yard loads to the project. This would be adjusted by the quantity of concrete actually being delivered per load.

Next five trucks loads => 10 CY x 5 = 50 CY

50 CY x 0.829 = 41.45 CY to be sampled

Therefore, the sample will be taken from the truck containing the 41st CY. After approximately 1 CY of concrete has been discharged the sample should be taken. This is actually the seventh truckload delivered to the project this day as the first two truckloads were sampled before the random selection process started. The process would continue for the next sample using “38” then “39” etc.
8. APPLICATIONS FOR AGGREGATE AND OTHER MATERIALS

a. Determine the lot or sublot size according to the contract documents. The lot or sublot shall be determined to the nearest 100 tons.

b. Determine the locations of the test (or sampling) sites as defined in Section 3 using random numbers from Table 3, or from another Random Number Generator.

c. In order to determine which random values should be used, enter the table on a line chosen by chance. The first two or last two digits of the next automobile license plate you see is one way to select the entry point. Another way is to start a digital stopwatch and stop it several seconds later, using the decimal part of the seconds as your entry point.

**Sampling from a Belt or Flowing Stream:** Example: The specification calls for one sample from every 1000 Tons of aggregate. If the random number is 0.371, the sample would be taken at (0.371) (1000 Tons) = 371 Tons.

Example: One sample per day is specified. For a 9 hours day using the random number 0.199, the sample would be taken at (0.199)(9 hrs) = 1.79 hr = 1 hr, 48 minutes into the day.

AASHTO T 2 permits this time to be rounded to the nearest 5 minutes.

**Sampling from Haul Units:** Example: The specification calls for the samples to be based on a number of haul units. Determine the number of hauling units that comprise a lot. Multiply the selected random number(s) by the number of units to determine which unit(s) will be sampled.

If 20 haul units comprise a lot and one sample is needed, using the random number 0.773, the sample would be taken from the (0.773) (20) = 15.46, or 15th haul unit.

**Sampling from a Roadway with Previously Placed Material:** Example: The specification calls for a sample from a location on a job. The process as defined in Section 5, Applications for Asphalt Paving Density should be used where a X and Y measurement is needed to determine the testing location.
WSDOT Test Method T 724

Method of Preparation of Aggregate for ACP Mix Designs

1. SCOPE

This method of test is intended for the processing and preparation of aggregate samples for use in mix designs and calibrations for asphalt concrete, asphalt treated base, or open graded products.

2. APPARATUS

a. Sieves — shall conform to the specifications of sieves for testing purposes.

b. Mechanical sieve shaker — of sufficient size to separate the material to the specification sieves.

c. Oven(s) — of appropriate size, capable of maintaining a uniform temperature of 325 ± 25°F (163 ± 14°C).

d. Container — pans or containers of suitable size to dry and store the aggregate.

e. Balance — capacity of at least 8 kg sensitive to 0.1 g and meeting the requirements of AASHTO M231.

f. Aggregate washer (optional).

3. PROCEDURE

a. Representative sample(s) of the production aggregates shall be obtained.

b. Dry the aggregate in an oven to a constant mass.

   Note: When developing an Ignition Furnace Calibration Factor, samples from separate stockpiles can be combined in the same percentages as the job mix formula prior to further processing. The combined sample should be at least four times the amount required for a single test (i.e., IFCF determination).

c. Sieve the aggregate over all the specification sieves designated for class of mix being tested. Place the material retained on each sieve in separate containers.

d. Wash the separated aggregate samples, except the portion passing the #200 (0.075 mm) sieve, in accordance with WAQTC FOP for AASHTO T 27/11.

e. Dry the washed, aggregate samples to constant mass.

f. Recombine the aggregate samples to match the grading of the job mix formula. The sample size as determined by the specific test procedure performed.
# Performance Exam Checklist

**Method of Preparation of Aggregate for ACP Mix Designs**  
**WSDOT Test Method T 724**

<table>
<thead>
<tr>
<th>Participant Name</th>
<th>Exam Date</th>
</tr>
</thead>
</table>

## Procedure Element

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure, and if required,</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>has the current calibration/verification tags present?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Representative sample(s) of the production aggregates obtained per AASHTO T2?</td>
<td>☐</td>
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<tr>
<td>4. Aggregate dried in an oven to a constant mass?</td>
<td>☐</td>
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<tr>
<td>5. Aggregate sieved over designated sieves for class of mix being tested?</td>
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<tr>
<td>6. Material retained on each sieve placed in separate containers?</td>
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<tr>
<td>7. Separated aggregates washed, except the portion passing the No. 200 (0.075mm)</td>
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<tr>
<td>sieve, in accordance with POP for AASHTO T27/T11?</td>
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<tr>
<td>8. Washed aggregate samples dried in an oven to a constant mass?</td>
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<tr>
<td>9. Aggregate recombined to match the grading of the job mix formula?</td>
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<tr>
<td>10. Sample size determined by the specific test procedure to be performed?</td>
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</tr>
</tbody>
</table>

First attempt:  Pass ☐  Fail ☐  
Second attempt: Pass ☐  Fail ☐  

Signature of Examiner ________________________________

**Comments:**

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
WSDOT Test Method T 726

Mixing Procedure for Asphalt Concrete

1. SCOPE

This is the mixing procedure for laboratory prepared specimens of asphalt concrete, asphalt treated base, or open graded asphalt products. The aggregates used in this procedure are prepared by means of WSDOT Test Method No. 724.

2. EQUIPMENT

   a. Mixing Spoon — A large metal spoon capable of handling hot mix asphalt.
   b. Scoop — A metal scoop of ample size, capable of handling hot mix asphalt.
   c. Curing Pan — A heat resistant pan of ample size to handle samples of hot mix asphalt.
   d. Mixing Bowl — A heat resistant bowl for hand mixing or mechanical mixer of ample size to handle samples of hot mix asphalt.
   e. Mechanical Mixer — A mechanical mixer with heat source may be used in lieu of hand mixing.
   f. Balance — The balance shall have capacity of 11 kg and sensitive to 0.1 gm.
   g. Oven — An oven of appropriate size, capable of maintaining a uniform temperature within the allowable tolerance for the grade of asphalt.

3. PROCEDURE

   a. Place samples of aggregate in oven preheated to mixing temperature specified from supplier of asphalt binder or as indicated on mix design report for at least 2 hours.
   b. Heat asphalt and mixing bowl(s) to mix temperature specified from supplier of asphalt binder or as indicated on mix design report.
   c. Stir the asphalt binder and verify that the temperature of asphalt binder is within the temperature recommended by the asphalt supplier or as indicated on mix design report.
   d. After materials are heated place mixing bowl on balance and tare.
   e. Place heated aggregate in mixing bowl.
   f. Form a crater in the aggregate and weigh in asphalt in accordance with design information, see calculation below.

       Note: If mixing bowl is not buttered an additional sample should be prepared, mixed and then discarded to properly coat the mixing bowl with asphalt and fines.
   g. Mix aggregate and asphalt for approximately 3 minutes or until aggregate is completely coated with asphalt. This can be accomplished by hand mixing or by mechanical mixer.
   h. Transfer mixed material to the labeled heat resistant pan for curing or other testing as required.
   i. Repeat steps A thru H for each sample to be mixed.
Calculation for Mass of Liquid Asphalt:

Designated Mass of Asphalt = \frac{(A) D}{(1 - A)}

Where: \ A = \text{Designated asphalt content (expressed in decimal)}
\ D = \text{dry aggregate mass (from step 3(c))}

Example:
The designated asphalt content is 5.3%, and dry aggregate mass is 1567.1 grams.

Designated Mass of Asphalt = \frac{(0.053)1567.1}{(1 - 0.053)} = \frac{83.1}{0.947} = 87.7g
### Performance Exam Checklist

**Mixing Procedure for Asphalt Concrete**  
*WSDOT Test Method T 726*

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Test</th>
<th>Retest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure, and if required,</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>has the current calibration/verification tags present?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Aggregate samples prepared as per WSDOT Test Method T724?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. Mixing bowl(s), aggregate and asphalt binder heated to appropriate</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>mixing temperature?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Asphalt binder stirred and temperature confirmed by thermometer?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. Heated mixing bowl and paddle placed on scale and scale then tared?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7. Heated aggregate sample placed in bowl and scale then tared?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8. Crater formed into center aggregate, weigh in asphalt binder in</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>accordance with mix design information?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Mix aggregate and asphalt for approximately 3 minutes or until</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>aggregate is completely coated?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. When mixing is complete carefully scrape off mixing apparatus,</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>tools and bowl is dumped into correctly marked pan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Repeat steps 4 - 8 for each sample to be mixed?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12. All calculations performed correctly?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

First attempt: Pass ☐ Fail ☐  
Second attempt: Pass ☐ Fail ☐

Signature of Examiner ____________________________________________

Comments:

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WSDOT Standard Operating Procedure SOP 728

Method for Determining the Ignition Furnace Calibration Factor (IFCF) for Hot Mix Asphalt (HMA)

1. SCOPE

This method may be affected by the type of aggregate in the mixture. Accordingly, to optimize accuracy, a calibration factor will be established with the testing of a set of HMA calibration samples for each mix type. This procedure must be performed before any acceptance testing is completed.

The calibration process should be repeated each time there is a significant change in the mix ingredients or design.

2. APPARATUS

a. Equipment as described to perform AASHTO T 308 Method A.

3. SAMPLE PREPARATION

a. Prepare a minimum of two HMA calibration samples in accordance with WSDOT Test Method No. 724 and No. 726 or use previously prepared HMA calibration samples.

b. If the HMA calibration samples are not sufficiently soft to separate for testing, carefully heat the samples in an oven until sufficiently soft and no appreciable moisture exists, not to exceed 325 ± 25 °F (163 ± 14 °C). Do not heat the sample basket assemblies.

4. PROCEDURE

a. Test two HMA calibration samples in accordance with AASHTO T 308.

b. Determine the measured asphalt contents for each sample from the printed tickets.

c. If the difference between the measured asphalt contents of the two samples exceeds 0.15 percent, test two additional HMA calibration samples. From the four tests, discard the high and low results and determine the IFCF from the two remaining results. Calculate the difference between the actual and measured asphalt contents for each sample. The IFCF is the average of the differences expressed in percent by mass of the asphalt mixture.
WSDOT Standard Operating Procedure SOP 729

In-Place Density of Bituminous Mixes Using the Nuclear Moisture-Density Gauge
FOP for WAQTC TM 8

NUMBER AND LOCATIONS OF NUCLEAR TESTS

Control lots representing 400 tons (400 metric tones) or less of mix shall be established. Nuclear gauge tests for compaction control during paving construction shall be taken at a minimum of five locations per control lot. The locations will be picked at random by WSDOT Test Method No. 716.

MAXIMUM DENSITY DETERMINATION FOR PAVEMENT COMPACTION CONTROL

a. Maximum Density is to be determined daily per FOP for T209, or at shift change for continual paving projects, at the Field Lab, on the first mix sample taken in accordance with the sampling plan (i.e., random number).

b. On the initial day of production of a new Job Mix Formula, two determinations shall be made to establish an initial average value. Sample at the beginning of production and with the first mix test of the day. The Maximum Density value from the Mix Design shall not be included in this average.

c. If the two Maximum Densities determined on the initial day do not agree within 48 kg/m\(^3\) (3.0 lb./ft.\(^3\)), a third determination shall be made. The average density shall be based on the two closest set of results.

d. The Running Average is defined as the sum of the last five Maximum Density values divided by 5. Until five Maximum Density values have been determined the running average will be the average of however many tests are used.

e. Subsequent Daily determinations shall be compared with previous data (the previously computed running average). If the Daily test deviates from the Running Average by more than 3.0 lb./ft.\(^3\) (± 48 kg/m\(^3\)), a second determination shall be made on another portion of the same sample. If the second test confirms (agrees within ± 48 kg/m (3.0 lb./ft.\(^3\))) the first test a new running average will be initiated, discarding all previous results. If the second test agrees with (within 3.0 lb./ft.\(^3\) (± 48 kg/m\(^3\))) of the running average then the first test will be discarded and the second test will be included in the running average.

f. Ongoing changes or revisions to the Job Mix Formula do not require a revision or new start for the running average unless the result varies by more than 3.0 lb./ft.\(^3\) (± 48 kg/m\(^3\)).
ACCEPTANCE

a. For acceptable compaction, nuclear gauge test results for the control lot shall be determined by WAQTC FOP for TM8, as required by current specifications or contract plans.

b. The percent compaction equals the average of two inplace nuclear gauge wet density readings in accordance with TM8, times the gauge correlation factor divided by the current average “Rice” density multiplied by 100.

\[
\text{percent compaction} = \frac{(WD) \times (CF)}{\text{Avg. Gmm}} \times 100
\]

WD = average of two inplace nuclear gauge wet density readings in accordance with TM8.

CF = gauge correlation factor.

Average Gmm = Avg. “Rice” Density
WSDOT Standard Operating Procedure SOP 730

Correlation of Nuclear Gauge Determined Densities With Asphalt Concrete Pavement Cores

1. Gauge-core correlation shall be required for statistical evaluation of degree of asphalt compaction.
   a. For each combination of gauge and initial job mix formula.
   b. For direct transmission and for back scatter modes (when used).
   c. For a change in direct transmission probe depth.

2. A new gauge-core correlation is not required.
   a. For different contracts if JMF and gauge are the same.
   a. For a change in bases (i.e., surfacing to overlay).
   a. When the job mix formula has been adjusted in accordance with Section 9-03.8(6)A of the Standard Specifications.

3. Gauge correlation is based on 10 density determinations and 10 cores taken at corresponding locations. Gauge densities shall be determined on the day of paving. Cores should be taken no later than the day following paving and before traffic has been allowed on roadway. The sites for correlation cores do not have to be record density core sites and therefore consideration should be given to selecting sites out of the travel way.

4. Obtain a pavement core from each of the test sites. The core should be taken between the two nuclear gauge footprints. If direct transmission was used, locate the core at least 1 in. (25 mm) away from the edge of the drive pin hole.

5. Core densities shall be determined in conformance with AASHTO T 166 Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens or AASHTO 275 Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens.

6. Correlation factor shall be determined using Standard Form 350-112: Correlation Nuclear Gauge to Core Density, or other comparable forms.
WSDOT Standard Operating Procedure SOP 731

Method for Determining Volumetric Properties of Asphalt Concrete Pavement Class Superpave

1. SCOPE

This procedure covers the determination of volumetric properties of Asphalt Concrete Pavement Class Superpave i.e. Air Voids (Va), Voids in Mineral Aggregate (VMA), Voids Filled with Asphalt (VFA), and Dust to Binder Ratio ($P_{200}/P_{be}$).

2. REFERENCES

a. TM 6, WAQTC FOP for Moisture content of Bituminous Mixtures by Oven
b. T27/11, WAQTC FOP for AASHTO for Sieve Analysis of Fine and Coarse Aggregates and for Materials Finer Than No. 200 (0.075mm) in Mineral Aggregates by Washing
c. T 166, WSDOT FOP for AASHTO for Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
d. T 168, WSDOT FOP for AASHTO for Sampling of Bituminous Paving Mixture
e. T 209, WSDOT FOP for AASHTO FOP for Maximum Specific Gravity of Bituminous Paving Mixtures “Rice Density”
f. T 308, WSDOT FOP for AASHTO FOP for Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
g. T 312, WSDOT FOP for AASHTO for Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
h. T 712, WSDOT Test Method for Standard Method of Reducing Bituminous Paving Mixtures

3. CALIBRATION OF COMPACTOR

a. The gyratory compactor will be calibrated in accordance with WSDOT VP-58 and according to the manufacturer’s established calibration procedure. Anytime the gyratory compactor is moved to a new testing site a new calibration is required in accordance with WSDOT VP-58.

4. TEST SAMPLES

a. All test samples shall be obtained per WSDOT FOP for AASHTO T 168, and reduced in accordance with WSDOT Test Method No. 712. It is recommended that the gyratory test sample be the first sample acquired in order to minimize heat loss.

b. The size of the gyratory sample shall be such that it will produce a compacted specimen 115.0 ± 5.0 mm in height. Generally, 4750 to 4850 grams is adequate.

c. Place the gyratory sample in an oven set no more than 25º F above the compaction temperature (Note 1) as soon as possible to reduce sample cooling. The gyratory test is temperature sensitive, so the sample should only be heated until it achieves the compaction temperature.
Note 1: The compaction temperature for each mix design can be found on the mix design report. Any change in compaction temperature must be confirmed by the temperature viscosity chart provided by the asphalt supplier, which can be obtained from the paving Contractor.

5. PROCEDURE

a. Place a compaction mold, base plate, and top plate (if required), in an oven set at no more than 25º F above compaction temperature (Note 2) for a minimum of 60 minutes prior to the estimated beginning of compaction.

Note 2: Never heat any gyratory compactor mold in excess of 350º F.

b. Place a thermometer into the center of the mix, do not stir the mixture. (Note 3) Compact the sample immediately upon achieving compaction temperature.

Note 3: While the gyratory test sample is heating it is beneficial to prepare and/or run the other tests as times permits.

c. Perform the sample compaction in accordance with WSDOT FOP for AASHTO T312 section 9.

d. Determine Rice Density per WSDOT FOP for AASHTO T 209.

e. Determine asphalt content and gradation per WSDOT FOP for AASHTO T 308 and WSDOT FOP for T27/11.

f. Determine moisture content per WAQTC FOP for TM 6.

g. Allow the gyratory compacted specimen to cool at room temperature for 15 to 24 hours. Determine the Bulk Specific Gravity (Gmb) of the specimen in accordance with WSDOT FOP for AASHTO T 166 Method A.

