



1    **CRSI Standard for**  
 2    **Epoxy Coating Plant: Straight Bar, Custom, and Textured Lines**

3    **SECTION I. COMMON REQUIREMENTS**

4    **1. INTRODUCTION**

- 5        1.1. This Standard specifies procedures used to monitor the application process and assess quality during the  
 6            application of epoxy coating to straight steel reinforcing bars, pre-fabricated steel reinforcing bars and  
 7            products, and textured bars and products.  
 8        1.2. This Standard also describes minimum requirements for testing, inspection, acceptance criteria,  
 9            documentation, and corrective actions as part of a quality control program.

10  
 11    **2. REFERENCED DOCUMENTS**

- 12        2.1. ASTM International<sup>1</sup>
- 13            2.1.1. STP 447B Manual on Test Sieving Methods
- 14            2.1.2. D3330 / D3330M Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape
- 15            2.1.3. D3652 / D3652M Standard Test Method for Thickness of Pressure-Sensitive Tapes
- 16            2.1.4. D3759 / D3759M Standard Test Method for Breaking Strength and Elongation of Pressure-  
 17            Sensitive Tape
- 18            2.1.5. D4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
- 19            2.1.6. G62 Standard Test Methods for Holiday Detection in Pipeline Coatings
- 20            2.1.7. G8 Standard Test Methods for Cathodic Disbonding of Pipeline Coatings
- 21            Note: Coating under this standard is generally performed according to ASTM A775/A775M, ASTM  
 22            A884/A884M, ASTM A934/A934M, ASTM A1078/A1078M, or ASTM A1124/A1124M.
- 23        2.2. SSPC<sup>2</sup>
- 24            2.2.1. VIS1 Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast  
 25            Cleaning
- 26            2.2.2. SSPC-PA 2 Measurement of Dry Coating Thickness with Magnetic Gages
- 27        2.3. CRSI
- 28            2.3.1. Visual Contamination Standard
- 29            2.3.2. Chloride Visual Standard
- 30            2.3.3. Copper Sulfate Visual Standard
- 31

<sup>1</sup> ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania, USA

<sup>2</sup> SSPC - 40 24th St 6th Fl, Pittsburgh, PA 15222



- 32        2.4. ASME
- 33            2.4.1. B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)
- 34
- 35    **3. DEFINITIONS**
- 36        3.1. Abrasive Blast Cleaner
- 37            3.1.1. Equipment that uses abrasive material to clean and profile the steel .
- 38        3.2. Batch
- 39            3.2.1. Set of products that are processed as a group.
- 40        3.3. Coating Application Line
- 41            3.3.1. The coating application system associated with a single coating booth or abrasive blast cleaner.
- 42        3.4. Coating Quality Manual (CQM)
- 43            3.4.1. A manual describing the Plant commitment to and methods for obtaining quality.
- 44        3.5. Corrosion-resistant Coating
- 45            3.5.1. Coating applied directly to steel products to provide corrosion protection based on ASTM A775,
- 46                      A884, A934, A1078, or similar specifications.
- 47        3.6. “Kick-off” table
- 48            3.6.1. An area attached to the coating line used for storage of bars immediately after coating and curing
- 49                      operations.
- 50        3.7. Plant
- 51            3.7.1. Postal address location of the coating line.
- 52        3.8. Plant Quality Statement (PQS)
- 53            3.8.1. A statement from a Company Senior Executive that outlines the Plant’s commitment to quality.
- 54        3.9. Product
- 55            3.9.1. An individual element of steel being coated (e.g. a single bar or a single section of welded wire
- 56                      fabric)
- 57        3.10. Product Size
- 58            3.10.1. The weight and physical dimensions of steel being coated.
- 59        3.11. Production Shift
- 60            3.11.1. Consecutive run time, not to exceed 12 hours.
- 61        3.12. Quality Inspector (QI)
- 62            3.12.1. Personnel responsible for coating quality activities and documentation.
- 63        3.13. Quality Manager (QM)
- 64            3.13.1. A manager responsible for all issues relating to coating within a plant.
- 65
- 66

- 67 3.14. Strands
- 68 3.14.1. The individual tracks on the coating line that a bar can follow during the coating process on a
- 69 straight bar line.
- 70 3.15. Textured coating
- 71 3.15.1. A texturing surface treatment material applied after a corrosion-resistant coating is applied to steel
- 72 and based on ASTM A1124.
- 73 3.16. Time of examination
- 74 3.16.1. Time of examination is defined in this specification as a point of time measured in hours and
- 75 minutes.
- 76 3.17. Time-to-Support
- 77 3.17.1. The time between when a section of product exits the powder spray cloud and makes contact with
- 78 any support system.
- 79 3.18. Time-to-Cure
- 80 3.18.1. The time between when a section of product exits the powder spray cloud and makes contact with
- 81 the quenching water, if used, or when it is first handled, if air cooled.
- 82 3.19. Void
- 83 3.19.1. Area on the coated product that was not coated due to contact with the coating line equipment.
- 84

#### 85 4. DOCUMENTATION

- 86 4.1. Coating Quality Manual - All plants shall develop and maintain a Coating Quality Manual (CQM). The CQM
- 87 shall:
- 88 4.1.1. Be signed by an authorized representative of the manufacturing organization.
- 89 4.1.2. Document facility name, street address and telephone number and the name of the person
- 90 responsible for maintaining the CQM at the plant.
- 91 4.1.3. Describe requirements for annual review and updating. Changes to the CQM shall be highlighted
- 92 or underlined and tracked by revision date.
- 93 4.1.3.1. This review shall evaluate existing documentation for accuracy and conformance with
- 94 current practice and applicable standards. Based on this review, changes to the CQM
- 95 shall be made.
- 96 4.1.4. Include an organization chart, and a description of the duties and responsibilities assigned to key
- 97 personnel in the quality program.
- 98 4.1.5. Describe the coating application systems at the plant, including the number of blast cleaners, the
- 99 number of lines, the number of products coated at the same time (e.g. strands), and identifying
- 100 whether cleaning and coating occurs in line.

