***(September 8, 2020)***

***Rock Bolt and Rock Dowel Materials***

Rock bolts shall be continuously threaded steel reinforcement bars conforming to either; AASHTO M 31 Grade 60 or 75 deformed bar, ASTM 615 Grade 60 or 75 deformed bar, ASTM A 706 Grade 60 or 80 deformed bar, ASTM A 722 Grade 150 Type II, or AASHTO M 275 Grade 150 Type II and shall be capable of being post-tensioned to the design loads, performance test loads, and proof loads specified. The bending requirements of AASHTO M 31, ASTM 615, and ASTM 706 shall be waived.

Rock dowels shall be continuously threaded steel reinforcement bars conforming to either; AASHTO M 31 Grade 60 or 75 deformed bar, ASTM A 615 Grade 60 or 75 deformed bar, or ASTM A 706 Grade 60 or 80 deformed bar with a minimum size of a No. 7 bar for Type 1 rock dowels, and a minimum size of a No.11 bar for Type 2 rock dowels. The bending requirements of AASHTO M 31, ASTM 615, and ASTM 706 shall be waived.

Anchor bar steel for rock bolts and dowels shall be provided with epoxy coating in accordance with either AASHTO M 284, ASTM A 775, or ASTM A 934. The patching material, compatible with coating material and inert in grout selected for use, shall be supplied with each shipment.

Bearing plated shall be galvanized in accordance with either AASHTO M 111, AASHTO M 232, ASTM A 123, or ASTM A 153, and shall conform to ASTM A 36 Grade 36 or ASTM A 572 Grade 50. Bearing plate size will be reviewed and approved by the Engineer in accordance with Section 6.10 of Post Tensioning Institute "Recommendations for Prestressed Rock and Soil Anchors". Bearing plate thickness shall be not less than ¾ inch and its dimensions not less than 2 inches greater than the drill hole diameter.

Nuts and couplers shall be galvanized in accordance with either AASHTO M 232 or ASTM A 153 and exceed 100 percent of the MUTS (Minimum Ultimate Tensile Strength) of the bar. For Grades 60, 75, and 80 bar the nuts and coupler shall conform to either AASHTO M 169 or ASTM A 108. For Grade 150 bar the nuts shall conform to either ASTM A 29 or ASTM A 536, couplers shall conform to ASTM A 29.

Washers shall be galvanized in accordance with AASHTO M 232 or ASTM A 153 and conform to ASTM F 436. Spherical and beveled washers shall be galvanized in accordance with AASHTO M 232 or ASTM A 153 and conform to ASTM A 536 or ASTM A 47.

Centralizers shall be fabricated from plastic or material which is non-detrimental to the pre-stressing steel. Wood shall not be used.

Grout shall conform to Section 9-20.3(2).

Sleeved bondbreakers for rock bolts shall be fabricated from plastic tube or pipe having the following properties:

1. Restistant to chemical attack from aggressive environment, grout or corrosion inhibiting compound.

2. Resistant to aging by ultra-violet light.

3. Non-detrimental to bolt. Resistant to damage caused by abrasion, impact, crushing and bending during handling and installation.

4. Enable the bolt to elongate during testing.

5. Resistant to distortion caused by heat generated by the curing of the grout.

The wall thickness of sleeved bondbreaker shall meet the following:

| Type | Nominal | Minimum |
|---|---|---|
| HDPE/PP | 0.060 in. (1.5 mm) | 0.050 in. (1.25 mm) |
| PVC | 0.040 in. (1.0 mm) | 0.035 in. (0.9 mm) |

Corrosion inhibiting compounds shall be provided by the manufacturer or shall be either a grease, wax, or gel and conforms to the following:

| Properties | Test Method | Criteria | | |
|---|---|---|---|---|
| | | Grease | Wax[1] | Gel[1] |
| Dropping Point, °F min. | ASTM D 566 | 300° | N/A | N/A |
| Melting Point, °F min. | ASTM D 127[(2)] | N/A | 145° | 500° |
| Oil Separation @160°F, max. | FTMS 791B Method 321.2 | 0.5 | N/A (product is liquid) | 0.5 |
| Water, % max. | ASTM D 95 | 0.1 | 0.4 | 0.4 |
| Flash Point °F, min. | ASTM D 92 | 300° | 300° | |
| Accelerated Corrosion Test: Salt Fog @ 100°F @ 5 mils, hrs. min. | ASTM B 117 | 1000 | 1000 | 1000 |
| Water Soluble Ions, ppm max. | | | | |
| a. Chloride | ASTM D 512 | 10 | 10 | 10 |
| b. Sulfides | APHA 4500S$^2$-E | 10 | 10 | 10 |
| c. Nitrates | ASTM D 3867 | 10 | 10 | 10 |
| Soak Test: Salt Fog 50/50 Immersion, hrs. | ASTM B 117 Modified | 720+ | 720+ | 720+ |
| Sheathing Compatibility @150°F | | | | |
| a. Hardness % max change | ASTM D 4289 | 15% change | 15% change | 15% change |
| b. Volume % max change | ASTM D 4289 | 10% change | 10% change | 10% change |
| c. Tensile Strength % max change | ASTM D 638 | 30% change | 30% change | 30% change |
| Note 1: A combination of wax and gel is possible when approved by the Engineer.<br>Note 2: ASTM D 566 may be used when the wax product consistency warrant it. | | | | |

Anchorage covers for rock bolts shall be galvanized in accordance with either AASHTO M 111 or ASTM F2329 as applicable, and have a minimum thickness of 0.20 inches; and shall conform to either ASTM A 53 for pipe, or ASTM A 500 for tubing, or ASTM A 36, ASTM A 529, ASTM A 572, ASTM A 588, or AASHTO M 270 for fabricated steel.