6. VOLUMETRIC CALCULATIONS

a. Calculate %Gmm @Ndesign as follows:

\[
%G_{mm}@N_{design} = \frac{G_{mb}}{G_{mm}} \times 100
\]

Example:

\[
%G_{mm}@N_{design} = \frac{2.383}{2.493} \times 100 = 95.6\%
\]

Where:

%G_{mm}@N_{design} = % Theoretical Maximum Specific Gravity @ N_{design}

G_{mb} = bulk specific gravity of the compacted specimen

G_{mm} = maximum specific gravity of the paving mixture (Rice)

N_{design} = Number of design gyrations
b. Calculate \( \%G_{\text{mm initial}} \) as follows:
\[
\%G_{\text{mm initial}} = 100 \times \left( \frac{G_{\text{mb}}h_d}{G_{\text{mm}}h_i} \right)
\]
Example:
\[
\%G_{\text{mm initial}} = 100 \times \left( \frac{2.383 \times 110.0}{2.493 \times 123.1} \right) = 85.4\%
\]
Where:
\( %G_{\text{mm initial}} \) = % Theoretical Maximum Specific Gravity @ \( N_{\text{initial}} \)
\( h_d \) = height of specimen at design gyration level
\( h_i \) = height of specimen at initial design gyration level
\( N_{\text{initial}} \) = # of initial gyrations

c. Calculate Air Voids (\( V_a \)) as follow:
\[
V_a = 100 \times \left( 1 - \frac{G_{\text{mb}}}{G_{\text{mm}}} \right)
\]
Example:
\[
V_a = 100 \times \left( 1 - \frac{2.383}{2.493} \right) = 4.4\%
\]
Where:
\( V_a \) = percent air voids

d. Calculate Voids in Mineral Aggregate (VMA) as follows:
\[
VMA = 100 \times \left( 1 - \frac{G_{\text{mb}}P_s}{G_{\text{sb}}} \right)
\]
Example:
\[
VMA = 100 \times \left( 1 - \frac{2.383 \times 0.948}{2.630} \right) = 14.1\%
\]
Where:
\( P_s \) = percent of aggregate in the mix in decimal form
\( G_{\text{sb}} \) = bulk specific gravity of the combined aggregate
VMA = Voids in Mineral Aggregate, percent
e. Calculate Voids Filled with Asphalt (VFA) as follows:

\[ VFA = 100 \times \left( \frac{VMA - V_a}{VMA} \right) \]

Example:

\[ VFA = 100 \times \left( \frac{14.1 - 4.4}{14.1} \right) = 68.8\% \]

Where:

VFA = Voids Filled with Asphalt, percent

f. Calculate Gravity Stone Effective (G\textsubscript{se}) as follows:

\[ G_{se} = \frac{100 - P_b}{\left( \frac{100}{G_{mm}} - \frac{P_b}{G_b} \right)} \]

Example:

\[ G_{se} = \frac{100 - 5.2}{\left( \frac{100}{2.493} - \frac{5.2}{1.025} \right)} = 2.706 \]

Where:

G\textsubscript{se} = Gravity Stone Effective (specific gravity of aggregates, excluding voids permeable to asphalt)

P\textsubscript{b} = The percent by mass of binder in the total mixture including binder and aggregate

G\textsubscript{b} = Gravity Binder

\textbf{Note 4:} G\textsubscript{b} is the specific gravity of the asphalt binder. It is imperative that current G\textsubscript{b} is used in the volumetric calculations. Any changes in the binder specific gravity must be confirmed by the temperature viscosity curve provided by the asphalt supplier, which can be obtained from the paving Contractor.
g. Calculate Percent Binder Effective ($P_{be}$) as follows:

$$P_{be} = - \left( P_s \times G_b \right) \left( \frac{G_{se} - G_{sb}}{G_{se} \times G_{sb}} \right) + P_b$$

Examples:

$$P_{be} = - (94.8 \times 1.025) \left( \frac{2.706 - 2.630}{2.706 \times 2.630} \right) + 5.2 = 4.2$$

Where:

$P_{be} =$ percent binder effective, the percent by mass of effective asphalt content minus the quantity of binder lost by absorption into the aggregate particles.

$P_s =$ percent aggregate in the mixture

$G_b =$ Gravity binder

$G_{se} =$ effective specific gravity of the aggregate

$G_{sb} =$ bulk specific gravity of the combined aggregate

$P_b =$ percent binder

h. Calculate dust-to-binder ratio ($P_{200}/P_{be}$) as follows:

$$P_{200}/P_{be} = \frac{P_{200}}{P_{be}}$$

Example:

$$P_{se} = (94.8 \times 1.025) \left( \frac{2.706 - 2.630}{2.706 \times 2.630} \right) + 5.2 = 4.2 \%$$

Where:

$P_{200}/P_{be} =$ dust-to-binder ratio

$P_{200} =$ percent of aggregate passing the No. 200 sieve

7. REPORT

Report asphalt content, gradation, and moisture content on WSDOT Form 350-560EF, and report volumetric properties on WSDOT Form 350-162 or other report approved by the State Materials Engineer.
WSDOT FOP for ASTM C 805

Rebound Hammer Determination of Compressive Strength of Hardened Concrete

1. SCOPE

This test method is not intended as an alternative for strength determination. If the proper method is used, by an experienced operator, it can be a useful tool in estimating strength. In some specifications it has been designated as a criteria for evaluating early strength gain for opening work to traffic. The procedure provided herein is in conformance with ASTM C 805. In case of any apparent conflicts the procedure from the referenced standard shall apply. It is recommended that the region is notified, or assistants with field testing.

2. EQUIPMENT

a. Use hammer type N for testing concrete in building and bridge construction.

b. Rebound hammers shall be serviced and verified/calibrated at least annually using a calibration anvil, semiannually if in heavy use. Interim checks against a newly-adjusted hammer are recommended.

c. Immediately after calibration a consistent object, such as a column or foundation should be tested and record the average readings. This item can now be used as a reference, in the same way as an anvil.

3. SELECTION OF TEST LOCATION

a. Vertical, formed surfaces of concrete structures are preferred.

b. Avoid form joints, honeycombs, raked surfaces, and porous areas. Avoid thin structural parts and specimens less than 4 in. (100 mm) thick.

4. PREPARATION OF TEST LOCATION

a. Before testing, remove any plasterwork or coating or the cement slurry from the top surface of the concrete.

b. Slightly uneven surfaces shall be smoothed by hand with the carborundum stone supplied with the hammer.

c. A minimum area of 6 in. (150 mm) in diameter will be ground to permit 10 test hammer impacts to be made on the mortar without hitting coarse aggregate particles.

d. With old concrete the excessively hard surface layer must be removed to a depth of about \( \frac{3}{8} \) in. (13 mm) For this work a high speed, hand-held, power grinder should be sufficient.

5. TESTING THE SPECIMEN

a. Lightly pressing on the head of the impact plunger, release the plunger and allow it to slide out of the housing.

b. Press the plunger against the point of the concrete surface to be tested, holding the hammer exactly at right angles to the surface being tested. Maintain pressure on the instrument and slowly increase the pressure on the housing to effect release of the plunger. Just before it disappears completely in the housing, the hammer is released.

This FOP is based on ASTM C 805-97
c. After the impact, the hammer mass rebounds by a certain amount which is indicated on the scale by the rider. Do not touch the push-button lock mechanism until after the hammer is released and has stabilized.

d. Estimate the rebound number on the scale to the nearest whole number and record the rebound number.

e. By simply removing the hammer from the spot tested, it is reset for a further test and at the same time the indication is canceled. The rider never returns quite to zero while the plunger is in its extended position.

f. Take ten readings from each test area. No two impact tests shall be closer together than 1 in. (25 mm). Examine the impression made on the surface after impact, and if the impact crushes or breaks through a near-surface air void disregard the reading and take another reading.

g. After having finished the tests, the plunger is locked in its rear position by means of the push-button. Locking should always be done after releasing the impact, with the plunger still inside the housing. The lock also serves for fixing the rebound reading after impact tests in dark or not easily accessible locations.

6. CALCULATION OF REBOUND NUMBERS AND INTERPRETATION OF REBOUND VALUES

a. Discard readings differing from the average of 10 readings by more than 6 units and determine the average of the remaining readings. If more than two readings differ from the average by six units, discard the entire set of readings and determine rebound numbers at 10 new locations within the test area.

b. Converting the rebound number to estimated compressive strength (psi) (Mpa) shall be done after calculating the average of at least ten readings. Compute the average reading of the ten values accumulated. Convert this reading to estimated compressive strength using the calibration scale on the side of the hammer.

c. The test hammer is calibrated for horizontal impact direction, for testing vertical surfaces. On the side of the test hammer there is a label showing the curves used to convert rebound values to estimated compressive strength. If you are testing a vertical surface you use the 0° scale.

d. When using it on inclined or horizontal surfaces, the rebound value must be corrected. To correct the reading for an inclination angle, testing in an upwards direction use the +45° or +90° curves, testing downwards use the −45° or −90° curves. The direction of impact, horizontal, downward or upward must be the same for readings to be compared, unless a correction factor is established.
7. REPORTING TEST INFORMATION
   All of the following should be recorded, if known:
   
   Date and time of testing.
   Identification of location tested in the concrete construction and the type and size of member tested.
   Design strength of concrete tested.
   Surface characteristics.
   If the surface was ground and depth of grinding for older (+/yr) concrete.
   Type of form material used.
   Curing conditions and type of exposure to the environment.
   Hammer identification, serial number, and date of last calibration/verification.
   Air temperature at the time of testing.
   Orientation of hammer during test.
   Individual rebound test readings and average rebound number for each area tested.
   Remarks regarding discarded readings or unusual conditions.

8. OTHER FACTORS THAT MAY AFFECT TEST RESULTS
   Concrete at 32°F (0°C) or less may exhibit high rebound values, as will near surface coarse aggregate. The temperature of the hammer itself may affect the rebound number. Rebound hammers at 0°F (−22°C) may exhibit lower readings. A lightweight aggregate mix may also show lower readings.

9. REFERENCED DOCUMENTS
   ASTM Standard C805-94.
   Operating instructions, Schmidt Concrete Test Hammer.
Performance Exam Checklist

*Rebound Hammer Determination of Compressive Strength of Hardened Concrete*

FOP For ASTM C 805

<table>
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<tr>
<th>Procedure Element</th>
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<tbody>
<tr>
<td>1. Copy of current procedure available at test site?</td>
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</tr>
<tr>
<td>2. Hammer properly serviced and calibrated or verified?</td>
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<tr>
<td>3. Test location properly prepared?</td>
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<tr>
<td>4. Test location meets minimum size requirement?</td>
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<tr>
<td>5. Ten acceptable readings taken in each test area?</td>
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<td>6. Readings properly spaced in test area?</td>
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</tr>
<tr>
<td>7. Test readings properly converted to estimated strength?</td>
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<td>8. Test information properly recorded?</td>
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<tr>
<td>9. All calculations performed correctly?</td>
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**Equipment**

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</thead>
<tbody>
<tr>
<td>10. Where required are calibration/verifications tags present on equipment used in this procedure?</td>
<td>☐</td>
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</tr>
<tr>
<td>11. All equipment functions according to the requirements of this procedure?</td>
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<td>☐</td>
</tr>
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</table>

First attempt:  Pass ☐  Fail ☐  Second attempt:  Pass ☐  Fail ☐

Signature of Examiner  __________________________________________

Comments:

________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
WSDOT Test Method T 807

Method of Operation of California Profilograph and Evaluation of Profiles

1. SCOPE
   a. The operation of the California Profilograph, the procedure used for determining the Profile Index from profilograms of pavements made with the Profilograph, and the procedure used to locate individual high points in excess of 0.3 in. (7.62 mm) are described in Parts I, II, and III, respectively, in this test method.

Part I

Operation of the California Profilograph

2. PROCEDURE
   a. Equipment
      The California Profilograph consists of a frame 25 LF (7.62 m) long supported upon multiple wheels at either end arranged in a staggered pattern such that no two wheels cross the same bump at the same time. The profile is recorded from the vertical movement of a wheel attached to the frame at midpoint and is in reference to the mean elevation of the 12 points of contact with the road surface established by the support wheels (see Figure 1). The profilogram is recorded on a scale of 1 in. = 25 LF (25 mm = 7620 mm) longitudinally and 25 mm = 25 mm (or full scale) vertically. Motive power is provided manually.
   b. Operation
      The instructions for assembling the Profilograph are contained in a booklet accompanying each unit. Particular attention should be paid to the listed precautions.

      In operation, the Profilograph should be moved at a speed no greater than a walk so as to eliminate as much bounce as possible. Too high a speed will result in a profilogram that is difficult to evaluate.

      Calibration of the Profilograph should be checked periodically. The horizontal scale can be checked by running a known distance and scaling the result on the profilogram. If the scale is off, the profile wheel should be changed to one of a proper diameter. The vertical scale is checked by putting a board of known thickness under the profile wheel and again scaling the result on the profilogram. If the scale is off, the cause of the incorrect height should be determined and corrected.
3. **PROCEDURE**

a. **Equipment**

To determine the Profile Index, use a plastic scale 1.70 LF (43.18 mm) wide and 1.70 in. (536.45 mm) long representing a pavement length of 528 LF (161 m) at a scale of 25 mm = 7.62 m a plastic scale for the Profilograph may be obtained by the districts from the OSC Materials Laboratory. Near the center of the scale is an opaque band 0.2 in. (5.1 mm) wide extending the entire length of 21.12 in. (536.45 mm). On either side of this band are scribed lines 0.1 in. (2.54 mm) apart, parallel to the opaque band. These lines serve as a convenient scale to measure deviations or excursions of the graph above or below the blanking band. These are called “scallops.”

b. **Method of Counting**

Place the plastic scale over the profile in such a way as to “blank out” as much of the profile as possible. When this is done, scallops above and below the blanking band usually will be approximately balanced. See Figure 2.

The profile trace will move from a generally horizontal position when going around super-elevated curves making it impossible to blank out the central portion of the trace without shifting the scale. When such a condition occurs, the profile should be broken into short sections and the blanking band repositioned on each section while counting as shown in the upper part of Figure 3.

Starting at the right end of the scale, measure and total the height of all the scallops appearing both above and below the blanking band, measuring each scallop to the nearest 0.05 in. (1.27 mm) (half a tenth). Write this total on the profile sheet near the left end of the scale together with a small mark to align the scale when moving to the next section. Short portions of the profile line may be visible outside the blanking band but unless they project 0.03 in. (0.762 mm) or more and extend longitudinally for 2 LF (610 mm) (0.8 in. (2 mm) on the profilogram) or more, they are not included in the count. (See Figure 2 for illustration of these special conditions.)

When scallops occurring in the first 0.1 mile (161 m) are totaled, slide the scale to the left, aligning the right end of the scale with the small mark previously made, and proceed with the counting in the same manner. The last section counted may or may not be an even 0.1 mile (161 m). If not, its length should be scaled to determine its length in kilometers. An example follows:

<table>
<thead>
<tr>
<th>Section length, miles (km)</th>
<th>Counts, tenth of an in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10 (0.16)</td>
<td>5.0</td>
</tr>
<tr>
<td>0.10 (0.16)</td>
<td>4.0</td>
</tr>
<tr>
<td>0.10 (0.16)</td>
<td>3.5</td>
</tr>
<tr>
<td>400 ft. = 0.076</td>
<td>2.0</td>
</tr>
<tr>
<td>Total</td>
<td>14.5</td>
</tr>
</tbody>
</table>

The Profile Index is determined as “inches per mile in excess of the 0.2 in. (5.1 mm) blanking band” but is simply called the Profile Index. The procedure for converting counts of Profile Index is as follows:
Using the figures from the above example:

Length = 0.376 mi. (0.605 km), total count = 14.5 tenths of an inch

Profile Index = \[ \frac{1 \text{ mi. (1 km)}}{\text{length of profiles in miles (km)}} \times \text{a total count in mm} \]

PrI = \[ \frac{1 \text{ mi. (1 km)}}{0.376 \text{ mi. (0.605 km)}} \times 1.45 = 3.9 \]

(Note that the formula uses the count in inches rather than tenths of a inch and is obtained by dividing the count by ten.)

The Profile Index is thus determined for the profile of any line called for in the specifications.

To determine the daily profile index to check the Contractors methods and procedures, profile indexes may be averaged for two or more profiles of the same section of road if the profiles are the same length.