- 101 4.1.6. Identify the measuring and testing equipment used to determine that the product and materials  
102 meet minimum specifications.
- 103 4.1.7. Identify the frequency and methods of measuring, testing equipment calibration and requirements  
104 for record-keeping. At minimum, this shall include equipment used for: anchor profile testing,  
105 handheld holiday testing, infrared temperature, coating thickness measurement, abrasive gradation  
106 (scale), and cathodic disbondment (electrode).
- 107 4.1.8. Include a Plant Quality Statement (PQS) from a Company Senior Executive that outlines the plant's  
108 commitment to quality and compliance with applicable ASTM standards and purchaser's  
109 specifications.
- 110 4.1.9. Describe access, including location, to the CQM, and applicable CRSI standards, ASTM standards  
111 and purchasers or governing specifications that shall allow access for all personnel involved in  
112 coating.
- 113 4.1.10. Describe methods for assurance and documentation of the presence of QM or QI during the coating  
114 application process.
- 115 4.1.11. Describe the authority of QM and QI.
- 116 4.1.12. Describe retention of all quality control documentation.
- 117 4.1.13. Provide examples of all forms to be used to document quality.
- 118 4.1.14. Include frequency of training and methods used to train the production personnel involved in the  
119 coating process and the QI and to document this training including, as a minimum:
- 120 4.1.14.1. Training topics and materials provided.
- 121 4.1.14.2. Attendance forms signed by those trained.
- 122 4.1.15. Define requirements for QM (or designated representative) led meetings to review and evaluate  
123 the quality techniques of all QI once every six months in the plant using the manufacturer's  
124 equipment and to assess compliance of those techniques with the CQM.
- 125 4.1.15.1. Minutes of QM/QI review and evaluation meetings.
- 126 4.1.15.2. Attendance forms signed by the attendees of the meetings.
- 127 4.1.16. Define requirements for documentation, observation, and testing as part of a quality program as  
128 required in Sections 5 through 13, including:
- 129 4.1.16.1. Documentation of QI inspections.
- 130 4.1.16.2. Minimum acceptable levels to ensure products comply with the applicable standards or  
131 purchaser's specifications.
- 132 4.1.16.3. Corrective action procedures to be taken when minimum acceptable levels are not  
133 achieved.
- 134 4.1.17. Identify statistical process control methods, if used.
- 135 4.1.18. Define methods used for handling External Audits documents.

- 136 4.1.19. Define methods used for handling customer complaints.
- 137 4.1.20. Describe the method and frequency for a representative of plant management to conduct a
- 138 documented review of the QI inspection paperwork for general compliance with the requirements
- 139 of the CQM.
- 140
- 141 **5. SURFACE CONDITION OF UNCOATED PRODUCTS**
- 142 5.1. Contaminants
- 143 5.1.1. Prior to blasting, all uncoated products shall be visually inspected to ensure they are free of visible
- 144 contaminants such as oil, grease, and salts.
- 145 5.1.1.1. Products with visible contaminants that cannot be removed prior to abrasive blast
- 146 cleaning shall not be abrasive blast-cleaned or coated.
- 147 5.1.2. The QI shall examine products for contamination at least once per production shift and product size
- 148 change.
- 149 5.1.2.1. The QI shall document the time and results of the examinations.
- 150 5.2. Surface Defects
- 151 5.2.1. All uncoated products shall be visually inspected to ensure they are free of sharp edges on
- 152 deformations, rolled-in slivers, or similar defects that would affect continuity of the epoxy coating.
- 153 5.2.1.1. Products with surface defects that cannot be removed shall not be abrasive blast-
- 154 cleaned or coated.
- 155 5.2.2. The QI shall examine product for surface defects at least once per production shift and product size
- 156 change.
- 157 5.2.2.1. The QI shall document the time and results of these examinations.
- 158 5.3. Abrasive Blast Cleaning
- 159 5.3.1. Uncoated products shall be cleaned by abrasive blasting such that all visible traces of mill scale,
- 160 rust, and other foreign matter are removed.
- 161 5.3.2. High-pressure, dry-air knives and/or brushes shall be used after abrasive blast cleaning to remove
- 162 dust, grit, and other foreign matter from the abrasive blast-cleaned steel surface. The air knives or
- 163 brushes shall not deposit oil, water, or other contaminants on products.
- 164 5.3.3. The QI shall perform a visual comparison with SSPC-VIS 1, Visual Standard for Abrasive Blast-
- 165 Cleaned Steel, for each abrasive blast cleaner and each product size being abrasive blast-cleaned,
- 166 a minimum once every four hours of production, and whenever the size of product being abrasive
- 167 blast-cleaned is changed.
- 168 5.3.3.1. Abrasive blast-cleaned product shall meet the requirements of SSPC-SP 10, Near-
- 169 White Blast Cleaning.

- 170 5.3.3.2. Samples shall be taken on a rotating basis from each position/strand on each coating  
171 application line.
- 172 5.3.3.3. The QI shall document the time and results of the examinations.
- 173 5.3.3.4. SSPC-VIS 1, Visual Standard for Abrasive Blast-Cleaned Steel, shall be kept at a  
174 location accessible to where the abrasive blast-cleaned product is inspected.
- 175 5.3.4. The QI shall conduct the Backside Contamination Tape Test (TM-1), Detection of Chlorides –  
176 Paper Test (TM-3A), and Copper Sulfate Test (TM-4) on the same randomly selected product.
- 177 5.3.4.1. The QI shall document the time the sample was taken and results of these  
178 examinations.
- 179 5.3.4.2. Samples shall be taken on a rotating basis from each position/strand on each coating  
180 application line.
- 181 5.3.4.3. The minimum acceptance criteria for these three tests are defined as follows:
- 182 5.3.4.3.1. Backside contamination – The average of the backside contamination  
183 measurements shall not exceed:
- 184 5.3.4.3.1.1. 20% for plain and deformed reinforcement that is straight
- 185 5.3.4.3.1.2. 25% for all other products (bent reinforcement, mesh, baskets,  
186 and accessories).
- 187 5.3.4.3.2. Chlorides – Chlorides shall not exceed trace levels (0.03%) in the test  
188 results per TM-3A.
- 189 5.3.4.3.3. Copper Sulfate – Mill scale (as identified by the copper sulfate test) shall not  
190 exceed:
- 191 5.3.4.3.3.1. 3% for plain and deformed reinforcement that is straight
- 192 5.3.4.3.3.2. 5% for all other products (bent reinforcement, mesh, baskets,  
193 and accessories).
- 194 5.3.4.4. The tests shall be conducted once every four hours of production for each abrasive  
195 blast cleaner and each product size being abrasive blast-cleaned, and whenever the  
196 product being abrasive blast cleaned is changed.
- 197 5.4. Anchor Profile
- 198 5.4.1. Uncoated product shall be abrasive blast-cleaned such that the surface of the product has an  
199 anchor profile with a maximum roughness depth,  $R_{max}$ , of 1.5 to 4.0 mil [40 to 100  $\mu\text{m}$ ]. If the  
200 product wire size is less than 0.1875 inches, the minimum anchor profile shall be 1.2 mils.
- 201 5.4.2. The QI shall perform surface profile measurements using electronic stylus instruments according  
202 to TM-5A – Electronic Stylus (Profilometer) Measurements of Profile of Blast Cleaned Steel.
- 203 5.4.2.1. The QI shall document the time the specimen was taken, product, and measurements  
204 of peak count,  $P_c$ , and maximum roughness depth,  $R_{max}$ .