Example:

<table>
<thead>
<tr>
<th>Section length, mi. (km)</th>
<th>Counts, tenths of an inch</th>
<th>Left wheel track</th>
<th>Right wheel track</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.26 (0.10)</td>
<td></td>
<td>5.0</td>
<td>4.5</td>
</tr>
<tr>
<td>0.26 (0.10)</td>
<td></td>
<td>4.0</td>
<td>5.0</td>
</tr>
<tr>
<td>0.26 (0.10)</td>
<td></td>
<td>3.5</td>
<td>3.0</td>
</tr>
<tr>
<td>400 LF = 0/0 mi. (0.076)</td>
<td></td>
<td>2.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Total</td>
<td>0.376</td>
<td>14.5</td>
<td>14.0</td>
</tr>
</tbody>
</table>

PrI (by formula) = \[ \frac{3.9 + 3.7}{2} = 3.8 \]

Averages = \[ \frac{3.9 + 3.7}{2} = 3.8 \]

The specifications state which profiles to use when computing the average Profile Index for control of construction operations.

c. Limitations of Count in 0.1 mi. (0.1 km) Sections

When the specifications limit the amount of roughness in “any one-tenth mile section,” the scale is moved along the profile and counts made at various locations to find those sections if any, that do not conform to specifications. The limits are then noted on the profile and can be later located on the pavement preparatory to grinding.

d. Limits of Counts — Joints

When counting profiles, a day’s paving is considered to include the last portion of the previous day’s work, which includes the daily joint. The last 15 to 30 LF (4.57 to 9.14 m) of a day’s paving cannot usually be obtained until the following day. In general, the paving contractor is responsible for the smoothness of joints if he places the concrete pavement on both sides of the joint. On the other hand, the contractor is responsible only for the pavement placed by him if the work abuts a bridge or a pavement placed under another contract. Profilograph readings when approaching such joints should be taken in conformance with current specifications.
EXAMPLE SHOWING METHOD OF DERIVING PROFILE INDEX FROM PROFILOGRAMS

Figure 2

21.12" = 0.1 Mile (Horiz. Scale of 1" = 25')

Total count for this 0.1 mile section is \(13\frac{1}{2}\) tenths of an inch, or 13.5 inches per mile.

TYPICAL CONDITIONS

- Scallop are areas enclosed by profile line and blanking band. (Shown crosshatched in this sketch)

SPECIAL CONDITIONS

- Small projections which are not included in the count.
- Rock or dirt on the Pavement. (Not counted)
- Double peaked scallop. (Only highest part counted)
Figure 3
Part III
Determination of High Points in Excess of 0.3 in. (7.62 mm)

4. PROCEDURE

a. Equipment

Use a plastic template having a line 1 in. (25.4 mm) long scribed on one face with a small hole or scribed mark at either end, and a slot 0.3 in. (7.62 m) from and parallel to the scribed line. See Figure 3. (The 1 in. (25.4 mm) line corresponds to a horizontal distance of 0.3 in. (7.62 m) on the horizontal scale of the profilogram.) The plastic template may be obtained from the Olympia Service Center Materials Laboratory.

b. Locating High Points in Excess of 0.3 in. (7.62 m).

At each prominent peak or high point on the profile trace, place the template so that the small holes or scribe marks at each end of the scribed line intersect the profile trace to form a chord across the base of the peak or indicated bump. The line on the template need not be horizontal. With a sharp pencil, draw a line using the narrow slot in the template as a guide. Any portion of the trace extending above this line will indicate the approximate length and height of the deviation in excess of 0.3 in. (7.62 m).

There may be instances where the distance between easily recognizable low points is less than 1 in. (25.4 mm) (30 LF (7.62 m)). In such cases, a shorter chord length shall be used in making the scribed line on the template tangent to the trace at the low points. It is the intent, however, of this requirement that the baseline for measuring the height of bumps will be as near 30 LF (7.62 m) (1 in. (25.4 mm)) as possible, but in no case to exceed this value. When the distance between prominent low points is greater than 0.3 in. (7.62 m) (1 in. (25.4 mm)), make the ends of the scribed line intersect the profile trace when the template is in a nearly horizontal position. A few examples of the procedure are shown in the lower portion of Figure 3.
1. SCOPE

This method covers the fabrication of 50-mm (2-in.) cube specimens for compressive strength testing of grouts and mortars.

2. EQUIPMENT

   a. Specimen Molds

   Specimen molds for the 50 mm (2 in.) cube specimens shall be tight fitting. The molds shall not have more than three cube compartments and shall not be separable into more than two parts. The parts of the molds, when assembled, shall be positively held together. The molds shall be made of hard metal not attacked by the cement mortar. For new molds, the Rockwell hardness number shall not be less than HRB 55. The sides of the molds shall be sufficiently rigid to prevent spreading or warping. The interior faces of the molds shall be plane with a permissible variation of 0.002 in. (0.05 mm) for new molds and 0.002 in. (0.50 mm) for molds in use. The distances between opposite faces shall be 2 ± 0.02 in. (50 ± 0.50 mm). The height of each compartment shall be 1.985 in. to 2.01 in. (49.62 mm to 50.25 mm). The angle between adjacent interior faces, and between interior faces and top and bottom planes of the mold, shall be measured at points slightly removed from the intersection of the faces, and shall be 90 ± 0.5 degrees.

   b. Base Plates

   Base plates shall be made of a hard metal not attacked by cement mortar. The working surface shall be plane and shall be positively attached to the mold with screws into the side walls of the mold.

   c. Cover Plates

   Cover plate shall be made of a hard metal or glass not attacked by cement mortar. The surface shall be relatively plane.

   d. Tamper

   The tamper shall be made of a nonabsorptive, nonabrasive, nonbrittle material such as a rubber compound having a Shore A durometer hardness of 80 ± 10, or seasoned oak wood rendered nonabsorptive by immersion for 15 minutes in paraffin at approximately 392°F (200°C), and shall have a cross-section of 1/2 in. × 1 in. (13 mm × 25 mm) and a length of about 5 to 6 in. (125 to 150 mm). The tamping face shall be flat and at right angles to the length of the tamper.

   e. Trowel

   A trowel which has a steel blade 4 to 6 in. (100 to 150 mm) in length, with straightedges.

3. FIELD PROCEDURE

   a. Three or more specimens shall be made for each period of test specified.

   b. Seal the surfaces where the halves of the mold join by applying a coating of light cup grease. The amount should be sufficient to extrude slightly when the halves are tightened together. Repeat this process for attaching the mold to the base plate. Remove any excess grease.
c. Apply a thin coating of release agent to the interior faces of the mold and base plate. (WD-40 has been found to work well as a release agent) Wipe the mold faces and base plate as necessary to remove any excess release agent and to achieve a thin, even coating on the interior surfaces. Adequate coating is that which is just sufficient to allow a distinct fingerprint to remain following light finger pressure.

d. The grout or mortar shall be mixed according to the manufacturer’s instructions. Begin molding the specimens within an elapsed time of not more than 2 1/2 minutes from completion of the mixing.

e. For plastic mixes, place a first layer of mortar about 1 in. (25 mm) deep in all the cube compartments (about one-half the depth of the mold). Tamp the mortar in each cube compartment 32 times in about 10 seconds making four rounds, each round perpendicular to the other and consisting of eight adjoining strokes over the surface of the specimen, as illustrated in Figure 1, below. The tamping pressure should be just sufficient to ensure uniform filling of the molds. The four rounds of tamping (32 strokes) shall be completed in one cube before going on to the next. When the tamping of the first layer is completed, slightly over fill the compartments with the remaining mortar and then tamp as specified for the first layer. During tamping of the second layer, bring in the mortar forced out onto the tops of the molds after each round of tamping, by means of gloved fingers and the tamper, before starting the next round of tamping. On completion of tamping, the tops of all the cubes should extend slightly above the tops of the molds.

![Figure 1](Rounds_1_and_3.png)  
![Figure 1](Rounds_2_and_4.png)
f. Bring in the mortar that has been forced out onto the tops of the molds with a trowel and smooth off the cubes by drawing the flat side of the trowel (with the leading edge slightly raised) once across the top of each cube at right angles to the length of the mold. Then, for the purpose of leveling the mortar and making the mortar that protrudes above the top of the mold of more uniform thickness, draw the flat trailing edge of the trowel (with leading edge slightly raised) once lightly along the length of the mold. Cut off the mortar to a plane surface flush with the top of the mold by drawing the straight edge of the trowel (held nearly perpendicular to the mold) with a sawing motion over the length of the mold.

g. When fabricating fluid mixes, steps e. and f. need not be followed. Instead, the cube mold is filled with mortar and cut off to a plane surface with a sawing motion over the length of the mold.

h. Immediately after molding, place cover plate on top of the mold, cover the sample with wet burlap, towels, or rags, seal it in a plastic sack in a level location out of direct sunlight, and record the time. Allow the sample to set undisturbed, away from vibration, for a minimum of four hours before moving.

i. Deliver the sample to the Regional or State Materials Laboratory in the mold within 24 hours. **Time of molding MUST be recorded on the Transmittal.** If delivery within 24 hours is unachievable, contact the Laboratory for instructions on caring for the cubes.

4. **LAB PROCEDURE:**

a. Once received in the lab, the molded sample is to be immediately placed in a moist curing room, with the upper surfaces exposed to the moist air but protected from dripping until the sample is a minimum of 20 hours old or has cured sufficiently that removal from the mold will not damage the cube. If the specimens are removed from the mold before they are 24 hours old they are to be kept on the shelves of the moist curing room until they are 24-36 hours old.

b. When the specimens are 24-36 hours old, immerse them in a lime-saturated water storage tank. (Note 1) The specimens are to remain in the storage tank until time of test. (Curing test specimens of material other than hydraulic cement shall be in conformance with the manufacturer’s recommendations.)

Note 1: The storage tank shall be made of noncorroding materials. The water shall be saturated with calcium hydroxide such that excess is present. Stir the lime-saturated water once a month and clean the bath as required by AASHTO M-201.
Performance Exam Checklist

*Field Method of Fabrication of 50-mm (2-in.) Cube Specimens for Compressive Strength Testing of Grouts and Mortars*

WSDOT Test Method T 813

<table>
<thead>
<tr>
<th>Participant Name</th>
<th>Exam Date</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. Three cubes made for each time period of test?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. All joints (mold halves, mold to base plate) sealed with light cup grease?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. Adequate coating of release agent applied to interior surfaces of the mold?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. Grout or mortar mixed according to manufacturer’s instructions?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7. Molding began within 2-1/2 minutes from completion of mixing?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8. Molding performed in two lifts? (not necessary if mix is fluid)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9. Lifts tamped 32 times, made up of 4 rounds of 8, each perpendicular to the other?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10. For second layer, mortar forced out of the mold brought back in before each round?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11. Mix extends slightly above the mold at the completion of tamping?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12. Mortar smoothed by drawing flat side of trowel across each cube at right angles?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13. Mortar leveled by drawing the flat side of trowel lightly along the length of mold?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14. Mortar cut off flush with mold with edge of trowel using sawing motion?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15. Time of molding recorded?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16. Cover plate placed on top of the mold and covered with wet burlap, towel or rag?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>17. Covered sample sealed in a plastic sack in a level location out of sunlight?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>18. Sample delivered to the laboratory in the mold within 24 hours?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>19. Transmittal includes the time of molding?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

First attempt: Pass ☐ Fail ☐                                                                                                                     Second attempt: Pass ☐ Fail ☐

Signature of Examiner ________________________________________________
WSDOT Test Method T 914

Practice for Sampling of Geotextiles for Testing

1. **SCOPE**
a. This practice covers a procedure for use in the division of shipments of geotextiles into lots and the sampling of lots for testing.

2. **DEFINITIONS**
a. Geotextile — Any permeable textile used with foundation, soil, rock, earth, or any other geotechnical material, as an integral part of a manmade product, structure, or system.
b. Lot — All geotextile rolls within a consignment (i.e., all rolls sent to the project site) which were manufactured at the same manufacturing plant having the same product name and specifications, style, or physical characteristics of a particular geotextile product.
c. Lot Sample — Sample(s) from one or more geotextile rolls taken at random to represent an acceptance sampling lot and used as a source of laboratory samples.
d. Production Unit — As referred to in this practice, it shall be considered to be synonymous with the geotextile roll as shipped by the manufacturer. Two or more geotextile rolls joined together by sewn seams shall be considered as separate rolls.
e. Minimum Average Roll Value — The test results of any sampled roll in a lot shall meet or exceed the minimum values specified.

3. **SUMMARY OF PRACTICE**
a. Instructions are given within this practice for dividing shipments or consignments of geotextiles into lots and for the determination of the number of production units in a lot sample.

4. **SIGNIFICANCE AND USE**
a. This sampling procedure will provide a representation of the lot which is adequate to establish minimum average roll values as defined by this practice.

5. **PROCEDURE**
a. Division into lots — Divide the shipment or consignment into lots as defined by 2.b. above.
b. Determination of lot sample size.
   (1) Take geotextile rolls for the lot sample. Consider the geotextile roll to be the primary sampling units.
   (2) Select at random the number of geotextile rolls from each lot for the lot sample corresponding to the total number of units in the lot, as shown in Table 1. If the lot as defined in this practice contains only a portion of a geotextile roll, the lot shall be considered to contain one production unit for the purpose of sampling.
c. Laboratory sample selection.
   (1) Obtain a laboratory sample from each geotextile roll in the lot sample. The minimum laboratory sample size shall be a minimum of 5 feet long by the full width of the geotextile roll. The laboratory sample must also contain a minimum area of 6.0 yd.² (5.0 m²) of geotextile.
(2) The laboratory sample should not be taken from the outer wrap of the roll nor the inner wrap of the core (i.e., do not take the sample from the geotextile at the very ends of the roll).

Table 1

<table>
<thead>
<tr>
<th>Number of Rolls in Lot</th>
<th>Number of Rolls to be Selected for Lot Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 24</td>
<td>1</td>
</tr>
<tr>
<td>25 to 49</td>
<td>2</td>
</tr>
<tr>
<td>50 to 99</td>
<td>3</td>
</tr>
<tr>
<td>100 to 125</td>
<td>5</td>
</tr>
<tr>
<td>125 to 216</td>
<td>6</td>
</tr>
<tr>
<td>217 to 343</td>
<td>7</td>
</tr>
<tr>
<td>344 to 512</td>
<td>8</td>
</tr>
<tr>
<td>513 to 729</td>
<td>9</td>
</tr>
<tr>
<td>730 to 1,000</td>
<td>10</td>
</tr>
</tbody>
</table>

6. SAMPLE SUBMITTAL

a. All geotextile samples submitted to the FOSSC Material Laboratory are to be prepared and shipped as follows:

Woven Geotextiles — Roll sample around a 4-in diameter minimum, tube such as PCV pipe or cardboard mailing tube and wrap to protect sample from shipping damage and ultraviolet light (UV) exposure.

Nonwoven Geotextiles — Fold sample to a minimum 2 ft x 2 ft (0.6 m x 0.6 m) square, or roll as for woven geotextile. Wrap or box sample for shipment to protect from shipping damage and ultraviolet (UV) light exposure.

b. If sample is for Acceptance of Lots used on project, the following information must be submitted with the sample:

(1) Manufacturer’s name and current address.
(2) Full product name.
(3) Geotextile roll number(s).
(4) Proposed geotextile use(s).
(5) Certified test results.
(6) The Lot Number being submitted for acceptance. In lieu of a manufacturer provided Lot Number, the Bill of Lading Number can be used.

Testing by the State Materials Laboratory will not begin until all of the required information is received.
Performance Exam Checklist

*Practice for Sampling Geotextiles for Testing*  
*WSDOT Test Method T 914*

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</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Sampling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Shipment or consignment divided into lots.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Determine the number of rolls in the shipment or consignment to be sampled from Table 1.</td>
<td></td>
<td></td>
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<tr>
<td>c. Rolls to be sampled selected at random.</td>
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</tr>
<tr>
<td>d. Samples are a minimum 1.5 yd. (1.37 m) long by the full width of the roll and a minimum of 6 sq yd (5 square meters).</td>
<td></td>
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</tr>
<tr>
<td>e. Sample does not include outer wrap or inner wrap of the roll.</td>
<td></td>
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</tr>
<tr>
<td>3. Shipment Preparation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Woven geotextiles must be rolled and shall not be folded.</td>
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<td></td>
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<tr>
<td>b. Non-woven geotextiles should be rolled or folded but not folded to less than a minimum of 2 feet square.</td>
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<tr>
<td>c. Wrap the sample (or box if folded) to protect from ultra-violet light exposure.</td>
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</tr>
<tr>
<td>4. Sample Transmittal Inclusions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Manufacturers name and current address (usually on the mfg. Cert).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Full product name (Style 4551, 180N, Geotex 801).</td>
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<td></td>
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<tr>
<td>c. Geotextile roll number.</td>
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<tr>
<td>d. Proposed use(s), include survivability and class if appropriate.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Certified test results, must include UV stability after 500 hours.</td>
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<td></td>
</tr>
<tr>
<td>f. Lot number assigned (can be the bill of lading number).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First attempt: Pass [ ] Fail [ ]  
Second attempt: Pass [ ] Fail [ ]

Signature of Examiner

________________________________________
WSDOT Test Method for ASTM C 939

Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)

This standard is issued under the fixed designation C 939; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (e) indicates an editorial change since the last revision or reapproval. This specification has been approved for use by agencies of the Department of Defense.

1. SCOPE

1.1 This test method covers a procedure, used both in the laboratory and in the field, for determining the time of efflux of a specified volume of fluid hydraulic cement grout through a standardized flow cone and used for preplaced-aggregate (PA) concrete; however, the test method may also be used for other fluid grouts.

1.2 It is for use with neat grout and with grouts containing fine aggregate all passing a No. 8 (2.36-mm) sieve.

1.3 This test method is intended for use with grout having an efflux time of 35 s or less.

1.4 When efflux time exceeds 35 s, flowability is better determined by flow table, found in Test Method C 109, using 5 drops in 3 s.

1.5 The values stated in SI units are to be regarded as the standard.

1.6 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1 ASTM Standards:

C 109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)

C 938 Practice for Proportioning Grout Mixtures for Preplaced-Aggregate Concrete

3. SUMMARY OF TEST METHOD

3.1 The time of efflux of a specified volume of grout from a standardized flow cone is measured.

4. SIGNIFICANCE AND USE

4.1 This test method is applicable to the determination of the fluidity of various fluid grout mixtures.

5. INTERFERENCES

5.1 The presence of solid particles retained on the No. 8 (2.36-mm) sieve or lumps of unmixed material in the grout may cause the grout to flow unevenly through the discharge tube of the flow cone or stop the flow completely. Uneven flow will result in slower transit of the grout, thereby indicating a false consistency.

1This Test Method is based on ASTM C 939-97.
6. APPARATUS

6.1 *Flow Cone*, with dimensions as shown in Figure 1. The discharge tube shall be stainless steel. The body can be stainless steel, cast aluminum, or other essentially noncorroding metal.

*Note 1:* Cones with high-density polyethylene bodies are acceptable for field use in situations where precision as described in this test method is not required.

6.2 *Receiving Container*, capacity 2000 mL, minimum.

6.3 *Ring Stand* or other device, capable of supporting the flow cone in a vertical, steady position over the receiving container.

6.4 *Level*, carpenter’s or similar.

6.5 *Stop Watch*, least reading of not more than 0.2 s.

6.6 *Grout Mixer*, conforming to Practice C 938.

7. TEST SAMPLE

7.1 The grout test sample shall be in excess of 1725 mL and shall be representative of the grout in the mixer.

7.2 When sampling and testing is being done for the purpose of proportioning or comparing mixes or for qualifying materials, the temperature of the dry materials and mixing water shall be such that the temperature of the freshly mixed grout is 73.4 ± 3°F (23 ± 1.7°C), unless otherwise specified.

8. CALIBRATION OF APPARATUS

8.1 Mount the flow cone firmly in such a manner that it is free of vibration. Level the top to assure verticality. Close the outlet of the discharge tube with a finger or a stopper. Introduce 1725 ± 5 mL of water into the cone. Adjust the point gage to indicate the level of the water surface. Then allow the water to drain.

8.2 Before first use of the flow cone with grout and periodically thereafter, check the accuracy of the cone by filling it with water as described in 8.1. After checking or adjusting the point gage, start the stop watch and simultaneously remove the finger. Stop the watch at the first break in the continuous flow of water. The time indicated by the stop watch is the time of efflux of water. If this time is 8.0 ± 0.2 s, the cone may be used for determining the time of efflux of grout.

9. PROCEDURE

9.1 Moisten the inside of the flow cone by filling the cone with water and, 1 min before introducing the grout sample, allow the water to drain from the cone. Close the outlet of the discharge tube with a finger or a stopper. Introduce the grout into the cone until the grout surface rises to contact the point gage, start the stop watch, and simultaneously remove the finger or stopper. Stop the watch at the first break in the continuous flow of grout from the discharge tube, then look into the top of the cone; if the grout has passed sufficiently, such that light is visible through the discharge tube, the time indicated by the stop watch is the time of efflux of the grout. If light is not visible through the discharge tube, then the use of the flow cone is not applicable for grout of this consistency. At least two tests having times of efflux within 1.8 s of their average shall be made for each grout mixture.
9.2 The test for time of efflux shall be made within 1 min of drawing of the grout from the mixer or transmission line. When grout is being placed over a significant period of time, the time of efflux may be determined at selected intervals to demonstrate that the consistency is suitable for the work.

10. REPORT

10.1 Report the following information:

10.1.1 Identification of sample,

10.1.2 Identification of materials in the sample, the proportions, and whether laboratory prepared or taken from the field production mix,

10.1.3 Average time of efflux to nearest 0.2 s and time interval from completion of mixing at which the test was made, and

Note 2: Other means of indicating grout level may be used as long as accurate indication of grout level on volume is obtained.

10.1.4 Temperature, ambient and of the sample at the time of test.

11. PRECISION AND BIAS

11.1 Precision — The following within-laboratory, multiple-operator precision applies. The single laboratory standard deviation has been found to be 0.88 s. Therefore, results from two properly conducted tests on the same material should not differ by more than 2.49 s.

11.2 Bias — No statement on bias can be prepared because there are no standard reference materials.

12. KEYWORDS

12.1 flow cone; grout; preplaced—aggregate concrete; time of efflux
# Performance Exam Checklist

**Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)**  
**FOP FOR ASTM C 939**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. Is the grout that is being tested a “fluid grout?”</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. Will the grout pass through a No. 8 (2.36 mm) sieve?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. Is the cone set level and vibration free?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. Is the grout test sample in excess of 1.8 quarts and representative of the grout being produced?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7. Is the grout being produced at the specified temperature (73.4 ± 3 F)?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8. Does the tester have a verified stopwatch capable measuring to a time of 0.2 sec.?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9. Was the water calibration performed prior to use and is there a record of the previous calibrations for this cone?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10. Was adjustment of the level indicator required?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Note:** The calibration with water of a volume of 1725 mL ± 5 mL is to be 8 seconds ± 0.2 seconds to be considered valid for acceptance.

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Was the cone filled with water a minute prior to introducing grout?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12. Water drained and cone outlet closed with a stopper/finger then grout introduced into the cone until the grout surface rises to contact the point gauge?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13. Stopwatch started as stopper/finger is removed and then stopped and then stopped at the first break in continuous flow is observed?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14. Immediately observe to see if discharge tube is clear and light is visible through it?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15. Repeat procedure and determine if the second observed flow rate is within 1.8 s of the average of the two flow rates.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Procedure Element</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>-----</td>
<td>----</td>
</tr>
<tr>
<td>16. Record the average time of efflux to the nearest 0.2 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. All calculations performed correctly?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First attempt: Pass ☐ Fail ☐</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second attempt: Pass ☐ Fail ☐</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Signature of Examiner __________________________________________________________

Comments:

__________________________________________________________________________
__________________________________________________________________________
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__________________________________________________________________________
Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base

1. SCOPE

1.1 These test methods cover the nondestructive measurement of the dry film thickness of nonmagnetic coatings applied over a ferrous base material using commercially available test instruments. The test methods are intended to supplement manufacturers’ instructions for the manual operation of the gages and are not intended to replace them. They cover the use of instruments based on magnetic measuring principles only. Test Method A provides for the measurement of films using mechanical magnetic pull-off gages and Test Method B provides for the measurement of films using magnetic electronic gages.

1.2 These test methods are not applicable to coatings that will be readily deformable under the load of the measuring instruments, as the instrument probe must be placed directly on the coating surface to take a reading.

1.3 The values given in SI units of measurement are to be regarded as the standard. The values in parentheses are for information only.

1.4 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. REFERENCED DOCUMENTS

2.1 ASTM Standards:
   - D 609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products
   - D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels

2.2 Steel Structures Painting Council Standard:
   - SSPC-PA2 Measurement of Dry Paint Thickness with Magnetic Gages

TEST METHOD A—MAGNETIC PULL-OFF GAGES

3. SUMMARY OF TEST METHOD

3.1 Instruments complying with this test method measure thickness by using a spring calibrated to determine the force required to pull a magnet from a ferrous base coated with a nonmagnetic film. The instrument must be placed directly on the coating surface to take a reading.

3.2 The attractive force of the magnet to the substrate varies inversely with the thickness of the applied film. The spring tension required to overcome the attraction of the magnet to the substrate is shown on the instrument scale as the distance (in mils or microns) between the magnet and the substrate.

4. SIGNIFICANCE AND USE

4.1 Many coating properties are markedly affected by the thickness of the dry film such as adhesion, corrosion protection, flexibility, and hardness. To be able to compare results obtained by different operators, it is essential to know film thickness.

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1 This FOP is based on ASTM D 1186-01

Washington State Department of Transportation
4.2 Most protective and high performance coatings are applied to meet a requirement or a specification for the dry-film thickness of each coat, or for the complete system, or both. Coatings must be applied within certain minimum and maximum thicknesses to fill their expected function. In addition to potential performance deficiencies, it is uneconomical to apply more material than necessary when coating large areas. This test method is used to measure film thickness of coatings on ferrous metals.

5. **APPARATUS**

5.1 *Permanent Magnet*, small, either attached directly to a coil spring (“pencil” gage) or to a horizontal lever arm that is attached to a helical spring (“dial-type” gage). Increasing force is applied to the magnet by extending the coil spring in the first case or turning a graduated dial that coils the helical spring in the second. The readings obtained are shown directly on the instrument scale.

5.2 *Coating Thickness Standards*, with assigned values traceable to national standards are available from several sources, including most manufacturers of coating thickness gages.

6. **TEST SPECIMENS**

6.1 When this test method is used in the field, the specimen is the coated structure or article on which the thickness is to be evaluated.

6.2 For laboratory use, apply the material to be tested to panels of similar roughness, shape, thickness, composition and magnetic properties on which it is desired to determine the thickness.

 **NOTE 1**—Applicable test panel description and surface preparation methods are given in Practice D 609.

 **NOTE 2**—Coatings should be applied in accordance with Practices D 823 or as agreed upon between the contracting parties.

7. **VERIFICATION OF CALIBRATION OF APPARATUS**

7.1 Different gage manufacturers follow different methods of calibration adjustment. Verify calibration according to manufacturer’s instructions.

7.2 The section of the type of standards used to verify calibration should be predicated upon which type provides the best and most appropriate calibration considering: type of gage, sample surface geometry, and contract requirements. Appendix X1 provides information helpful to making an informed selection of standards.

7.3 Following the manufacturer’s operating instructions, measure the thickness of a series of calibration standards covering the expected range of coating thickness. To guard against measuring with an inaccurate gage, recheck the gage at regular intervals. That interval should be set by agreement between contracting parties and maintained throughout the control process.

 **NOTE 3**—Generally “Dial-type” instruments can be used in any position, while “pencil-type” instruments may be used in the vertical position only unless they have separate indicators for the horizontal and vertical positions. Follow the manufacturer’s recommendations.

8. **PROCEDURE**

8.1 Use the instrument only after calibration has been verified in accordance with Section 7.

8.2 Ensure that the coating is dry prior to use of the instrument.
8.3 Inspect the probe tip and surface to be measured to ensure that they are clean. Adherent magnetic filings or other surface contaminants will affect gage readings.

8.4 Take readings in locations free of electrical or magnetic fields. The location should also be free of vibration when using mechanical magnetic pull-off instruments.

8.5 The accuracy of the measurement can be influenced when made within 25 mm (1 in.) of the edge or right angle in the sample.

8.6 Measure the coating, following the manufacturer’s instructions.

8.7 Verify calibration periodically to ensure that the instrument continues to read properly. If the instrument is found to be out of adjustment, remeasure the thicknesses taken since the last satisfactory calibration check was made.

8.8 Take a sufficient number of readings to characterize the surface.

8.8.1 For laboratory measurements, a recommended mini-mum is three for a 75 by 150-mm (3 by 6-in.) panel and more in proportion to size.

8.8.2 For field measurements, a recommended minimum is five determinations at random for every 10 m² (100 ft²) of surface area. Each of the five determinations should be the mean of three separate gage readings within the area of a 4-cm (1.5-in.) diameter circle.

8.9 Make measurements at least 13 mm (1/2 in.) away from any edge or corner of the specimen. If it is necessary to measure closer than 13 mm (1/2 in.), verify the effect (if any), the edge has on the measurement.

NOTE 4—For additional information describing the number of measurements to be taken on large structures, and on non-smooth surfaces, refer to SSPC PA-2.

9. REPORT

9.1 Report the following information:

9.1.1 Instrument used, serial number,

9.1.2 Range, and mean of the thickness readings, and

9.1.3 Depending upon the application, record the individual readings as well.

Report the information on the attached form.

Material represented by the test specimens when tested under this method and found to meet the specified minimum coating thickness may be accepted. Any specimens which does not meet the minimum coating thickness will not be retested using this test method. Samples of the material will be submitted to either the Eastern Region Consolidated Materials Laboratory or the State Material laboratory for referee testing in accordance with AASHTO T 65.
Field Report of Thickness of Nonmagnetic Coating on a Ferrous Base

Contract _________________ Bid Item No ________ Item ________________________________

Specimen No. _____________________________

Specification: ______________________ Coating Thickness Required _______________ (mils),(mm)

Surface area of test specimen __________________ m² (ft²)  Test represents ______________________

Instrument Serial No. ____________________________ Calibration Date _______________________

Tested by: _________________________________________________________ Date: ___/___/20___

<table>
<thead>
<tr>
<th>Reading No.</th>
<th>Test Location</th>
<th>Reading</th>
<th>Avg Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2</td>
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<td></td>
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<td>3</td>
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<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average

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Testing of coating thickness involves measuring the thickness of a coating on a ferrous base. The report includes information on the contract, bid item, item, specimen number, specification, coating thickness required, surface area of the test specimen, and other relevant details. The table provides readings taken at different locations, with an average calculation for the test results.
10. PRECISION AND BIAS

10.1 A new round-robin study was performed recently. Data are being analyzed statistically. When completed, the required “Repeatability and Reproducibility” sections of this test method will be written and the round-robin study documented in an ASTM research report.

10.2 Bias—The bias for Test Method A of this standard for measuring dry film thickness cannot be determined because each instrument has its own bias.

TEST METHOD B—ELECTRONIC GAGES

11. SUMMARY OF TEST METHOD

11.1 Instruments complying with this test method measure thicknesses by placing a probe on the coated surface and use electronic circuitry to convert a reference signal into coating thickness.

11.2 Instruments of this type determine, within the probe or the instrument itself, changes in the magnetic flux caused by variations in the distance between the probe and the substrate.

12. APPARATUS

12.1 The testing apparatus shall be an electrically operated instrument utilizing a probe that houses a permanent magnet or coil energized by alternating current that is placed directly on the surface. The coating thickness is shown on the instrument’s display.

12.2 Coating thickness standards with assigned values traceable to national standards are available.

13. TEST SPECIMENS

13.1 See Section 6.

14. CALIBRATION OF APPARATUS

14.1 See Section 7.

15. PROCEDURE

15.1 See Section 8. Exclude steps 8.5 and 8.7.

16. REPORT

16.1 See Section 9.

17. PRECISION AND BIAS

17.1 Precision—See Section 10.

17.2 Bias—The bias for Test Method B of this standard for measuring dry film thickness cannot be determined because each instrument has its own bias.

18. KEYWORDS

18.1 coating thickness; dry film thickness; magnetic gages; nondestructive thickness; paint thickness

APPENDIX

X1. CHARACTERISTICS AFFECTING GAGE READINGS

X1.1 It is always good practice to ensure the reliability of gage readings by performing a verification test periodically, either before or after critical determinations. This practice ensures that, not only is the gage reading correct, but also that it is correctly calibrated to provide maximum accuracy of readings on the sample. Not all applications require this level of certainty so, while suggested, the inclusion of this practice is up to the contacting individuals to decide on implementation.
X1.2 Certain characteristics of samples may affect the accuracy of the calibrations. These include, but may not be limited to:

X1.2.1 Surface profile of the substrate (roughness),  
X1.2.2 Surface profile of the coating,  
X1.2.3 Thickness of the substrate,  
X1.2.4 Geography of the sample surface (curves with small radii, small diameters, complex curves, etc.), and  
X1.2.5 Any characteristic that affects the magnetic or eddy current permeability of the substrate or coating, such as residual magnetism, or lack of homogeneity of magnetic characteristics.

X1.3 Calibration done on smooth, polished standards ensure that a gage can be properly calibrated, and that calibration is appropriate for any measurements on samples of the same characteristics, but it may not be the best for measurements of samples that differ from the calibration materials. When possible, verification should be done on samples of known thickness of coating applied to substrates as similar as possible to the sample to be tested.

X1.4 It is not practical to provide known thickness standards for all possible sample configurations. An alternative method is to verify calibration on a bare substrate as similar as possible to the sample, using a nonmagnetic metal foil, plastic shim or film of known thickness to simulate a coating.

X1.5 In using this verification of calibration method, it is necessary to be aware of additional characteristics that can affect the measured values. Plastic or brass shim stock typically has an inherent curve. This curve can act as a leaf spring and cause a magnetic pull-off gage to be “pushed” off the surface prematurely, resulting in an incorrect reading.

X1.6 With some materials and thickness, it is possible that the shim will not lie flat, which will also cause an erroneous reading. Various techniques exist to minimize this effect, such as mounting the shim in a holder that maintains tension on the shim to eliminate the tendency of the shim to curve.

X1.7 Other factors experienced with plastic shims, which are not usually present with painted or plated calibration standards include (but are not limited to):

X1.7.1 Permanent creases in the shim due to folding,  
X1.7.2 Air entrapment between the shim and substrate,  
X1.7.3 Distortion due to environmental conditions, such as temperature, and  
X1.7.4 Shim thickness inconsistency due to the pressure of the probe tip. This may be a permanent “dimple” in the shim.

X1.8 Even with these factors affecting potential accuracy of plastic shims, in many applications, verification of calibration using plastic shims on the sample to be measured, can be a more appropriate (accurate) calibration than using plated or painted standards.

X1.9 No matter what standards are used, they should be periodically verified to ensure the assigned value is correct. Even metal coated on metal can wear or be damaged to an extent that readings are affected.
## Performance Exam Checklist

**Nondestructive Measurement of Thickness of Nonmagnetic Coatings on a Ferrous Base**  
**FOP For ASTM D 1186**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Test</th>
<th>Retest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. Instrument calibrated in accordance with the manufacturer’s instructions before use employing a suitable thickness standard?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. Several readings taken and recorded taking into account edge and curvature effects?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. The average thickness converted to oz. ft² (g/m²) using appropriate conversion factor?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

First attempt: Pass ☐ Fail ☐  
Second attempt: Pass ☐ Fail ☐

Signature of Examiner __________________________________________

Comments:

________________________________________________________________
________________________________________________________________
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________________________________________________________________
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________________________________________________________________

November 2002
WSDOT FOP for ASTM D 4791

Standard Test Method for
Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

1. Scope

1.1 This test method covers the determination of the percentages of flat particles, elongated particles, or flat and elongated particles in coarse aggregates.