- 205 5.4.3. Replica tape testing according to TM-6 – Surface Profile Measurements Using Replica Tape shall  
206 be used as an alternate to the profilometer when a profilometer is unavailable. The procedures for  
207 such use shall be described in the CQM.
- 208 5.4.3.1. Replica tape shall not be used for more than a period of 4 consecutive production  
209 weeks.
- 210 5.4.3.2. The QI shall document the time the specimen was taken, product size, and  
211 measurements of maximum roughness depth.
- 212 5.4.3.3. The use of replica tape testing shall be documented by the QI.
- 213 5.4.4. Testing shall be conducted once per production shift for each abrasive blast cleaner and whenever  
214 the product size is changed.
- 215 5.4.4.1. Samples shall be taken on a rotating basis from each position/strand on coating  
216 application line.
- 217 5.5. Abrasive Contamination – Oil
- 218 5.5.1. The blasting abrasive shall be evaluated for oil contamination using TM-8.
- 219 5.5.1.1. The blasting abrasive shall exhibit no visible oil.
- 220 5.5.2. The QI shall test the blasting abrasive for oil once from each blast cleaner per production shift and  
221 whenever oil contaminants is discovered on cleaned product.
- 222 5.5.2.1. The QI shall document the time the abrasive specimen was taken and results of these  
223 tests.
- 224 5.6. Abrasive Contamination – Chloride
- 225 5.6.1. Chloride contaminants in the blasting abrasive shall be evaluated using TM-3A.
- 226 5.6.1.1. The chloride contamination level shall not exceed trace levels (0.03%).
- 227 5.6.2. The QI shall test the blasting abrasive once from each blast cleaner per production shift and  
228 whenever chlorides contaminants are discovered on cleaned products.
- 229 5.6.2.1. The QI shall document the time the abrasive specimen was taken and results of the  
230 examinations.
- 231 5.7. Abrasive Gradation
- 232 5.7.1. The blasting abrasive shall be within the range of gradation targeted by the Plant.
- 233 5.7.2. The target gradation range of the blasting abrasive shall be identified and a hard copy shall be  
234 posted near the blasting operation.
- 235 5.7.3. The QI shall perform a sieve analysis of the blasting abrasive in accordance with ASTM STP-447B,  
236 Manual on Test Sieving Methods (TM-7).
- 237 5.7.4. Testing shall be conducted a minimum of once per week for each abrasive blast cleaner.
- 238 5.7.4.1. The QI shall document the time the abrasive specimen was taken and the results of  
239 these tests.



240  
241  
242  
243  
244  
245  
246  
247  
248  
249  
250  
251  
252  
253  
254  
255  
256  
257  
258  
259  
260  
261  
262  
263  
264  
265  
266  
267  
268  
269  
270  
271  
272  
273

**6. HEATING**

6.1. Steel Surface Temperature

- 6.1.1. The steel surface temperature shall be within the powder manufacturer’s recommended temperature range for the specific epoxy powder and product size.
- 6.1.2. The surface temperature of the steel shall be measured before coating using non-sulfurous temperature-sensitive crayons (TM-9) or infrared temperature gauge corrected for steel emissivity or both.
  - 6.1.2.1. The surface temperature of the steel shall be measured and recorded a minimum of every half-hour and whenever the product size is changed.
- 6.1.3. An infrared temperature gauge shall be used to measure the steel surface temperature after the epoxy coating has been applied.
  - 6.1.3.1. The surface temperature of the steel shall be measured and recorded a minimum of every half-hour and whenever the product size is changed.
- 6.1.4. Temperature readings shall be taken on a rotating basis from each position/strand on each coating application line.
- 6.1.5. The QI shall measure surface temperature of the steel before and after coating at least once per production shift and whenever the product size changes.
  - 6.1.5.1. The QI shall document the time and results of these measurements.

**7. EPOXY POWDER**

7.1. Receiving, Storage, and Handling of Epoxy Powder

- 7.1.1. Receiving, Storage and Handling Temperature
  - 7.1.1.1. Temperature of the epoxy powder shall be checked from a randomly selected container upon delivery.
    - 7.1.1.1.1. This shall be documented for all deliveries.
  - 7.1.1.2. Epoxy powder shall be stored in closed containers in an area where the temperature is continuously maintained within the epoxy powder manufacturer’s specified limits.
    - 7.1.1.2.1. The storage area temperature shall be continuously measured and documented by an automatic temperature logging system.
    - 7.1.1.2.2. The QI shall measure and document the storage area temperature once per shift.
  - 7.1.1.3. Epoxy powder that exceeds the powder manufacturer’s storage or transportation temperature limits shall be clearly marked or tagged and shall not be used to coat steel

- 274 unless approved in writing by the powder manufacturer. The plant shall maintain  
275 documentation of:
- 276 7.1.1.3.1. Manufacturer's recertification of epoxy powder that has exceeded its powder  
277 manufacturer's temperature limits, if the powder is recertified.
- 278 7.1.1.3.2. Disposition of epoxy powder that exceeds the epoxy powder manufacturer's  
279 temperature limits.
- 280 7.1.2. Expiration
- 281 7.1.2.1. The QI shall verify that the age of the epoxy powder does not exceed the powder  
282 manufacturer's expiration date prior to use.
- 283 7.1.2.1.1. The QI shall document the lot(s) in use and the time and results of this  
284 verification at least once per shift.
- 285 7.1.2.2. Epoxy powder that exceeds the powder manufacturer's expiration date shall be clearly  
286 marked or tagged and shall not be used to coat steel unless approved in writing by the  
287 powder manufacturer. The plant shall maintain documentation of:
- 288 7.1.2.2.1. Manufacturer's recertification of epoxy powder that has exceeded its  
289 manufacturer's expiration date, if the powder is recertified.
- 290 7.1.2.2.2. Disposition of epoxy powder that exceeds the powder manufacturer's  
291 expiration date.
- 292 7.1.3. Powder Certification
- 293 7.1.3.1. For each batch of epoxy powder, the epoxy powder manufacturer shall provide a written  
294 certification of compliance to the applicable ASTM standards for the epoxy powder.
- 295 7.1.3.2. The epoxy powder manufacturer shall also certify that the epoxy powder supplied has  
296 the same composition as the epoxy powder that was prequalified to establish  
297 compliance to the applicable ASTM standards.
- 298 7.1.3.3. The epoxy powder manufacturer shall provide documentation identifying the following  
299 information:
- 300 7.1.3.3.1. product name and type,
- 301 7.1.3.3.2. batch number,
- 302 7.1.3.3.3. quantity represented,
- 303 7.1.3.3.4. date of manufacture,
- 304 7.1.3.3.5. powder expiration date,
- 305 7.1.3.3.6. allowable storage and transportation temperature ranges, and
- 306 7.1.3.3.7. name and address of manufacturer.
- 307 7.1.3.4. The QI shall maintain the written certifications of compliance of the epoxy powder.  
308



- 309 7.2. Epoxy Powder Application
- 310 7.2.1. Time interval prior to coating
- 311 7.2.1.1. The time interval between abrasive blast cleaning and application of the epoxy coating
- 312 shall be measured and documented at least once per production shift on each batch
- 313 that is being blasted and at any time the production is stopped.
- 314 7.2.1.2. The time interval shall not exceed:
- 315 7.2.1.2.1. For products coated on a straight bar line: 60 minutes
- 316 7.2.1.2.2. For products coated on a custom line: the time permitted by the applicable
- 317 standard or a maximum of 180 minutes.
- 318 7.2.1.3. The QI shall document the time and results of the inspections once per production shift.
- 319 7.2.2. Examination for oxides
- 320 7.2.2.1. When abrasive blast cleaning and coating application are not in-line:
- 321 7.2.2.1.1. Production personnel shall visually examine the products immediately prior
- 322 to coating for oxide formations to ensure acceptance under SSPC-SP 10 on
- 323 an on-going basis.
- 324 7.2.2.1.2. The QI shall examine blast-cleaned products for oxide formations
- 325 immediately prior to coating to ensure acceptance to SSPC-SP 10. If oxides
- 326 are visible, the products shall be re-blasted.
- 327 7.2.2.1.3. The QI shall document the time and results of the inspections once per
- 328 production shift.
- 329 7.2.3. Epoxy powder application system
- 330 7.2.3.1. The QI shall examine the performance of the electrostatic epoxy powder application
- 331 system to provide a consistent and continuous coating a minimum of once per
- 332 production shift and shall require adjustments as necessary.
- 333 7.2.3.1.1. The QI shall document the time of the inspection and results of the
- 334 inspections at least once per production shift.
- 335 7.3. Air Supply
- 336 7.3.1. The QI shall examine the compressed air drying system to ensure that it is functional.
- 337 7.3.2. System components shall be maintained according to the manufacturer's recommendations.
- 338 7.3.2.1. The QI shall document the time and results of the examination of the air drying system
- 339 all modifications at least once per production shift.
- 340