1.2 The values stated in inch-pound units are to be regarded as the standard except in regard to sieve size and the size of aggregate, which are given in SI units in accordance with Specification E 11. The SI units in parentheses are for information purposes only.

1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

Note: WSDOT will be determining flat and elongated particles in accordance with section 8.4.

2. Referenced Documents

2.1 WSDOT Standards:

T 2 WSDOT FOP for AASHTO for the Sampling of Aggregates
T 248 WSDOT FOP for AASHTO for Reducing Field Samples of Aggregates to Testing Size
T 27/11 WAQTC FOP for AASHTO for the Sieve Analysis of Fine & Coarse Aggregates & Materials Finer Than 75 mm (No. 200) in Mineral Aggregates by Washing

3. Terminology

3.1 Definitions:

3.1.1 flat or elongated particles of aggregate—those particles of aggregate having a ratio of width to thickness or length to width greater than a specified value (see Terminology C 125).

3.1.2 flat and elongated particles of aggregate—those particles having a ratio of length to thickness greater than a specified value.

3.1.3 length—maximum dimension of the particle.

3.1.4 width—maximum dimension in the plane perpendicular to the length

3.1.5 thickness—maximum dimension perpendicular to the length and width.

4. Summary of Test Method

4.1 Individual particles of aggregate of specific sieve sizes are measured to determine the ratios of width to thickness, length to width, or length to thickness.

1This Test Method is Based on ASTM D 4791-99
5. Significance and Use

5.1 Flat or elongated particles of aggregates, for some construction uses, may interfere with consolidation and result in harsh, difficult to place materials.

5.2 This test method provides a means for checking compliance with specifications that limit such particles or to determine the relative shape characteristics of coarse aggregates.

6. Apparatus

6.1 The apparatus used shall be equipment suitable for testing aggregate particles for compliance with the definitions in 3.1, at the dimensional ratios desired.

6.1.1 Proportional Caliper Device—The proportional caliper devices illustrated in Fig. 1, Fig. 2, and Fig. 3 are examples of devices suitable for this test method. The device illustrated in Fig. 1 and Fig. 2 consists of a base plate with two fixed posts and a swinging arm mounted between them so that the openings between the arms and the posts maintain a constant ratio. The axis position can be adjusted to provide the desired ratio of opening dimensions. Fig. 1 illustrates a device on which ratios of 1:2, 1:3, 1:4, and 1:5 may be set. The device illustrated in Fig. 3 contains several fixed posts and has the capability of measuring various ratios simultaneously.

6.1.1.1 Verification of Ratio—The ratio settings on the proportional caliper device shall be verified by the use of a machined block, micrometer, or other appropriate device.

6.1.2 Balance—The balance or scales used shall be accurate to 0.5 % of the mass of the sample.

![Proportional Caliper Diagram]

**FIG. 1 Proportional Caliper**
7. Sampling

7.1 Sample the coarse aggregate in accordance with in FOP for AASHTO T2 Practice D-75. The mass of the field sample shall be the mass shown in FOP for AASHTO T2 Practice D-75.

7.2 Thoroughly mix the sample and reduce it to an amount suitable for testing using the applicable procedures described in FOP for AASHTO T 248 Practice C 702. The sample for test shall be approximately the mass desired when dry and shall be the end result of the reduction. Reduction to an exact predetermined mass shall not be permitted. The mass of the test sample shall conform to the following:

<table>
<thead>
<tr>
<th>Nominal Maximum Size Square Openings, in. (mm)</th>
<th>Minimum Mass of Test Sample, lb (kg.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 (9.5 )</td>
<td>2 (1)</td>
</tr>
<tr>
<td>1/2 (12.5)</td>
<td>4 (2)</td>
</tr>
<tr>
<td>3/4 (19)</td>
<td>11 (5)</td>
</tr>
<tr>
<td>1 (25.0)</td>
<td>22 (10)</td>
</tr>
<tr>
<td>1 1/2 (37.5)</td>
<td>33 (15)</td>
</tr>
<tr>
<td>2 (50)</td>
<td>44 (20)</td>
</tr>
<tr>
<td>2 1/2 (63)</td>
<td>77 (35)</td>
</tr>
<tr>
<td>3 (75)</td>
<td>130 (60)</td>
</tr>
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<td>3 1/2 (90)</td>
<td>220 (100)</td>
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<tr>
<td>4 (100)</td>
<td>330 (150)</td>
</tr>
<tr>
<td>4 1/2 (112)</td>
<td>440 (200)</td>
</tr>
<tr>
<td>5 (125)</td>
<td>660 (300)</td>
</tr>
<tr>
<td>6 (150)</td>
<td>1100 (500)</td>
</tr>
</tbody>
</table>

8. Procedure

8.1 If determination by mass is required, oven dry the sample to constant mass at a temperature of 230 + 9°F (110 + 5°C). Dry in accordance with FOP for AASHTO T 255. If determination is by particle count, drying is not necessary.

8.2 Sieve the sample to be tested in accordance with FOP for AASHTO T 27/11 Test Method C 136. If the material retained on each required size (3/8 and larger) is more than 5% of the sample, reduce the material in accordance with FOP for AASHTO T 248 until approximately 100 particles are obtained for each required size. Using the material retained on the 9.5 mm (3/8 in.) or 4.75 mm (No. 4), as required by the specification being used, reduce each size-fraction present in the amount of 10% or more of the original sample in accordance with Practice C 702 until approximately 100 particles are obtained for each size fraction required.

8.3 Flat Particle Test and Elongated Particle Test—Test each of the particles in each size fraction, and place in one of the following groups: (1) flat, (2) elongated, (3) neither flat nor elongated:

8.3.1 Use the proportional caliper device, positioned at the proper ratio, shown in Fig. 2, as follows:

8.3.1.1 Flat Particle Test—Set the larger opening equal to the particle width. The particle is flat if the thickness can be placed in the smaller opening.

8.3.1.2 Elongated Particle Test—Set the larger opening equal to the particle length. The particle is elongated if the width can be placed within the smaller opening.
8.3.2 After the particles have been classified into the group described in 8.3, determine the proportion of the sample in each group by either count or by mass, as required.

8.4 Flat and Elongated Particle Test—Test each of the particles in each size fraction and place in one of two groups: (1) flat and elongated or (2) not flat and elongated.

8.4.1 Use the proportional caliper device, set at the desired ratio.

8.4.2 Measurement:

8.4.2.1 On proportional caliper devices similar to the devices shown in Fig. 1 and Fig. 2, set the larger opening equal to the length of the particle. The particle is flat and elongated if the particle, when oriented to measure its thickness, can pass completely through the smaller opening of the caliper.

Metric Equivalents

<table>
<thead>
<tr>
<th>in.</th>
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<td>7/8</td>
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</tr>
</tbody>
</table>
8.4.2.2 On calipers similar to the one described in Fig. 3, set the minimum dimension of the proportional caliper device such that the particle, when oriented to measure its thickness, passes snugly between the post and swing arm. The particle is flat and elongated if the particle, when oriented to measure its length, fails to pass the desired large opening of the proportional caliper device.

8.4.3 After the particles have been classified into the groups described in 8.4, determine the proportion of the sample in each group by count or mass, as required. Note: WSDOT performs this test by weight.

9. Calculation

9.1 Calculate the percentage of flat and elongated particles to the nearest 1% for each sieve size greater than 3/8 in. (9.5 mm), as required.

10. Report

10.1 Include the following information in the report:

10.1.1 Identification of the coarse aggregate tested, and

10.1.2 Grading of the aggregate sample, showing percentage retained on each sieve.

10.1.3 For flat particle tests and elongated particle tests:

10.1.3.1 Number of particles in each sieve size tested,

10.1.3.2 Percentages, calculated by number or by mass, or both, for: (1) flat particles, (2) elongated particles, and (3) total flat particles and elongated particles for each sieve size tested, and
10.1.3.3 The dimensional ratios used in the tests.

10.1.4 For flat and elongated particle tests:

10.1.4.1 Number of particles in each sieve size tested,

10.1.4.2 Percentages, calculated by number or by mass, or both, for flat and elongated particles for each sieve size tested,

10.1.4.3 The dimensional ratio used in the tests, and

10.1.5 When required, weighted average percentages based on the actual or assumed proportions of the various sieve sizes tested. Report the grading used for the weighted average if different from that in 10.1.2.

10.2 Report results using WSDOT form 350-161, or other report approved by the State Materials Engineer.

11. Precision and Bias

11.1 Precision—The precision of this test method is being determined.

11.2 Bias—Since there is no accepted reference material suitable for determining the bias for this test method, no statement on bias is being made.

12. Keywords

12.1 aggregates; coarse aggregates; particle shape
Performance Exam Checklist

FLAT AND ELONGATED PARTICLES IN COARSE AGGREGATE

**FOP FOR ASTM D 4791**

<table>
<thead>
<tr>
<th>Procedure Element</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tester has a copy of the current procedure on hand?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Field sample obtained per AASHTO T-2?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Sample thoroughly mixed prior to reducing to testing size?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Sample reduced to testing size per AASHTO T-248?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Mass of the test sample conforms to the table in Section 7.2, ASTM D-4791?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PROCEDURE**

1. If determination by mass, sample oven dried to a constant weight prior to mass determination? |     |    |
2. Sample sieved per AASHTO T27/T11?                                              |     |    |
3. Proportional caliper device positioned at proper ratio?                          |     |    |
4. Each size fraction larger than 3/8 inch retaining 10% or more of the original sample reduced per AASHTO T-248 until approximately 100 particles are obtained for each size fraction required? |     |    |
5. Each particle of each size fraction tested for FLAT and ELONGATED using the proportional caliper device put in the appropriate group classification? (Flat & Elongated or Not flat & Elongated) |     |    |
6. Proportion of the sample of each sieve size determined by Mass?                  |     |    |
7. Percent of Flat and Elongated particles figured to the nearest 1% for each sieve size? |     |    |
8. Record number of particles in each sieve size tested?                           |     |    |
9. Record percentages calculated by Mass?                                         |     |    |
10. All calculations performed correctly?                                          |     |    |

First attempt: Pass [ ] Fail [ ] Second attempt: Pass [ ] Fail [ ]

Signature of Examiner __________________________________________
# Chapter 10

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- 10-1.2 Requirements for Notes
- 10-1.3 Source Documents

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  - 10-2.1B Quantity Details
  - 10-2.1C Item Quantity Ticket
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<tr>
<td>10-5.2</td>
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Chapter 10

10-1 General

10-1.1 Introduction

This chapter is intended to provide reference and guidance for the project office’s use in the keeping of Construction Contract Records. While there may be differing needs or circumstances that must also be met within each project office, it is intended that this guidance be used to help identify the minimum requirements that are necessary in order to establish an adequate method of record keeping. These minimum requirements also help to establish a basic level of uniformity among all project offices statewide.

This can help to facilitate the review of records by others and promotes greater efficiency when engineering personnel are transferred or reassigned between different projects or even different project offices. If a clear method of record keeping can be identified prior to the beginning of work, then original field notes and records can be easily prepared and maintained as the work progresses. This will also help to reduce the effort required to produce the final contract records upon completion of the project.

Successful contract documentation requires that measurements and calculations supporting contract payments are accurate and that records of these actions are complete. Contract records and documentation must be sufficiently detailed and maintained in a manner that will withstand an audit and be clear enough to be read and understood by anyone unfamiliar with the project. The Project Engineer is responsible to ensure that these accurate and complete records are maintained for all construction project work. If questions or assistance is needed, the statewide Documentation Engineer as well as the Regional Documentation Engineer are both available as resources for the Construction Project Office’s use.

It is recommended that original field notes be kept in a form that can be filed and retained as basic documentation. Field notes taken on scratch paper and then passed to the office should not be considered as acceptable documentation. Transcription of field notes to final record form should be avoided due to the possibilities of error and the unnecessary cost of duplication.

All personnel are responsible to ensure that notes are made correctly and are complete with all pertinent information. Sample notes have been included with this chapter and are intended as a guide or reference in preparing final record notes.

Facsimile machines and electronic mail are normal business practices in most state and private offices. It is acceptable to take action on these types of correspondence; however, in order to properly document and follow the conditions noted in the contract, exchanging or mailing original copies of the documents should follow up all facsimile and electronic mail. This is especially true for any item that requires a commitment by either the Contractor or the Washington State Department of Transportation (WSDOT). Follow up mail copies are required for all issues that require a signature.

10-1.2 Requirements for Notes

Documentation of contract items that are not specifically covered by the sample field notes can, in most instances, be created using the examples as a guide for similar items. The following notations should be carefully observed for correct procedure:

1. Each set of notes should contain the date when they were made and the initials of the persons making them.

2. Each set of notes, except staking notes, should contain the date when the phases of work are accomplished, the initials of the persons who compute and check the quantities noted, the dates when the quantities were computed, the dates when the computations were subsequently checked, the locations where the work was performed, and the corresponding group number.

3. When field notes are used as the basic source document in supporting a payment to the Contractor, they must include the date and initials of the person making the entry into the project ledger, the person verifying the entry, and the six-digit entry number.

4. Each pay quantity identified in the field notes should be designated with the corresponding item number and correct item name listed in the contract.

5. It is recommended that the correct field book or loose leaf sheet always be used for the particular kind of work being staked or measured.

6. The degree of accuracy required for computing unit quantities should be consistent with standards established in Chapter 10-2.1B.

7. It is recommended that sets of field notes and field books be numbered and titled in order to prevent their loss and to aid in tracking payments and their supporting information.

10-1.3 Source Documents

Field notes are one of the many items that might be considered as a Source Document. It is recommended that all field notes, base line notes, centerline notes, and grade books be recorded in bound books. If looseleaf books are to be used, care must be exercised to prevent lost pages.
Notes should be recorded in a manner that is neat, clear, uncrowded, and in sufficient detail so as to be easily understood.

Original entries later determined to be in error must not be obliterated by erasing, application of correction fluid, or taped over. Instead a line should be cleanly drawn through the mistaken entry and corrections entered directly above with the initials of the person making the change. This is very important, as erasures will destroy the legal standing of notes. When revisions require abandonment of a considerable portion of notes, they shall be crossed out and a cross reference made of the book and page number where the revised notes may be found.

Each Final Records book should be labeled and contain a title page using Forms 422-009 and 422-009B. Each book is to be numbered and a table of contents included on the first page following each book’s title sheet. It is essential that original field notes and documents be carefully organized, kept, recorded, and maintained in safe filing facilities during the active stage of a project. These documents should be transferred to safe, adequate, and recoverable storage after the contract is completed. At all times, when not in use, all source documents, reports, survey notes, etc., should be kept in fire resistant files where possible. Additional information on source documents can also be found in Section 10-4.2 of this chapter.

10-2 Measurement of Items of Work
10-2.1 General

10-2.1A Introduction
It is essential that the Project Engineer ensure proper controls are exercised when measuring items of work. The Project Engineer should also ensure that payments are not made for any item that cannot be substantiated by the project records regardless of the work’s stage of completion. Items that are paid on the basis of weight or truck volume require measurement of the quantities involved, evidence for receipt of the materials, and documentation for both of these operations through the use of item quantity tickets or other delivery records.

10-2.1B Quantity Details
The number of significant decimal places to which quantities should be measured and/or computed varies with the value or unit bid price of the respective items involved. Unless advised otherwise, the Project Engineer should use the following guidelines.

<table>
<thead>
<tr>
<th>Bid Price</th>
<th>Significant Decimal Per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $10 per unit</td>
<td>1</td>
</tr>
<tr>
<td>From $10 to $100 per unit</td>
<td>0.1</td>
</tr>
<tr>
<td>Over $100 per unit</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Quite often, good practice would dictate that the various parts of a particular quantity be calculated to a higher significant decimal place or in some other unit, a unit other than that used for payment, and then be converted to the payment unit in the summation. Good judgment should be used in selecting when to actually apply rounding to the quantity. In general, it is considered proper to apply rounding at the first summation of each isolated part. For example, at the summation of a day’s item quantity tickets the quantity to be recorded should be rounded to the proper significant decimal place and the rounded quantity recorded into the project ledger.

10-2.1C Item Quantity Ticket
A three part Item Quantity Ticket (IQT), Form 422-021, has been developed for use as a tool in documenting the many items that are paid for on the basis of quantities of materials or other bid item services that are received at the project site. An example of an IQT can be found in Figure 10-1. When using either the State provided IQT or Contractor provided IQT, the Project Engineer should ensure that the items noted below, identified as minimum required information for documenting receipt of materials and for supporting payment of those materials, are completely filled out on each IQT utilized. Additional information may be added to the item quantity tickets at the option of the Project Office. However, this additional information would be intended only as a convenience for project staff in their work monitoring material use. The Project Engineer should also ensure that the carrier transporting each load of material or the person responsible for the particular contract bid item or service is issued an item quantity ticket for each delivery of the material or service to the jobsite.

In lieu of using Form 422-021, tickets may also be furnished by the Contractor, commercial scale companies, or suppliers at commercial plants or material sources. These tickets are sometimes electronically produced. In some instances these tickets can be programmed in advance of the hauling to accurately print, on each ticket, the minimum required information as noted below. While this can be done by the contractor in an effort to cooperate with the Project Office towards successful completion of the project, the Project Engineer must ultimately ensure that the minimum required information is accurately noted on each ticket.

The following minimum required information is to be recorded on each State-provided IQT, Contractor provided IQT, or IQT’s produced by fully automated scales:

- Contract Number
- Date
- Contract Unit Bid Item No.
- Initials of person accepting the item on the jobsite
- Unit of measure
• Identification of hauling vehicle, as appropriate

• Record of the gross, tare, and net weights. If the scale has a tare beam so that the net weight can be read directly or when using batch plants or storage silos with direct reading scales, only the net weight need be recorded. If the unit of measurement is cubic meters, cubic yards, hours, etc. only the net amount need be recorded.

In addition to this minimum required information, there are a number of other items that could also be included on the item quantity tickets. While this information is helpful to others who may also be using these same tickets for monitoring materials, materials placement, or other issues, this additional information is not required for documentation supporting payment for materials received. Placing this information on item quantity tickets can be helpful, but is solely at the option of the Project Office. Some of these optional items may include:

• The Group, Station, Mile, or Kilometer of material placement or use can be noted to help identify material’s location on the jobsite. It can also be used to help identify group payment.

• Contractor/Subcontractor completing the work represented by the ticket noted.

• Cumulative totals for the day.

• Pit number identifying the source of the material.

• Time weighed and initials of the person issuing the ticket.

• Time materials or services are received on the jobsite.

• Description of the material that matches the unit bid item name.

• Ticket serial number, etc.

A representative of WSDOT should be assigned as a receiver at the delivery site or at the site where the item is to be placed. The receiver should collect the tickets from the carrier upon delivery of the ticketed material, record any required or additional information on the ticket as necessary, and retain the original copy for payment. When using Contractor or State provided multiple part tickets, the Contractor’s representative should be provided the copy marked “Contractor” either upon delivery or at the end of each day’s operation.

For materials or services that are not paid for by weight, the receiver should complete the ticket at the point of delivery. The appropriate items required to identify the material or bid item service, the quantity, and its placement should then be filled in.

Payment and documentation of materials received should be based on the original tickets received at the project site. Any tickets that may be identified as missing should be reconciled immediately with the Contractor so they will not be in contention for payment at a later date. Unless the Project Engineer decides otherwise, when using the State provided item quantity tickets it is not necessary to retain the goldenrod or “Book” copy. Once the Contractor has been provided with the green copy of the ticket marked “Contractor” and the white copy of the ticket marked “Original” has been reconciled and approved for payment, the goldenrod or “Book” copy may be discarded.

10-2.1D Conversion Factors

Conversion factors for liquid asphalt can be found in Section 109.1 of the Standard Specifications. Where the plans require a weight measurement for minor items of construction, the contractor may request permission to convert volume to weight. When approved by the engineer, an agreed factor may be used to make this conversion and volume may be used to calculate the corresponding weight for payment. The provisions for this conversion factor can be found in Section 109.2(5) of the Standard Specifications. When using a conversion factor the Project Engineer must perform adequate tests and retain supporting data establishing the conversion factor or new price quotation. A letter of agreement or change order for the conversion factor is needed.

10-2.2 Items Measured by Weight

10-2.2A General Instructions

All materials paid on the basis of weight are to be weighed in accordance with the provisions of the Standard Specifications by a representative of WSDOT or at commercial scales operated by a commercial scale operator. When commercial scales are used a representative of WSDOT will periodically observe the weighing operation and scale check procedures. These periodic reviews are to be unscheduled and not less than twice a week. Both WSDOT and commercial scale operators will record the necessary weights and information on Item Quantity Tickets in accordance with Chapter 10 2.1C of this manual.

In accordance with Section 1-09.2(1) of the Standard Specifications, WSDOT and commercial scale operators will test the scales at least once daily. Several times each day the operator will also make certain the scale balances and returns to zero when the load is removed. The results of scale testing conducted by both WSDOT and commercial scale operators including determination of scale variance, AM/PM tare weights where needed, and intermittent scale balancing are to be recorded for each day’s production on the Scaleman’s Daily Report Form 422-027. These reports representing each day’s production are to be submitted to the engineer daily.
When platform scales are used the scale platform shall be of sufficient length to weigh the entire hauling vehicle or combination of connected vehicles at one time. When needed for gross weight determinations, tare weights for each truck are to be taken at least twice daily and recorded on a tare sheet, scaleperson’s diary, or shown on the Scaleman’s Daily Report. When using a lane beam scale, the tare weight for each individual truck is to be set on the beam at the time of weighing.

For most materials, material and tare weights will be measured to the nearest 100 pounds (50 kilograms). In determining quantities for materials produced from batch type mixing plants, where individual components of each batch of materials are weighed before mixing, the batch weights are acceptable for measurement and payment.

When placing surfacing materials, gravel backfill, riprap, and other similar materials the preferred method for acceptance of quantity is by Item Quantity Tickets. However, where it is reasonably certain that no diversion or substitution of materials can occur, or where an alternative method of calculating the approximate quantity received can be devised, the requirement for issuing and receiving a weight ticket for each individual truckload can be waived. The Project Engineer must approve the use of this procedure in advance of the hauling operation and document to the file the reasons for doing so. In making this decision the Project Engineer should review the risks and the benefit/costs for altering the standard method for receipt of materials. Among other things, this review could include labor savings, the proximity of the scale location to the point at which the materials are to be received, the potential or risk for diversion or substitution of materials, efforts made to mitigate those risks, as well as the methods used to verify the quantities of materials that are received. If an alternate method for receipt of materials is approved it must include provisions for keeping a scale sheet where the weights for each load are recorded along with the other information normally required for an Item Quantity Ticket. The method must also include a procedure for validating the quantities indicated by the dispatch record as being received. This might be a tally sheet, maintained at the project site, showing the arrival of each load. Another method might be a calculation of neat-line volume, which could be compared with weighed quantity to disclose a reasonable conversion factor. In any method, an occasional random check of a loaded vehicle will be needed to provide validation of both the weigher and the scale.

10-2.2C Weighing Equipment

Scales for the weighing of natural, manufactured, or processed highway and bridge construction materials that are required to be proportioned or measured and paid for by weight, are to be furnished, erected, and maintained by the Contractor, or be permanently installed, certified, commercial scales. All weighing equipment and scale operations must meet the specific requirements noted in Section 1-09.2 of the Standard Specifications.

10-2.3 Items Measured by Volume

10-2.3A Truck Measure

Except as noted below, when materials are measured and paid on the basis of volume delivered in trucks, the Project Engineer should ensure that a receiver is assigned at the point of delivery to issue or receive load tickets and to make periodic computations of yield where applicable.

Item Quantity Tickets (see Chapter 10-2.1C) should be used for recording the volume of materials paid on the basis of truck measure. The tickets should include all information previously noted as required for materials measured by weight, with the substitution of measured volume in place of measured weight to be shown as the quantity received.

Surfacing Material, Gravel, Topsoil, etc.

In lieu of issuing individual load tickets when surfacing materials, gravel backfill, top soil, etc., are measured and paid for on the basis of volume delivered in trucks, it is acceptable for the Project Engineer to maintain a field book record showing a recording for each delivery, issuing one ticket for the total amount delivered for each item at the end of each
work shift. The field book record will show the truck number, time of delivery, and volume for each load. The ticket issued shall show all pertinent data including reference to the field book number.

In documenting the size of loads received, ensure the following procedures are followed:

1. The truck box of each hauling conveyance will be measured, calculated, and recorded for final records to the nearest 0.1 cubic yard (cubic meter) based on a struck or water level height for the leveled load. Although state law requires 6 inches (152 millimeters) of freeboard on loaded aggregate material trucks, the actual quantity hauled or calculated may exceed the measured capacity. This is due to the normal practice of heaping material in the center of the load.

2. The material receiver should have sufficient loads leveled at the point of delivery in order to judge consistency in the quantity being hauled.

3. Load volume will be recorded to the nearest cubic yard (0.5 cubic meter) for pay purposes using the volume computed in part (1) above. If the Inspector questions whether a truck is fully loaded, the load will be leveled. If the vehicle is not fully loaded, the Inspector will measure and document the actual load to the nearest cubic yard (0.5 cubic meter).

**Water**

In order to document the amount of water delivered to the project, a Water Delivery Record, Form 422-024, should be maintained showing all pertinent information including time, volume, location of delivery for each load, contract number, and truck number. If the driver maintains the Water Delivery Record, it should be signed by the truck driver or the Contractor and initialed by the Inspector. Daily spot checks should also be completed verifying the quantities being delivered. When performed, random spot checks should be noted on the Delivery Record itself. At the end of each work shift an Item Quantity Ticket should be issued to cover the water delivered to the project that day. The Water Delivery Record should be maintained in a manner that allows it to be easily referenced to the corresponding WSDOT copy of the Item Quantity Ticket used for payment.

The Project Engineer should ensure that the capacity of each water truck is determined by measuring or weighing, and is recorded in the project records. It is recommended that copies of the truck identification and capacity records be attached to the water ticket book to ensure the information is available to the field Inspector.

When water meters are installed at the discharge point for hydrants or water trucks, the Inspector should record the meter reading at the beginning and end of each shift and issue a ticket for the net quantity of water placed in accordance with contract specifications for the item. The Project Engineer should also ensure that the meters are checked for accuracy and that the checks are recorded in support of payment documentation.

### 10-2.3B Cross-Sections

Many excavation items are measured by field cross sections and/or template notes. The Project Engineer should ensure that the project is staked and measured accurately in accordance with guidance noted in the “Basic Surveying” manual and utilizing sound engineering practices. As a minimum, the field notes should show the date the data was taken, weather, Crewmembers, and their assigned duties. When re-measurements are required, it is important that the same base line and elevation datum be used.

Documentation of volume measurement for excavation areas which require original and final measurements, should contain cross references between the original notes and the re-measure notes. Also references should be made to the transit notes and elevation datum for that excavation area.

### 10-2.3C Neat Line Measurement

Some items, such as concrete volumes, are paid based on dimensions detailed in the plans. For these items, the quantities need to be calculated and the calculations made a part of the record. If additional sketches or dimensions are also required in order to compute the quantities, these should be included in the records as well.

Other items, such as structure excavation and gravel backfill, are measured for payment using neat line volumes based on plan dimensions as a maximum limit. These items require field measurement to determine pay quantities that may be less than neat line maximums. Many times, sketches with the dimensions shown are desirable. The dimensions should show the limits of the actual work, except when these limits exceed the maximum allowed for payment, then the dimensions should be limited to the maximum allowed.

### 10-2.4 Items Measured by Hour/Day

When contract items are to be measured and paid for on an hourly or daily basis, the Project Engineer is to ensure that a WSDOT representative is assigned to verify the hours or days of payment, and issue Item Quantity Tickets or other verified field note records. At least one ticket should be issued at the end of each work shift or working period. The Project Engineer should ensure that tickets show all pertinent information for the item involved. Some items measured by the hour may be eligible for payment during non-shift hours; for example, a 24-hour flashing arrow used for lane closures or detours in effect during nonworking hours. In these situations, an Item Quantity Ticket for one shift may show more hours for payment than are actually available within the shift.
In order to ensure agreement on the hours or days of work performed, Item Quantity Tickets for items of work measured by the hour or by the day should be initialed by the Inspector and signed by the Contractor’s representative on a day-to-day basis.

10-2.5 Items Measured by Lump Sum

For items that are to be paid on a Lump Sum basis, the project records should identify the item, the date that the material was received, and/or the date work was accomplished. This can be accomplished by ensuring that a field note record is made showing the dates work was performed, has the initial of the Inspector, and shows the work to be 100 percent complete. A field note should also be used to show any estimated portions for progress payment of a Lump Sum amount prior to 100 percent completion. It must include the basis on which any quantities used for progress estimate payments were calculated.

10-2.6 Items Measured by Other Units

10-2.6A Linear Measurement

Records for materials measured by length should show the length measured, initials of the persons making the measurements, and the date measured.

For features, such as guard rail and barrier, that are paid by length and which contain repetitive elements or units, the length may be “measured” by calculation. In other words, if the length of a single element is known, then the number of elements may be counted and multiplied by that amount and a total “measured” length determined. Care should be taken to account for odd length elements, such as end sections and custom-fabricated pieces, and for areas where elements overlap or gaps exist.

Records for measurement should also include the beginning and ending stations of the work, recorded by the Inspector or person making the measurement, tying the work to its location on the project. The dates of construction should also be recorded.

10-2.6B Area Measurement

Records for materials or work measured by area should show the length and width measured or otherwise determined, initials of the persons making the measurements, and the date measured. In many instances a sketch of the area with the measurements would be very helpful in showing the computed area. The dates of construction should also be recorded.

10-2.6C Per Each Measurement

Records for materials or work measured per each unit should provide a listing showing the location of each item constructed, dates constructed, and initials of the Inspector or person measuring the item.

10-2.7 Items Bid at “No Charge”

Normal documentation procedures are not required for items bid at “no charge” if the items do not physically constitute a portion of the finished work. However, notes in the diary or Inspector’s Daily Report are necessary to show when the work was done. Examples of these items might include water, haul, and embankment compaction.

For items bid at “no charge” which physically constitute a portion of the finished work, normal documentation procedures, such as Item Quantity Tickets or cross sections, are required to show how the item was incorporated into the project. Examples of these items might include layering materials and prime coat aggregate.

10-3 Final Records for Projects Constructed by Contract

10-3.1 Records

These records consist of field books, Inspector’s record of field tests, project and Inspector’s diaries, Inspector’s Daily Reports, invoices, weigh bills, Item Quantity Tickets, receiving reports, project ledgers, mass diagrams, plotted cross-sections, computer listings, working profiles, and any other documents that could be considered a basis of payment for work performed or materials furnished. All records that are created during the administration of a construction project can be placed in one of two categories, Permanent Records, records kept by the Headquarters and State Archives for future reference, and Temporary Records, records kept by the Region for a limited period of time after which they are discarded by the Region.

10-3.1A Permanent Records

The Region should ensure that those records designated as Permanent Records, records that are to be permanently filed, are assembled as a portion of the overall project final records and are submitted to Headquarters, Engineering Records for filing. All final records sent to Headquarters for filing will be kept permanently as the Permanent Final Records for the completed project.

All final record books prepared for Permanent Final Records are to be numbered as outlined below.

Permanent Records consist of the following:

- Records provided by Headquarters:
  - Contracts
  - Change Orders
  - Contract Estimate Payments
Records provided by the Project Office in books numbered as follows:

- Final Record Book Number 1
- Project Engineer’s Diary – Book Number 2
- Inspector’s Daily Reports – Book Number 3
- Traffic Control Reports – Book Number 4
- Pile Driving Records – Book Number 5
- Post Tensioning Records – Book Number 6
- Miscellaneous Records – Book No. 7
- As Built Plans and Completed Contractor Provided Shop Drawings

10-3.1B Temporary Final Records

All records designated as Temporary Final Records are to be retained within the Region for a period of three years after which they may be destroyed. If a claim, lawsuit, or other circumstance is found to be pending at the end of this three year period, the Region should further retain those pertinent records until the issues have been resolved. The Region should ensure that those records designated as Temporary Final Records are also assembled as a portion of the overall project final records. The date for the beginning of this three year retention period for State-funded projects is the Acceptance Date; the date the State Construction Engineer signs the Final Contract Voucher Certification accepting the project. If Federal funds are involved in the project, the date for the beginning of this three-year retention period is the date that FHWA accepts the final payment voucher. The Headquarters Records Services will send a copy of Retention of Records on Federal Aid Projects (DOT Form 133-072) to the Region that specifically indicates the starting and ending dates for this period.

The following list contains some of the items that may be kept as Temporary Final Records. This listing is not a complete listing of all the possible items that could be grouped into this category. In short, Temporary Final Records consist of all project records that are not kept as Permanent Final Records. If Temporary Final Records are kept in numbered books then, in order to eliminate confusion with Permanent Final Records, these books are to be numbered consecutively beginning with Book Number 8. Examples of Temporary Final Records include:

- Item Quantity Tickets
- Project Engineer’s Copy of Estimates
- Project Correspondence

- Inspector’s Record of Field Tests
- Scaleman’s Diary and Scale Checks
- Scale Test Reports
- Concrete Pour Records
- Record of Field Audits
- Approval of Source of Materials
- Quantity Computation Sheets
- Surfacing Depth Check Records
- Prints of Shop Drawings
- Contractor’s Payrolls (Federal Aid Projects)
- Source document files
- Alignment (Transit) Book
- Grade Book
- Cross-Section Notes
- Drainage Notes
- Photographs
- Mass Diagrams
- Computer Summary Sheets
- Computer Listings
- Falsework and Form Plans
- Daily Report of Force Account Worked
- Quarterly Report of Amounts Credited DBE Participation
- Annual Report of Amounts Paid as MBE/WBE Participation
- Washington State Patrol Field Check list

10-3.2 Contracts

The original signed contract documents are maintained in the Contract Processing Section of the State Accounting Services Office during the active stage of a contract. After final payment has been made, Accounting sends these documents to Records Services for permanent filing.

10-3.3 Change Orders

Approved change orders are a legal part of the contract documents and are treated just like the original contract documents. For a complete discussion of change orders, see Chapter 1-2.4C.
10-3.4 Contract Estimate Payments

Documentation of contract estimate payments is facilitated by use of the electronic Contract Administration and Payment System (CAPS) which includes both the monthly progress estimates and the final estimate. For a complete discussion of the contract estimate process, see Chapter 1-3.1. Specific information on the final estimate package is found in Chapter 1-3.1D. After final payment has been made, Accounting sends these documents to Records Services for permanent filing.