## 341 8. CURING

342 *See Section II, III and/or IV depending on type of certification.*

343



344 **9. ASSESSMENT OF CURED EPOXY COATING**

345 *See Section II, III and/or IV depending on type of certification.*

346

347 **10. HANDLING AND STORAGE OF EPOXY-COATED PRODUCTS**

348 10.1. Handling and Storage

349 10.1.1. Handling systems and storage racks shall have padded contact areas. Bundling bands shall be  
350 padded or shall be made of a material that will prevent damage to the coating.

351 10.1.2. To minimize product abrasion from sags in the bundles, bundles shall be lifted with a strongback,  
352 spreader bar, multiple supports, or platform bridge.

353 10.1.3. The QI shall examine handling and storage systems for epoxy-coated products once per week.

354 10.1.4. The QI shall document the time and results of the examination.

355 10.2. Repair Materials

356 10.2.1. All patching material shall meet the requirements of the applicable standard.

357 10.2.1.1. Documentation shall be obtained from the material supplier upon receipt.

358 10.2.1.2. The QI shall document compliance before patching material is used.

359 10.3. Repair of Damaged Coating

360 10.3.1. Repair Processes

361 10.3.1.1. Damaged coating shall be repaired in accordance with the patching material  
362 manufacturer's written recommendations.

363 10.3.1.2. The patching material shall be used within the expiration date.

364 10.3.1.3. The maximum amount of repaired damaged coating shall not exceed the amount  
365 permitted by the applicable standard.

366 10.3.1.4. Repairs of damaged areas shall have a minimum coating thickness as required by the  
367 applicable standard. Repair thickness shall be verified by visual inspection.

368 10.3.1.5. The QI shall examine the repair processes to ensure compliance once per production  
369 week.

370 10.3.1.5.1. The QI shall document time and results of the examination.

371 10.3.2. Inspection and Repair of Damage

372 10.3.2.1. All epoxy-coated products shall be inspected for damaged coating before shipment.

373 10.3.2.2. All epoxy coating damaged prior to shipment shall be repaired with patching material.

374 10.3.2.3. The QI shall examine the epoxy-coated products ready for shipment to the jobsite to  
375 ensure all damage is repaired at least once per production shift.

376 10.3.2.3.1. The QI shall document the time and results of the examination.

377 10.4. Outdoor Storage



- 378            10.4.1. Epoxy-coated products shall be stored in a manner that protects them from exposure to moisture
- 379                            and direct sunlight if stored outside for more than 30 days.
- 380                            10.4.1.1.    The date of outdoor storage shall be documented.
- 381            10.4.2. The QI shall examine any epoxy-coated products stored outdoors at least once per week to assess
- 382                            length of outdoor storage and determine that the protective system is in place as required.
- 383                            10.4.2.1.    The QI shall document the time and results of the examination.
- 384

385    **11. PRODUCT IDENTIFICATION AND REJECTED MATERIAL**

- 386            11.1. The Plant shall maintain a product marking and identification system that permits traceability of the
- 387                            materials and products to quality records and processes throughout the Plant.
- 388            11.2. Materials that are deemed nonconforming shall be clearly identified and marked according to the applicable
- 389                            standard and separated from acceptable material.
- 390            11.3. The QI shall check inventory and product identification tags for compliance with product identification
- 391                            requirements, verify that rejected products are identified and separated at least once per production shift,
- 392                            and complete the applicable section of the Inspection Form.
- 393                            11.3.1. The QI shall document the time and results of the examination.
- 394

395    **12. EXTERNAL AUDITS**

- 396            12.1. All documentation relating to external audits shall be retained in the Plant's files.
- 397                            12.1.1. Action taken related to conformance shall be documented, and changes made to the CQM, if
- 398                            required.
- 399

400    **13. CUSTOMER COMPLAINTS**

- 401            13.1. The QM or designated person shall address customer complaints, determine root cause(s), and document
- 402                            findings and actions.
- 403                            13.1.1. Changes in procedures and/or training resulting from complaints shall be documented in the CQM.
- 404
- 405



406 **SECTION II. STRAIGHT BAR LINES**

407 *In addition to the Common Requirements, the following sections apply for straight bar lines.*

408

409 **8. CURING**

410 8.1. Time-to-Support

411 8.1.1. The QI shall examine the coated bars and material transport system for signs of epoxy coating  
412 damage or smearing related to uncured coating.

413 8.1.2. The QI shall measure the time-to-support, which is the time the coated bars take from exiting the  
414 epoxy powder spray cloud to the initial contact point. The time-to-support shall be equal to, or  
415 greater than, the gel time as defined by the powder manufacturer.

416 8.1.3. The QI shall document the time and results of these examinations at least once per production shift  
417 and whenever the bar size changes.

418 8.2. Time-to-Cure

419 8.2.1. The QI shall measure the time-to-cure, which is the time from when the coated steel exits the epoxy  
420 powder spray cloud to the time it is quenched with water (if used) or it is discharged from the “kick-  
421 off” table.

422 8.2.2. The time-to-cure shall comply with the time-to-cure requirements specified by the powder  
423 manufacturer for the operating coating temperature (i.e. the powder manufacturer’s cure time-  
424 temperature requirements).

425 8.2.3. The QI shall document the time and results of these examinations at least once per production shift  
426 and whenever the line speed or the bar size changes.

427

428 **9. ASSESSMENT OF CURED EPOXY COATING**

429 9.1. Continuity of Coating (Holiday Monitoring)

430 9.1.1. An operational in-line 67.5-V, 80,000 ohms wet-sponge type or similar direct-current holiday  
431 detector with an automated holiday counter shall be provided for each strand of the production line.

432 9.1.2. In-line and hand-held holiday detectors shall be operated and maintained in accordance with the  
433 manufacturer’s instructions.

434 9.1.2.1. Hand-held measurements are to be conducted according to TM-10 Coating  
435 Discontinuity (Holiday) Test.

436 9.1.3. Coated bars with a calculated average of more than one holiday per foot over the full length of bar,  
437 shall be rejected.

438 9.1.4. The QI shall compare the accuracy of the in-line holiday detector with a hand-held holiday detector  
439 at least once per production shift to ensure that the in-line system is operational.