10-3.5 Final Record Book No. 1

Final Record Book No. 1 is the first book of the Permanent Final Records for a construction contract. It contains indices to the records that have been compiled for both Permanent and Temporary Final Records. It also identifies the people who worked on the project and provides specific summary information. Final Record Book No. 1 is to be signed by the Regional Administrator or designee. Final Record Book No. 1 should contain a title sheet, Form 422 009, and should be assembled with a semi rigid, water resistant cover.

The following records are to be incorporated into Final Record Book No. 1 in the order as arranged below. No other material is to be included in this book.

1. Index. There are two indices referred to within Final Record Book No. 1. The first is an index or detailed listing showing the various sections of Final Record Book No. 1 itself. An example of an index for Final Record Book No. 1 can be found in Figure 10-2. The second index is actually the first section of the book. It provides a detailed listing of all records that have been kept and assembled for the project, including both Permanent Records and Temporary Records. An example of this listing or index for Section 1 can be found in Figure 10-3.

2. WSDOT Personnel List. Section 2 of Final Record Book No. 1 contains a listing of all WSDOT personnel assigned to the project and their classifications. Each person noted should place their identifying initials after their name on the listing in the same manner as it appears in other final record documents.

3. Comparison of Quantities. Section 3 of Final Record Book No. 1 contains this CAPS report prepared from the Final Estimate.

4. Final Estimate Sheets. Section 4 of Final Record Book No. 1 contains a copy of the Final Contract Voucher Certification.

5. Contract Estimate Payment Totals. Section 5 of Final Record Book No. 1 contains a copy of this report obtained from the final estimate.

6. Affidavit of Wages Paid. Section 6 of Final Records Book No. 1 contains all Affidavit of Wages Paid received from the Contractor, subcontractors, lower tier subcontractors or suppliers performing work or providing certain products to the project.

7. Change Orders. Section 7 of Final Records Book No. 1 contains a listing of all Change Orders prepared for the completed project.

8. Record of Construction Materials. Section 8 of Final Records Book No. 1 contains a tabulation showing the source of all construction materials. If material of a certain type was obtained from two or more sources, the station limits or parts of a structure relative to each source should be shown. Depending on the size of project and the method used to record this activity, a copy of the completed Record of Materials (ROM) or a summary from the contract’s ROM database may satisfy this requirement. This is an acceptable method as opposed to preparing a separate or duplicate listing.

When preparing the individual Final Record Books, other than Book No. 1, it is not necessary to label pages within each book. Where it is appropriate, a table of contents may be added to identify sections within a particular book.

10-3.6 Diary Records

Diary records consist of both the Project Diary(s) and the Inspector’s Daily Report (IDR). Together they should provide a complete narrative picture of the project, covering both the normal work processes and anything unusual that might have occurred on the project. Diary records are to be included in the project’s Permanent Final Records.

10-3.6A Project Engineer’s Diary

A complete, well-kept Project Diary is a valuable administrative tool. It is a collection point for many of the project’s pertinent facts arranged in any chronological order. It may show how questions were answered, how problems were solved, progress of the work, and unusual conditions pertaining to working days charged. It can provide data for analysis of both claims and requests for extensions of contract time. It is also available for reference long after the work is completed.

The Project Engineer should ensure that a Project Diary is kept current for every construction contract. It is recommended that the Project Diary be maintained primarily by the Project Engineer. However this responsibility may be delegated to the Assistant Project Engineer or to the Chief Field Inspector. At a minimum, one Construction Project Diary is required for each project. The Project Diary should be used to record all matters of importance which are not covered by other routine reports or may contain a record
of routine matters if the circumstances are unusual, conferences with the Contractor or the Contractor’s field representative, agreements made, special notes regarding equipment or organization, labor conditions, weather or other causes for delays if of any consequence, and any other matters that might have a bearing on the completion of the project. To avoid keeping separate diaries and to avoid duplication, the Project Engineer and the principal assistant(s) may make entries in the same diary. Each diary entry should include the date of the entry and be followed by a signature or initials on the line immediately under the entry to identify the writer. The Project Engineer is responsible for ensuring the existence of a Construction Project Diary for each project.

10-3.6B Inspector’s Daily Report

The Inspector’s Daily Report (IDR) is a record of operations for a specific type of work on the project, such as surfacing, grading, paving, bridge, etc., which is being inspected by the writer. Page one of the IDR is a structured sheet of questions addressing identification of work operations and the associated labor and equipment being used to accomplish the work. This page should be filled out completely for all questions that pertain to the specific type of work activity being inspected. Page two is a narrative portion that should include a notation of any orders given or received, discussions with the Contractor, unusual conditions, delays in the operations, and the presence of any visitors. If an operation is being inspected which results in the partial payment of an item, the item should be identified along with the basis for calculating the partial payment. It is also of value to note the Inspector or Engineer’s activities in the daily report.

The Project Engineer should ensure that the Inspector’s Daily Report, Forms 422-004, 422-004A, and 422-004B, are utilized for completing this daily report of activities. Each page of these forms is printed separately in a tablet in duplicate on NCR paper. Both types of tablets have the instructions printed on the tablet cover. The original copy is to be submitted to the Project Engineer each day.

If necessary, the Project Engineer should add comments or remarks on the original copies of the Inspector’s Daily Reports to clarify the report. The duplicate copy of the report should remain in the book for the Inspector’s immediate information and may be discarded when it is no longer useful for that purpose. The original copies of the Inspector’s Daily Report should be included in the Final Records for permanent retention.

Subject to the following, it is acceptable for inspectors to produce IDR’s by recording information onto a recording device while at the job site for later transcription to a paper format.

1. All information required on the regular handwritten form must appear on the typed version.
2. The inspector must read and sign the typed document. (It is desirable for this to take place within 24:48 hours of the reporting period. However, it is recognized that certain situations may not permit this time frame and therefore it is not mandatory.)
3. The inspector may make and initial hand corrections to the typed document.

Please note that inspectors who use lap top computers can also produce electronic versions of the IDR document. The electronically produced document must be complete, including signature, consistent with the above criteria.

10-3.7 Record of Accidents and Traffic Control

10-3.7A Record of Accidents and Traffic Surveillance

A separate file for each project is to be maintained containing information or documents pertaining to accidents that may have occurred on the project. This could include notes or letters to the file regarding an accident, supporting information for changes made to traffic control in response to an accident, and any accident reports that can be obtained. It should be noted that Chapter 1-2.3E of this manual does not require an accident report be obtained for every accident that may occur within the project limits. This file should also contain the records of traffic control surveillance prepared in accordance with Chapter 1-2.3E of this manual. Information in this file should be kept current and upon completion of the contract, submitted to Headquarters Engineering Records as a part of the project’s Permanent Final Records. When the Washington State Patrol provides the Project Engineer with traffic control assistance they also provide the Engineer with form 421-045, WSP Traffic Control Checklist. While this form is a part of the traffic control operations, it can be kept separately and made part of the Temporary Final Records.

10-3.7B Contractor’s Daily Report of Traffic Control

The Contractor’s Daily Report of Traffic Control (DOT Forms 421-040A and 421-040B), completed by the Contractor’s Traffic Control Supervisor, should also be included as part of the project’s Permanent Final Records. The Contractor’s Daily Report of Traffic Control is discussed in more detail in Chapter 1-2.3 of this manual.

10-3.8 Pile Driving Records

The Pile Driving Record Book, Form 450-004, should be included and made a part of the Permanent Final Records. The requirements for pile driving and pile driving records are further detailed in Chapter 6 of this manual.
10-3.9 Post Tensioning Records
The Post Tensioning Record Book, Form 450-005, should be included and made a part of the Permanent Final Records. The requirements for post tensioning and post tensioning records are further detailed in Chapter 6 of this manual.

10-3.10 Miscellaneous Records
Miscellaneous Records are optional records and may be included in the permanent records at the Project Engineer’s discretion. This part of the records is intended for items that might be considered of added importance. This might include photographs of special features or construction methods, information regarding opening to traffic, dedication activities, or other documentation of particular importance. Placing these in the Permanent Final Records will make them a matter of permanent record where they will be retained for future reference.

10-3.11 As-Built Plans
As-Built Plans are a record of changes made to the originally intended physical product of the contract. As Built drawings should reflect the same degree of detail as the original plan drawings. As Built Plans are necessary as a way of preserving the historical detail of what occurred on the project. As Built Plans can also be used as a basis to plan and design future projects in the same location and to make repairs to damaged structural components or other non-functioning facilities. In addition, state law requires that owners of “underground facilities” be able to locate these facilities within 24 inches (600 millimeters) of the outside dimensions. As Built Plans offer a convenient means for recording these facilities.

Within two weeks after a contract has been awarded, the State Pre-Contract Administration Office or Printing Services Office will furnish the Region Office with one set of large size black line prints of the contract plans which will be marked “For As Constructed Plans Only.” These plans shall be used by the Project Engineer solely for the purpose of preparing “As Built Plans.” All corrections, revisions, and additional sketches, necessary to depict the work as it was constructed should be shown on these plans. Corrections are to be made by lining out quantities or features that were changed during construction, then noting the correction or change in red ink. These corrections and revisions are to be noted on the plans in a manner that results in neat and legible sheets. A red pen that writes sharp, clear, and dark with a medium width line shall be used to mark these notations. Fine lined pens do not reproduce well when microfilmed and are not to be used. If electronic versions of these plans are available, corrections noted electronically and plotted in a manner that produces these same results are acceptable. Special care must be taken to ensure that changes in construction are noted on all contract plan sheets affected by the change. For instance, the change in location of a catch basin or manhole may affect the location listed in the structure note sheet, the drainage plan view sheet, and the drainage profile sheet.

If concrete foundations are partially removed, the remaining portions of the foundations should be shown on the As Built Plans. It is not required that the As-Built, Summary of Quantities sheets be revised to reflect final estimate quantities. Summary of Quantity sheets are to be marked identifying them as original plan quantities which are shown as preliminary estimates of work. It should also be noted that final As-Built quantities for individual unit bid items can be obtained from the final CAPS ledger for the project.

In order to help identify significant changes in work location or significant changes in the work completed at a particular location, the Quantity Tabulation sheets must be updated to show the actual physical feature items or the locations of installations where significant changes were made. Types of significant changes may include revisions to guardrail, guardrail termini, post types, anchors or anchor types, revisions to monuments, etc. The intent is to show what significant changes to the planned work were made. Except for significant changes to quantities of items used or items added at a particular installation, it is not necessary to update item quantities for actual quantities used. Final As Built quantities for the individual unit bid items can be more accurately obtained from the final CAPS ledger for the project.

In order to help identify significant changes in work location or the significant changes in the structure work completed at a particular location, the Structure Note sheets must be updated to show the actual physical feature items or the locations of installations where these significant changes were made. Types of significant changes may include structure notes that were added or revised, pipe size and types that were changed, revised locations for catch basins manholes, etc. The intent is to show what significant changes to the planned work were made. Except for significant changes to quantities of items used or items added at a particular installation, it is not necessary to update item quantities for actual quantities used. Final As Built quantities for the individual unit bid items involved can be more accurately obtained from the final CAPS ledger for the project.

Correction tape may only be used to complete corrections or revisions made to the Quantity Tabulation and Structure Note sheets. Correction tape is not to be used for noting corrections on any other plan sheet of the As-Built plans. If electronic versions of these sheets are available, corrections noted electronically that clearly depict that a change has been made and plotted in a manner that produces these same results, is acceptable.

In addition to the requirements outlined above for As-Constructed or As-Built contract plans, the Standard Specifications also require that the Contractor furnish the Engineer with original reproducible tracings or drawings suitable for micro-filming or for use in correcting
contract plans for; shop drawings, schematic circuit drawings etc. for Illumination, Traffic Signal Systems, and Electrical for shop drawings, including approved revisions for prestressed structural elements and all other structural steel components fabricated from shop plans. Specific requirements for these plans are outlined in Sections 6-02.3(26), 8-03.3(7), 8-03.3(10) and 8-20.3(17) of the Standard Specifications.

Upon project completion, all "As-Built" plans are to be arranged in numerical sequence, including a cover sheet with pertinent project data in the lower left corner, and submitted to the Headquarters Engineering Records office, where they will become a part of the project Permanent Final Records. The As-Built Plans will be processed for microfilming by Engineering Records and will be returned to the Region along with a set of the microfilm aperture cards when they are completed.

10-3.12 Final Record Field Notebooks

Field notebooks are bound books of notes that are used for specific kinds of work such as alignment notes, grading notes, pile driving notes, etc. Field notebooks can also consist of loose leaf field notes that have been bound together into books as well. Records that appear in the field books should not be duplicated and placed in other final record books. The only exception to this rule are copies of Field Note Records with multiple item numbers which may be copied as described in Chapter 10-4.3, Structure Notes.

Field notebooks should be consecutively numbered and each should have the pages numbered beginning with number one. Typing information in the field book is not necessary as hand lettering is preferred. As with other project records, erasure corrections of any kind are not permitted.

The quantities for payment for each item of work in the field notebook shall correspond directly to entries in the CAPS project ledger. Adequate cross-referencing must be made between the field notebook and the project ledger in order to trace item quantities and entries from one to the other.

The field notes should show the initials of the persons or person making them, the date, and the weather conditions if appropriate. In some cases different stages of work will be noted on the same page, such as staking, measurement, and construction. This would require dates and initials at each stage of work. The notes shall also show the dates that quantities are computed and checked along with the initials of those persons doing the work. In all cases, field notes should be neat and legible and show all necessary information. Figures 10-4 and 10-5 show sample field notes and summary for clearing.

Sketches should be shown when necessary to compute a quantity that cannot be computed from the As-Built Plans. Sometimes structure excavation sketches are helpful for determining the pay limits and computing the volume; other sketches are helpful on special details.

Current business practices provide for electronic calculation and storage of all types of detailed surveying data, quantity calculations, etc. Data forms for template input, calculation setup, forms for direct recording of field information, storage media for electronic files, as well as output for the calculated data shall all be treated as an original source documents. See Chapter 10-3.13 for further direction in regards to electronic data.

Remeasure cross section notes, where a deviation from the established roadway section or slopes has occurred, should be indexed carefully so that they can be identified readily with the original cross section. For convenience of calculation on remeasure, plotted cross sections may also be used.

Structure and drainage notes in the Final Record Field Notebook should show the stationing, distance left or right, angle or skew if applicable, flow line elevation and grade in the case of culverts, drains and ditches, and all information necessary for computation of the pay items involved in the construction. For convenience, it is recommended that all pay quantities pertaining to the construction of items listed on the Structure Notes sheets of the plans, be shown in the field book with structure note number, item number, and quantities, and that cross-references be used to show where the totals were obtained. It should be remembered that quantities must be segregated by group number as shown in the summary of quantities contained in the contract plans.

For use as an example, Figures 10-6 and 10-7 show the front and back of a completed field note for the installation of a reinforced concrete sewer pipe.

10-3.13 Electronically Produced Documents

There are many computer applications available for use on a WSDOT highway construction project. Included are programs for earthwork quantities, mass diagrams, basic cut and fill, geometry, surveying, and for determining structural quantities. In addition, there are many other "stand alone" applications created by individuals in each office for use on personal computers that are also recognized for these kinds of uses.

When electronic computations are used, the output generated must be bound together and identified with a title sheet for final record purposes. These documents are to be made a part of the three-year Temporary Final Records retained by the Region as explained in Chapter 10-3.1. When a computer program is used to calculate quantities for payment, the summary sheets containing the quantities entered in the project ledger must be treated as source documents with all required signatures, dates, ledger entry number, and sufficient cross referencing to provide a good audit trail.

10-3.14 Photographs

A detailed photographic record is an important part of the project documents. A photographic record could consist of filmed photographs, digital photos, infrared photographs,
video, etc. A photographic record should be taken of unusual equipment, construction methods, problem areas, areas of possible controversy, traffic control, and especially conditions in the area of an accident. In addition to these are “before” and “after” views taken from the same vantage point. These are particularly useful in documenting the progress of work. When photographs are to be maintained as a part of the project documents they must be fully identified. Photographs should clearly note when they were taken (date and time), where they were taken, and who took the picture. Although photographs are placed in the category of three-year Temporary Final Records, some Regions have extended the Region retention period for photographs or have even included them as a part of the project’s Permanent Final Records for permanent retention.

10-3.15 Pre-Estimate Reports

A Pre-Estimate report prepares the CAPS system to make an estimate payment. This report provides the opportunity for the project office to preview the estimate and is a means to allow for any corrections or deferments to be made before actual payment. The corrected Pre-Estimate Report used to make a progress payment must be signed by the Project Engineer in order to indicate authorization for payment. The signed Pre-Estimate Report must be retained in the project files, and become a part of the three-year Temporary Final Records. For additional information regarding progress payments and the CAPS system, see Chapter 1 3.1B of this manual.

10-3.16 Estimate Reports

When a payment is made to the Contractor for a progress or Final Estimate, the project office receives a copy of all the reports that are sent to the Contractor along with the warrant. The Contract Estimat Payment Advice report and the Contract Estimate Payment Totals report should be compared to the Pre-Estimate report verifying that the amount actually paid is the same as the amount authorized. These estimate reports should be kept with the completed Pre-Estimate reports in the project files, and become a part of the three-year Temporary Final Records. For additional information regarding progress payments and the CAPS system, see Chapter 1-3.1B of this manual.

10-4 Project Ledger System

10-4.1 General

The Contract Administration and Payment System (CAPS) provides both an accounting and payment system, while also acting as an information collection system. The CAPS program uses an electronic project ledger that is maintained current throughout the life of the project as the backbone of the system. All items of work on a project for which payment is made must be entered into the electronic project ledger.

Items posted in the ledger become the basis for payment and summary record document for dollars paid to the Contractor, quantity of work performed by the Contractor, status reports during the active life of the contract, and are also used as the basis for final reports when the project is completed.

As work is completed on the project, the project office continuously enters those quantities into the ledger, those records then become eligible for payment when the next progress estimate is due. Processing of monthly progress and project final estimates is further detailed in Chapter 1-3 of this manual. With the ledger entries completed, the application compiles all those records eligible for payment and transfers the data to the payment portion of the CAPS system. Because of the system’s ability to store information it is also used as an extensive resource for corporate information regarding the construction program and is used extensively by many other groups throughout WSDOT.

All electronic data incorporated into the CAPS system is stored on either an active file or a history file. These files are both permanently retained and are available for use whenever the need arises. It is not necessary, or intended, that paper copies of the project ledger be retained for final records.

Detailed instructions for the use of the CAPS system can be found in the CAPS Manual.

A key function of CAPS is to provide a complete audit trail for every pay item. An audit trail must be clearly maintained from the original source document through the actual payment to the Contractor. Audits are an effective tool used by both state and federal governments to ensure established procedures and processes are correctly used to maintain the most effective use of the public’s funds. It is important that WSDOT maintain sufficient records and documentation to clearly identify an audit trail that is capable of withstanding the test of audits.

In order to satisfy the requirements of an accounting audit, the following conditions must be met:

- There must be a source document for every ledger entry and vice-versa.
- There must be an orderly filing system to facilitate timely retrieval of source documents.
- Both Interim Progress Estimate and Final Estimate reports must be signed by the Project Engineer.
- The Contract Estimate Payment Advice report must be filed along with its corresponding Progress Estimate report.

10-4.2 Source Documents

Each ledger entry must be supported by a detailed source document, which specifically identifies the type, amount, and location of the work or material that is being entered into
CAPS for payment. Source documents used to support these entries are intended to be complete documents, documents that stand alone, and fully support the payment that is being made. If information from other documents is used in the source document, these additional document(s) must be clearly identified in order to complete the audit trail.

Some examples of source documents include Item Quantity Tickets, Field Note Records, Inspector’s Estimates, and Force Account sheets. Source documents are the beginning of the audit trail. They show that a WSDOT Inspector has observed and determined the amount of work performed by the Contractor. Also, the source document must show that all calculations have been checked by a second WSDOT employee to ensure they are correct.

Source documents must show four sets of dated initials as follows: (1) the person who does the original calculations; (2) the person who checks the original calculations; (3) the person who enters the payment quantity/amount in the CAPS ledger; and (4) the person who verifies the CAPS ledger entry. In addition, the source document must also show the ledger entry number.

Ledger entries for estimates of monthly progress quantities for grading, lump sum, or other such items must also be supported by a source document. Among other things, the source document must show the method used for determining the estimate. These methods and source documents must lead to an accurate measurement after the item of work has been completed. For lump sum items, the field notes or diaries can show an estimated percentage of work completed. If this percentage method is used, then a brief discussion outlining the basis for the calculation and any assumptions that were used should also be included.

Many project offices use electronic data collectors for surveying work. These data collectors eliminate the need for hand prepared field transit and field level books. Many project offices have also developed or routinely use other electronic programs or applications, which perform calculations and produce a report of the results. In using these applications there can be confusion regarding the need for checking data that has been compiled and reported electronically. In the absence of specific direction, when an electronically produced record or set of notes is used as a source document for a contract payment, the individual who originated the document should be noted. A second person can then check both input and output for both reasonableness and accuracy. This check may range from duplicating the process to verifying the input. Whatever the case may be, it is recommended that the dated initials of those two individuals be on the source document.

10-4.3 Source Document Filing Systems
Basic criteria for a good Source Document Filing System would include ease of set up, ease of use, and the capability to retrieve any specific document in a timely manner. The source document filing system should also be set up to coordinate easily with final records requirements. The filing system described here for source documents is not mandatory. However, it is presented as one alternative that works well with the CAPS electronic ledger system, the final records process, and is easy to use. The unique ledger entry number from CAPS makes this method work. Files are set up in two books or sets of notes. The first book is organized by Unit Bid Item Number and the second book is organized by Structure Note Number. Source documents are filed by Unit Bid Item Number except for drainage items, which are filed by Structure Note Number. With this method there is only one item per source document except for the drainage items. Drainage items are filed by Structure Note Number because their source document (field note record) normally has multiple items while the Structure Note Number is unique to a specific drainage facility. For all other items, if more than one item appears on a source document, a copy is made for each item noted, the desired item number is highlighted, and then the copy is filed behind their respective Unit Bid Item Number locations. This works extremely well if the source documents are placed in order by date in their respective files.

To look at the source document for a ledger entry, simply note the item number, entry number, and date; go to the file and look for the entry number within the item file. If files are maintained in order by date, this is made even easier. For ledger entries of drainage items, it is necessary to include the structure note number in the remarks section.

This system allows anyone to easily locate the source documents that support a contract payment. These records are retained in the Project Office until Final Record time when the source documents are bound into books with their respective titles and made a part of the three-year Temporary Final Records.

10-5 Region Project Documentation Reviews
10-5.1 General
The Region is responsible to ensure that reviews of record keeping and documentation procedures are completed during the progress of the work. This will help to ensure that the original field records are being properly prepared and that proper procedures are being followed. The Region should review specific pay items for correctness of the payments made as well as for procedural requirements for documenting and processing of contract payments, acceptance of materials and other pertinent contract administration requirements.
Reviews of specific pay items should be recorded on Form 421-014. Reviews of procedural items should be recorded on either Form 230-036A or Form 230-036B. Version A should be used for the first review made on a project. Version B places more emphasis on individual pay items and should be used for the second review or on larger projects during the initial review phase where this emphasis is more appropriate.

On projects that are estimated to cost more than $500,000, the Region should conduct an interim documentation review when the project is approximately 50 percent complete. This review should be thorough and complete to ensure that the documentation records are adequate and are being properly maintained. This review should include both procedural checks for those items listed on Form 230-036A and detailed reviews of specific pay items for accurate documentation practices of contract payments completed to date. Audit work for pay items may also be started at this time in preparation for the Final Records Review at Physical Completion. This early audit work could consist of checking any individual items that have been fully completed. Reviews of completed items that are recorded on Form 421-014, can be kept and then made a part of the Final Records check upon Physical Completion. Once the project has been completed, information from both procedural reviews and specific pay item reviews can then become a part of the Temporary Final Records.

On projects that are estimated to cost more than $500,000 and require more than 100 working days to construct, the interim documentation review should be considered as early as 30 percent completion but, where possible, no later than 50 percent completion. On these larger projects, it is particularly important that the interim reviews be sufficient to verify both documentation and procedural practices. However, on many projects, the nature of the work completed at 30 percent may or may not provide an adequate representation of the documentation procedure to merit a documentation review. In these instances, the Region should exercise considerable judgment regarding the timing of interim documentation reviews.

The Region reviewer should also exercise considerable judgment in deciding whether or not to perform additional documentation reviews in conjunction with the reviews described above. In addition to cost and time, other criteria should also be used to evaluate the need for additional documentation reviews. This could include results of previous documentation reviews as well as the history, knowledge, and experience of the specific project office personnel involved. The Region reviewer should be satisfied on a case-by-case basis that each project’s records are adequate and are being properly maintained.

It is recommended that each time a documentation review is performed on a project, that the Region reviewer discuss the results of the review with the project office staff, leaving a completed copy of Forms 230-036 and 431-014 to be included in the project temporary records.

10-5.2 Review Procedures for Final Estimates and Final Records

When work on the project is physically complete, it is important that the final records be completed and assembled in as timely a manner as possible. The final quantities should be checked and the final estimate or Final Contract Voucher Certification furnished to the Contractor as soon as is reasonably possible.

In order to facilitate this, the Project Engineer should ensure that the overall project final records, including the final contract quantities, are made ready for Region review as timely as can be and that the Region has completed their review work shortly thereafter.

The Region is responsible to ensure that the final records for the contract are complete, accurate and maintained in an orderly manner. The Region may exercise considerable judgment regarding the procedures used for this check. These procedures may include a complete check of all records or a representative sampling of records in order to validate all records maintained. If problems are discovered during the review of the representative sample, and if those problems indicate that the entire population might be flawed, then the entire population should be checked and corrected by the field office and a new representative sample taken. In conducting these final reviews the Region reviewer should mark the areas that have been checked, initialing and dating the records or portions of records that have been reviewed. The Examination Sheets for Contract Items, Form 421-014, and Documentation Review (Procedures), Forms 230-036A & B, should be kept until the contract final records check is completed and then filed with the Temporary Final Records where they can be further reviewed should an audit occur.
## Item Quantity Ticket

<table>
<thead>
<tr>
<th>Date *</th>
<th>Location</th>
<th>Group</th>
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<tr>
<td>Remarks</td>
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<table>
<thead>
<tr>
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<th>Time Weighed</th>
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<tbody>
<tr>
<td>AM</td>
<td>PM</td>
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<table>
<thead>
<tr>
<th>Received By *</th>
<th>Weighed By</th>
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<th>Truck Number *</th>
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<td>Tons</td>
<td>Hours</td>
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<tr>
<td>LBS.</td>
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<tr>
<td>Days</td>
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<table>
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<th>This Load</th>
<th>Total</th>
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<th>Ticket Number</th>
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Figure 10-1
## Contract #6767
### Johnson Creek Bridge 113/38

**Columbia Basin Region**

**Final Records Book Number 1**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SECTION</th>
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<tbody>
<tr>
<td>Listing of All Final Record books</td>
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<tr>
<td>Listing of State Personnel</td>
<td>2</td>
</tr>
<tr>
<td>Comparison of Quantities</td>
<td>3</td>
</tr>
<tr>
<td>Final Contract Voucher</td>
<td>4</td>
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<tr>
<td>Contract Estimate Payment Totals</td>
<td>5</td>
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<tr>
<td>Affidavit of Wages Paid</td>
<td>6</td>
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<tr>
<td>Change Orders</td>
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<tr>
<td>Record of Construction Materials</td>
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Figure 10-2
Contract #6767
Johnson Creek Bridge 112/38
Columbia Basin Region

Permanent Final Records
(Retained at Headquarters Records Services)

<table>
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<th>Book Description</th>
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<tbody>
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</tr>
<tr>
<td>Project Engineers Diary</td>
<td>2</td>
</tr>
<tr>
<td>Inspector’s Daily Reports</td>
<td>3</td>
</tr>
<tr>
<td>Traffic Control Reports</td>
<td>4</td>
</tr>
<tr>
<td>Pile Driving Records</td>
<td>5</td>
</tr>
<tr>
<td>Post Tensioning Records (Not used for this project)</td>
<td>-</td>
</tr>
<tr>
<td>Miscellaneous Records For Permanent Storage</td>
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<tr>
<td>As Built Plans (submitted under Separate cover dated 8/10/00)</td>
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Temporary Final Records
(Retained Within the Region)

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<td>Item Quantity Tickets</td>
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<td>Project Engineer’s Copy of Estimates</td>
</tr>
<tr>
<td>Inspector’s Record of Field Tests</td>
</tr>
<tr>
<td>Scaleman’s Diary and Scale Checks</td>
</tr>
<tr>
<td>Scale Test Reports</td>
</tr>
<tr>
<td>Concrete Pour Records</td>
</tr>
<tr>
<td>Record of Field Audits</td>
</tr>
<tr>
<td>Surfacing Depth Check Records</td>
</tr>
<tr>
<td>Approval of Source of Materials</td>
</tr>
<tr>
<td>Quantity Computation Sheets</td>
</tr>
<tr>
<td>Source document files</td>
</tr>
<tr>
<td>Drainage Notes</td>
</tr>
<tr>
<td>Contractor’s Payrolls (Federal Aid Projects)</td>
</tr>
<tr>
<td>Prints of Shop Drawings</td>
</tr>
<tr>
<td>Alignment (Transit) Book</td>
</tr>
<tr>
<td>Grade Book</td>
</tr>
<tr>
<td>Cross-Section Notes</td>
</tr>
<tr>
<td>Photographs</td>
</tr>
<tr>
<td>Mass Diagrams</td>
</tr>
<tr>
<td>Computer Summary Sheets</td>
</tr>
<tr>
<td>Computer Listings</td>
</tr>
<tr>
<td>Falsework and Form Plans</td>
</tr>
<tr>
<td>Daily Report of Force Account Worked</td>
</tr>
</tbody>
</table>

Figure 10-3

Construction Manual
January 2003
Crew: Lewis, M. Barnes, Toms

Weather: Clear, cool

Clearing & Grubbing

Group 1 Total 21.172 m² From reverse side

= 2.12 hectares

Group 2 Total 14.609 From page 4

= 1.46 hectares

Project Total = 3.58 hectares

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ITEM</th>
<th>GROUP NO.</th>
<th>DATE</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>BASIS OF MATERIAL ACCEPTANCE</th>
<th>CAPS ENTRY NO.</th>
<th>INITIALS</th>
<th>EST. NO.</th>
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<td>1</td>
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<td>-</td>
<td>2.12</td>
<td>-</td>
<td>-</td>
<td>7</td>
<td>64</td>
</tr>
<tr>
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<td>Clearing &amp; Grub.</td>
<td>2</td>
<td>2-14-95</td>
<td>-</td>
<td>1.46</td>
<td>-</td>
<td>-</td>
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<td>64</td>
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Figure 10-4
## Figure 10-5

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<th>STATION</th>
<th>LEFT</th>
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<th>LENGTH OR WIDTH</th>
<th>AREA $m^2$</th>
<th>REMARKS</th>
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<tr>
<td>57+400</td>
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<td>Begin Clearing</td>
<td>8-15</td>
<td>7</td>
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<td>18-0</td>
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<td>620</td>
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<td>61+000</td>
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<td>61+140</td>
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<td>5</td>
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<td>21</td>
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Figure 10-6
## STRUCTURE EXCAVATION

(PIPE STRUCTURE EXCAVATION WIDTH = 1 m )

<table>
<thead>
<tr>
<th>STATION</th>
<th>FLOW LINE</th>
<th>ORIGINAL GROUND</th>
<th>SUB-GRADE</th>
<th>CENTERLINE CUT</th>
<th>DRAWN</th>
<th>OFFSET</th>
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<tr>
<td>0+000</td>
<td>122.28</td>
<td>123.02</td>
<td></td>
<td></td>
<td></td>
<td>0.74</td>
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<tr>
<td>0+007</td>
<td>122.29</td>
<td>123.02</td>
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<td>122.97</td>
<td>0.69</td>
<td>BEGIN STR. EXC.</td>
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<tr>
<td>0+010</td>
<td>122.53</td>
<td>122.76</td>
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<td>122.80</td>
<td>123.14</td>
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<td>123.51</td>
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<td>0+040</td>
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<td>0+049.3</td>
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<td>123.81</td>
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</table>

### REMARKS

- **BEGIN STR. EXC.**
- **END STR. EXC.**

### Calculation:

- \( \text{Volume} = 0.65 \times 0.91 \times 0.61 = 0.26571 \text{m}^3 \)

### Total Volume:

- **Group 2**: \( 15.3 \text{m}^3 \)
- **Group 4**: \( 6.7 \text{m}^3 \)
- **Total**: \( 17.6 \text{m}^3 \)

---

**Figure 10-7**
<table>
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<th>C</th>
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<td>Acceptance of concrete, 6-8</td>
<td>Calendar cutoff dates, 5-7</td>
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<td>Acceptance samples and tests, 9-1</td>
<td>Caliper, 8-6</td>
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<tr>
<td>Acid soil/alkaline soil, 8-6</td>
<td>Cane, 8-6</td>
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<tr>
<td>Admixtures, 9-31</td>
<td>Cast-in-place concrete piling, 6-34</td>
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<tr>
<td>Aeration, 2-6</td>
<td>Castings, 9-19</td>
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<tr>
<td>Aerial photographs, 2-12</td>
<td>Catch basins, 7-5, 9-26</td>
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<td>Affidavit of wages paid, 1-69</td>
<td>Cement concrete pavement, 5-20</td>
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<td>Aggregates for asphalt concrete and asphalt treated base, 9-14</td>
<td>Change order - checklist, 1-33</td>
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<tr>
<td>Air entraining admixtures and water reducing admixtures, 9-31</td>
<td>Change order executed by ferries, 1-35</td>
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<td>Anchor bolts, 6-28, 9-21, 9-34</td>
<td>Change order executed by regions, 1-33</td>
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<td>Anchor bolts for luminaire, signal poles, and sign, 9-34</td>
<td>Change order executed by the State Construction Office, 1-33</td>
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<td>Changes in the work, 1-25</td>
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<td>Channel excavation, 2-15</td>
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<td>Clearing and grubbing - combined, 2-1</td>
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<td>Clearing the site, 6-2</td>
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<td>Concrete, 9-37</td>
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<td>Concrete culvert, sewer, drain, and underdrain pipe, 9-17</td>
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<td>Backflow, 8-17</td>
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<tr>
<td>Ballast and crushed surfacing, 4-1</td>
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<td>Ball and burlapped, 8-6</td>
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<tr>
<td>Bank run gravel, 9-15</td>
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<td>Bare root, 8-6</td>
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<tr>
<td>Barrier, 6-16</td>
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<td>Basis for acceptance, 9-40</td>
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<tr>
<td>Beam guardrail, guardrail anchors, and glare screen, 9-29</td>
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