- 440 9.1.4.1. The plant shall define a maximum allowable difference between hand-held and in-line  
441 holiday counts, and this shall be used for evaluating acceptance of the in-line system  
442 accuracy
- 443 9.1.4.2. Holiday counts from both the hand-held and in-line holiday detectors during this  
444 comparison shall be documented.
- 445 9.2. Thickness of Coating
- 446 9.2.1. Coating thickness shall be measured in accordance with TM-11 Coating Film Thickness.
- 447 9.2.2. The QI shall measure coating thickness on a minimum of two bars for each size for every two hours  
448 of production and in accordance with the applicable standard.
- 449 9.2.2.1. Specimens shall be taken on a rotating basis from each strand of each coating  
450 production line.
- 451 9.2.3. Coating thickness shall conform to the applicable standard at a minimum or as specified by the  
452 purchaser if more stringent.
- 453 9.2.4. The QI shall document the time the specimen was taken, the product tested/bar size, and  
454 measurements of coating thickness as required to evaluate compliance to the requirements of the  
455 applicable standard.
- 456 9.3. Flexibility of Coating
- 457 9.3.1. Bend tests shall be conducted on a minimum of one bar for each bar size, for each coating  
458 production line for every four hours of production or more frequently if specified by the purchaser.
- 459 9.3.1.1. The test specimen shall be taken on a rotating basis from each strand of each of the  
460 coating production lines.
- 461 9.3.2. The QI shall conduct the bend test in accordance with TM-12 Coating Flexibility Test for Epoxy-  
462 Coated Steel Reinforcing.
- 463 9.3.3. The coating flexibility shall comply with the applicable standard.
- 464 9.3.4. The QI shall document the time the sample was taken and the results of tests as required by TM-  
465 12.
- 466 9.3.5. Bend test specimens shall be retained from a minimum of thirty days of production.
- 467 9.4. Adhesion of Coating (if required)
- 468 9.4.1. Adhesion testing shall be conducted according to TM-13 Cathodic Disbondment Test in accordance  
469 with the applicable standard.
- 470 9.4.1.1. One bar for each coating production line shall be tested.
- 471 9.4.1.1.1. Specimens shall be taken on a rotating basis from each strand of each  
472 coating production line.





482    **SECTION III. CUSTOM LINES**

483    *In addition to the Common Requirements, the following sections apply for custom lines.*

484

485    **8. CURING**

486        8.1. Time-to-Cure

487            8.1.1. The QI shall measure the time-to-cure, which is the time from when the product exits the epoxy  
488                    powder spray cloud to the time it is handled, whenever the line speed or product size changes, but  
489                    not less than one per production shift. This time shall not be less than the cure time specified by  
490                    the powder manufacturer.

491            8.1.2. The time-to-cure shall comply with the time-to-cure requirements specified by the powder  
492                    manufacturer for the operating coating temperature (i.e. the powder manufacturer's cure time-  
493                    temperature requirements).

494            8.1.3. The QI shall document the time and results of the examination of temperature of coated products  
495                    and time-to-cure.

496

497    **9. ASSESSMENT OF CURED EPOXY COATING**

498        9.1. Continuity of Coating (Holiday Monitoring)

499            9.1.1. Hand-held holiday detectors shall be operated and maintained in accordance with the  
500                    manufacturer's instructions.

501            9.1.2. Hand-held measurements are to be conducted according to TM-10 Coating Discontinuity (Holiday)  
502                    Test.

503            9.1.3. Coated product with calculated average holidays per foot greater than that allowed by the  
504                    applicable standard shall be rejected.

505            9.1.4. The QI shall examine product with a hand-held holiday detector on a minimum of two products for  
506                    each size for every hour of production in accordance with the applicable standard.

507                    9.1.4.1. Holiday counts from the hand-held holiday detector shall be documented.

508        9.2. Thickness of Coating

509            9.2.1. Coating thickness shall be measured in accordance with TM-11 Coating Film Thickness.

510            9.2.2. The QI shall measure coating thickness on a minimum of two products for each size for every hour  
511                    of production in accordance with the applicable standard.

512                    9.2.2.1. The test specimen shall be taken on a rotating basis from each position/strand on each  
513                    of the coating application lines.

514            9.2.3. Coating thickness shall conform to the applicable standard at a minimum or as specified by the  
515                    purchaser if more stringent.

- 516 9.2.4. The QI shall document the time the specimen was taken, the product tested, and measurements  
517 of coating thickness as required to evaluate compliance to the requirements of the applicable  
518 standard.
- 519 9.3. Flexibility of Coating
- 520 9.3.1. Bend tests shall be conducted on a minimum of one representative sample of product for each  
521 product size, for each coating application line for every four hours of production or more frequently  
522 if specified by the purchaser.
- 523 9.3.1.1. The test specimen shall be taken on a rotating basis from each position/strand on each  
524 of the coating application lines.
- 525 9.3.2. The QI shall conduct the bend test in accordance with TM-12 Coating Flexibility Test for Epoxy-  
526 Coated Steel Reinforcing.
- 527 9.3.3. The coating flexibility shall comply with the applicable standard.
- 528 9.3.4. The QI shall document the time the sample was taken and results of tests as required by TM-12.
- 529 9.3.5. Bend test specimens shall be retained for a minimum of thirty days of production.
- 530 9.4. Adhesion of Coating
- 531 9.4.1. Adhesion testing shall be conducted according to TM-13 Cathodic Disbondment Test and/or TM-  
532 13A Accelerated Cathodic Disbondment Test in accordance with the applicable standard.
- 533 9.4.1.1. One representative sample of product for each coating application line shall be tested,  
534 at the frequency specified in the applicable standard.
- 535 9.4.1.1.1. The test specimen shall be taken on a rotating basis from each  
536 position/strand on each of the coating application lines.
- 537 9.4.1.2. The QI shall record the date and time the specimen was taken, period of time the test  
538 is conducted, the type of test, product size, product type and grade and test results on  
539 the Inspection Form.
- 540 9.4.1.3. The QI shall compile the cathodic disbondment test results and compute the 30-Day  
541 Moving Average. The 30-Day Moving Average shall be recorded on the Inspection  
542 Form.
- 543 9.4.1.4. Cathodic disbondment test specimens shall be retained for a minimum of thirty days of  
544 production.
- 545 9.5. Voids in Coating
- 546 9.5.1. Any voids or deficiencies in coating from production equipment shall be repaired with patching  
547 material and in accordance with the patching material manufacturer's written recommendations.
- 548 9.5.1.1. The QI shall examine the epoxy-coated products at least once per production shift to  
549 verify that voids are repaired appropriately.
- 550 9.5.1.2. The QI shall document the time and results of the examination.



551 **SECTION IV. TEXTURED COATING LINES**

552 *The following sections additionally apply for textured coating lines.*

553

554 **7. EPOXY POWDER (Continued from Common Requirements)**

555 7.4. Contamination of Corrosion-resistant and Textured Coatings

556 7.4.1. The QI shall conduct an inspection of cross-contamination between corrosion-resistant (i.e., non-  
557 textured) and textured coatings at least once per shift. The plant shall establish an inspection  
558 process and an acceptance criteria for this inspection in accordance with the written  
559 recommendations of the manufacturer. At minimum, the inspection process shall include a visual  
560 inspection. The visual inspection shall be based on a visual standard provided by the powder  
561 manufacturer.

562 7.4.2. The QI shall document the time and results of the inspection.

563

564 **9. ASSESSMENT OF CURED EPOXY COATING**

565 9.3. Flexibility of Coating

566 9.3.1. Bend tests shall be conducted on the combined textured coating system based on the applicable  
567 standard for the corrosion-resistant coating as outlined in Section II.9.3 or Section III.9.3.

568 9.4. Adhesion of Coating

569 9.4.1. Adhesion testing (cathodic disbondment testing) shall be conducted on the corrosion-resistant  
570 coating in accordance with the applicable standard as outlined in Section II.9.4 or Section III.9.4.  
571 (Note: Since this testing is done on the corrosion-resistant coating alone, this is not a requirement  
572 for certification of a Textured Coating Line.)

573 9.5. Thickness of Textured Coating

574 9.5.1. Corrosion-resistant coating and textured coating thickness shall be measured in accordance with  
575 TM-11 Coating Film Thickness.

576 9.5.2. Corrosion-resistant coating and textured coating thickness shall comply with the requirements of  
577 the applicable standard.

578 9.5.3. Frequency

579 9.5.3.1. Corrosion-resistant coating thickness testing shall be conducted on two products every  
580 4 hours of production for each coating line and whenever the product size is changed,  
581 or as required to meet the frequency requirements of the applicable standard,  
582 whichever is more frequent.

583 9.5.3.2. The total textured coating thickness shall be measured on a minimum of two products  
584 for each size for every two hours of production for each coating line and whenever the  
585 product size is changed, and in accordance with the applicable standard.

- 586 9.5.4. The test specimens shall be taken on a rotating basis from each position/strand on each of the  
587 coating application lines.
- 588 9.5.5. The QI shall document the time the specimen was taken, the product tested, and measurements  
589 of coating thickness as required to evaluate compliance to the requirements of the applicable  
590 standard.
- 591 9.6. Profile of Textured Coating Surface
- 592 9.6.1. The textured coating surface shall be measured in terms of  $R_z$  in accordance with TM-5B Electronic  
593 Stylus (Profilometer) Measurements of Profile of Textured Coating Surface.
- 594 9.6.2. The average  $R_z$  of readings shall comply with the requirements of the applicable standard.
- 595 9.6.3. Textured coating surface profile testing shall be conducted once per production shift for each  
596 coating line and whenever the product size or powder manufacturer is changed, or as required to  
597 meet the frequency requirements of the applicable standard, whichever is more frequent.
- 598 9.6.4. Samples shall be taken on a rotating basis from each strand on each coating line.
- 599 9.6.5. The QI shall document the time the specimen was taken, product/bar size, and the individual and  
600 average measurements of roughness depth,  $R_z$ .
- 601

**602 SECTION V. ANNEX 1 – TEST METHODS****603 TM-1 – Steel Contamination (Backside)****604 1. INTRODUCTION**

605 1.1. This standard describes a standard test method to determine the percentage of contamination on a steel surface prior  
606 to coating, commonly called “Backside Contamination.”

**607 2. REFERENCED DOCUMENTS****608 2.1. ASTM International**

609 2.1.1. D3330 / D3330M Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape

610 2.1.2. D3652 / D3652M Standard Test Method for Thickness of Pressure-Sensitive Tapes

611 2.1.3. D3759 / D3759M Standard Test Method for Breaking Strength and Elongation of Pressure-Sensitive Tape

**612 3. DEFINITIONS**

613 3.1. Backside contamination – the percentage of surface contamination observed using a 30x microscope on the surface  
614 of tape after it applied to a freshly cleaned reinforcing product after blasting.

**615 4. EQUIPMENT**

616 4.1. ¼-inch wide white adhesive tape such as 3M #471 or equivalent.

617 4.1.1. Tape shall meet adhesion to steel of 21-25 oz/in width, as per ASTM Test Method D3330 / D3330M.

618 4.1.2. Tape shall meet Tensile Strength at break of 13-15 lbs/inch width, as per ASTM Test Method D3759/  
619 D3759M.

620 4.1.3. Adhesive thickness shall be at least 1 mil thick, as per ASTM Test Method D3652/ D3652M.

621 4.1.4. Tape shall be acceptable for use in temperatures ranging from 40° to 120°F.

622 4.2. Visual contamination standards (Section 8)

623 4.3. Wood or plastic burnishing tool

624 4.4. 30x self-illuminated, hand-held, field inspection microscope with confined field of view.

**625 5. MATERIALS**

626 5.1. A sufficient length of uncoated, recently abrasive blast-cleaned, steel reinforcing product.

**627 6. PROCEDURE**

628 6.1. Do not handle test specimens with bare skin or otherwise contaminate the area of product to be tested.

629 6.2. Lightly adhere a piece of the white adhesive tape to the blasted surface. If coating deformed bar, apply the tape to an  
630 area between the deformations on the product.

631 6.3. Firmly rub the tape with the burnishing tool so that intimate contact between the tape and the steel is achieved.

632 6.4. Sufficient pressure should be applied so the level of contaminant removal is not affected by slight variations in pressure.

633 6.5. Remove the tape.

634 6.6. Examine the adhesive tape with 30x microscope, and compare to the visual contamination standards to determine the  
635 percentage of backside contamination and record the percentage associated with the visual standard image most  
636 closely represented by the observed contamination.

637 6.7. Repeat the procedure at two other areas on the product, on different sides of the product.

**638 7. RESULTS**

639 7.1. Record each individual result and determine the average backside contamination from the three results.

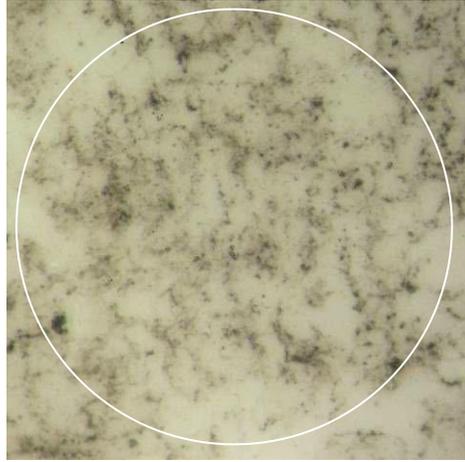
640



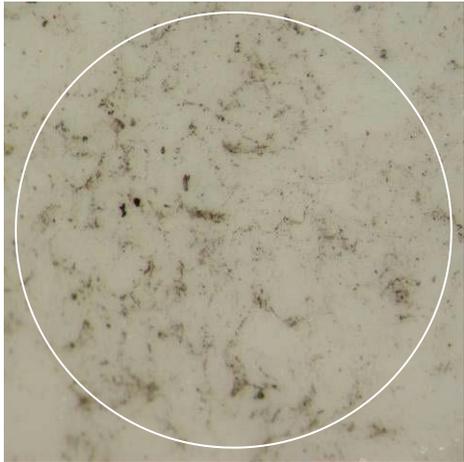
641 8. VISUAL CONTAMINATION STANDARDS FOR TM-1 BACKSIDE CONTAMINATION (Use 30x Microscope Only!)



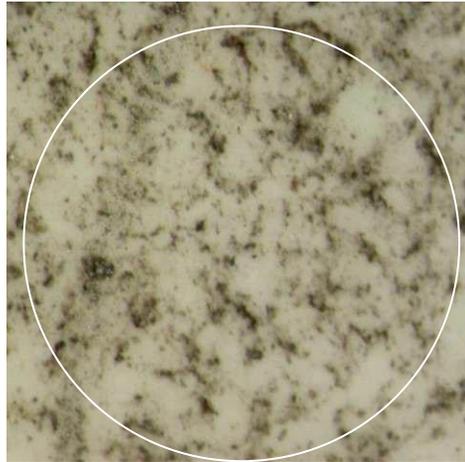
Trace



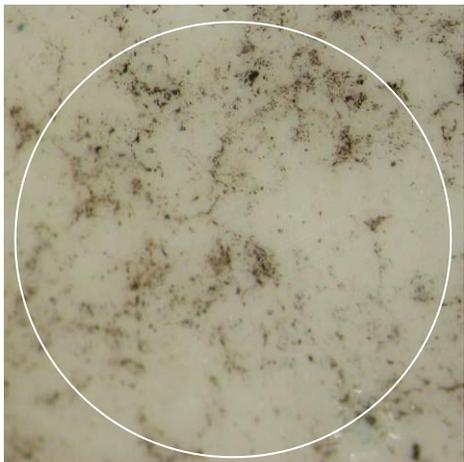
20%



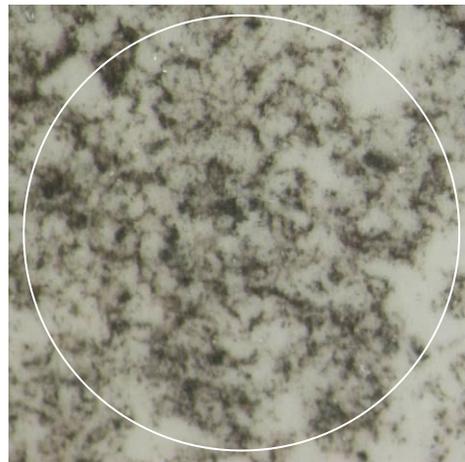
10%



30%



15%



50%



643  
644  
645  
646  
647  
648  
649  
650  
651  
652  
653  
654  
655  
656  
657  
658  
659  
660  
661

## TM-2 – Blast Cleaning

### 1. INTRODUCTION

1.1. This standard describes a standard test method to determine adequacy of abrasive blast cleaning of steel reinforcing.

### 2. REFERENCED DOCUMENTS

#### 2.1. SSPC

2.1.1. SSPC VIS 1 Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

2.1.2. SSPC-SP 10/NACE NO. 2, Near-White Blast Cleaning

2.1.3. SSPC Standard Reference Photographs

### 3. EQUIPMENT

3.1. Standard reference photographs.

### 4. MATERIALS

4.1. A sufficient length of uncoated, recently abrasive blast-cleaned, steel reinforcing product.

### 5. PROCEDURE

5.1. Examine the surface of a single product as set forth in SSPC VIS 1.

5.2. Examine the full perimeter of the product.

### 6. RESULTS

6.1 Compare observed condition of the product surface with the SSPC Standard Reference Photographs and record each individual result.



## 662 **TM-3A – Detection of Chlorides using Potassium Ferricyanide Test Paper**

### 663 **1. INTRODUCTION**

664 1.1. This standard describes a standard test method to detect ferrous salts on the product surface after abrasive blast  
665 cleaning or on blasting media.

666 1.2. CAUTION: Potassium ferricyanide is a poisonous chemical; use extreme care in handling!

667 1.2.1. Rubber gloves should be used at all times.

### 668 **2. EQUIPMENT**

669 2.1. Plastic spray bottle with distilled or deionized water.

670 2.2. Rubber gloves.

671 2.3. Chloride Visual Standard (Section 7)

672 2.4. Potassium ferricyanide test paper

673 2.4.1. This paper may be purchased from CRSI or made using the Appendix.

### 674 **3. MATERIALS**

675 3.1. A sufficient length of uncoated, recently abrasive blast-cleaned, steel reinforcing product.

676 3.1.1. Do not handle test specimens with bare skin or otherwise contaminate the area of product to be tested.

677 3.2. Sample of abrasive

### 678 **4. PROCEDURE – PRODUCT SURFACE**

679 4.1. Dampen the potassium ferricyanide test paper with distilled or deionized water from the spray bottle until the paper is  
680 saturated.

681 4.1.1. The test paper shall not be touched with skin.

682 4.2. Allow any excess water to drip off.

683 4.3. Lightly press the chloride test paper onto the product surface and keep into contact for thirty seconds.

684 4.4. Remove paper, turn it over, and observe for color change using normal or corrected vision.

685 4.5. Repeat the procedure on a total of three areas of the product.

### 686 **5. PROCEDURE – ABRASIVE**

687 5.1. Dampen the potassium ferricyanide test paper with distilled or deionized water from the spray bottle until the paper is  
688 saturated.

689 7.1.1. The test paper shall not be touched with skin.

690 5.2. Allow any excess water to drip off.

691 5.3. Place test paper on top of non-absorbent surface.

692 5.4. Sprinkle the abrasive on the wet test paper until the paper is covered.

693 5.5. Leave the abrasive on the chloride test paper for thirty seconds.

694 5.6. Remove abrasive and observe for color change using normal or corrected vision.

### 695 **6. RESULTS**

696 6.1. Compare the test strip to the Chloride Visual Standard (Section 7) to determine the chloride concentration on the steel.

697 6.2. Record each individual result and, if testing the product surface, determine the average of the three results.

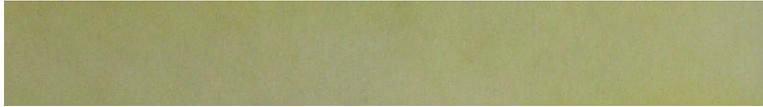
698

699

700



701 **7. CHLORIDE VISUAL STANDARD FOR TM-3A**



Zero – DI Water



Trace-0.03% NaCl



Moderate-0.3% NaCl



Heavy-3% NaCl

702

703

704

705

706

**Appendix to TM3-A – Manufacture of Potassium Ferricyanide Test Paper**

707

**1. MATERIALS**

708

- 1.1. Potassium ferricyanide (technical grade)

709

CAUTION: POISONOUS CHEMICAL; USE EXTREME CARE!

710

- 1.2. Distilled or deionized water.

711

- 1.3. Filter paper (Whatman Qualitative #40 or equivalent).

712

- 1.4. Plastic bags.

713

**2. PROCEDURE**

714

- 2.1. Make a 5% solution (by weight) of potassium ferricyanide in distilled or deionized water.

715

- 2.1.1. DO NOT USE TAP WATER.

716

- 2.2. Soak the filter paper in the solution and allow it to dry in clean atmosphere.

717

- 2.3. Cut the filter paper into strips and store in a sealed dark plastic bag.

718

- 2.4. Protect the chloride test paper from exposure to light.

719

720  
721  
722  
723  
724  
725  
726  
727  
728  
729  
730  
731  
732  
733  
734  
735  
736  
737  
738  
739  
740  
741  
742  
743  
744  
745

## TM-4 – Copper Sulfate Test

### 1. INTRODUCTION

- 1.1. This standard describes a standard test method to determine the presence of mill scale and other contaminants on an abrasive blast-cleaned steel reinforcing product.

### 2. EQUIPMENT

- 2.1. Copper sulfate crystals.
- 2.2. Distilled water.
- 2.3. A clean bottle for mixing the solution and an eyedropper.
- 2.4. A 30x self-illuminated, hand-held, field inspection microscope with confined field of view.
- 2.5. Copper Sulfate Visual Standard (Section 6).

### 3. MATERIALS

- 3.1. A sufficient length of uncoated, recently abrasive blast-cleaned, steel reinforcing product.
- 3.2. Do not handle test specimens with bare skin or otherwise contaminate the area of product to be tested.

### 4. PROCEDURE

- 4.1. Dissolve 5% by weight copper sulfate in distilled water.
- 4.2. Apply a few drops of copper sulfate solution to the surface of the abrasive blast-cleaned steel reinforcing product and allow to set for one minute.
- 4.3. Use 30x microscope to estimate the amount of mill scale and other non-reacting contaminants by comparing the surface to the Copper Sulfate Visual Standard (Section 6).
  - 4.3.1. Copper sulfate will react with clean steel and plate out to turn the steel a copper color. Copper sulfate will not react with mill scale, dirt, or rubber.
- 4.4. Test at least one area on opposite sides of the product (a minimum of two tests per product).

### 5. RESULTS

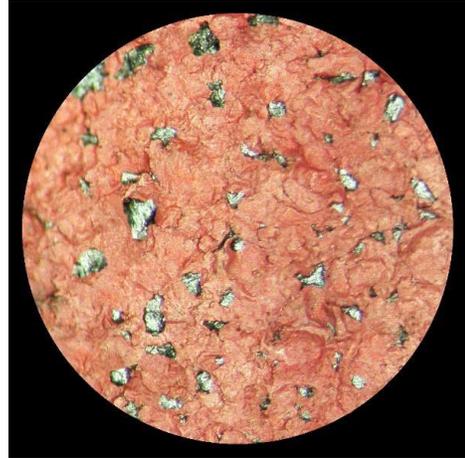
- 5.1. Compare the test strip to the Copper Sulfate Visual Standard (Section 6) to determine the mill scale level on the steel.
- 5.2. Record each individual result and determine the average from the results.



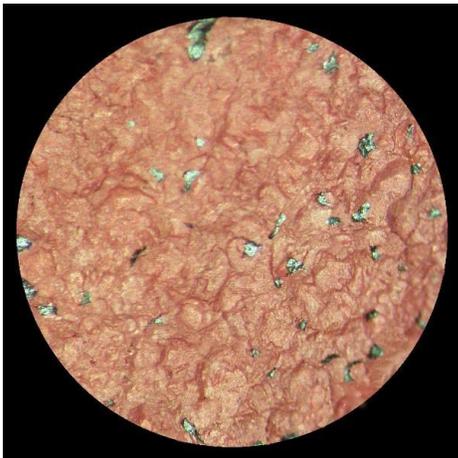
746 6. COPPER SULFATE VISUAL STANDARD FOR TM-4 (Use 30x Microscope Only!)



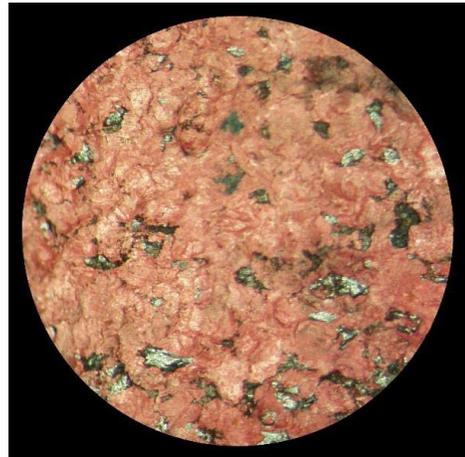
0% (Trace)



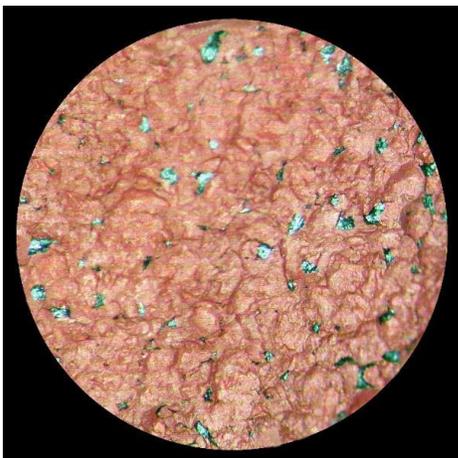
10%



3%



15%



5%

748 **TM-5A – Electronic Stylus (Profilometer) Measurements of Profile of Blast Cleaned Steel**

749 **1. INTRODUCTION**

750 1.1. This standard describes a standard test method to determine the roughness profile of blast cleaned steel prior to  
751 coating.

752 **2. REFERENCED DOCUMENTS**

753 2.1. ASME

754 2.1.1. B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

755 2.2. ASTM

756 2.2.1. D7127 Test Method for Measurement of Surface Roughness of Abrasive Blast Cleaned Metal Surfaces Using  
757 a Portable Stylus Instrument (Withdrawn 2021)

758 **3. EQUIPMENT**

759 3.1. A portable profilometer capable of measuring the maximum roughness depth,  $R_{(max)}$ , and peak count,  $P_c$ .

760 **4. MATERIALS**

761 4.1. A sufficient length of uncoated, recently abrasive blast-cleaned, steel reinforcing product.

762 4.2. Do not handle directly or otherwise contaminate the area of specimen to be tested.

763 **5. PROCEDURE**

764 5.1. Calibrate the profilometer in accordance with the manufacturer's instructions.

765 5.2. Set the profilometer's parameter selectors as follows:

766 5.2.1. Units: inches

767 5.2.2. Cutoff length (LC or  $\lambda_c$ ): 0.03 to 0.032 inches

768 5.2.3. Peak count threshold separation distance (Z):  $5 \times 10^{-6}$  to  $8 \times 10^{-6}$  inch

769 5.2.3.1. *[Note: For Mahr Perthometer M1, threshold is defined by distance above and below mean line.*

770 *Set unit to  $4/-4 \times 10^{-6}$  inch to achieve  $8 \times 10^{-6}$  inch Peak count threshold separation distance]*

771 5.3. Use the profilometer to measure the maximum roughness depth,  $R_{(max)}$ , and peak count,  $P_c$ , according to the  
772 manufacturer's recommendations.

773 5.4. Take a minimum of three readings for each product.

774 5.5. The readings shall represent different areas and both sides of the product.

775 **6. RESULTS**

776 6.1. Record each individual result and determine the average  $R_{(max)}$  and  $P_c$  from the three results.

777

778

779 **TM-5B – Electronic Stylus (Profilometer) Measurements of Profile of Textured Coating Surface**

780 **1. INTRODUCTION**

781 1.1. This standard describes a standard test method to determine the roughness profile of textured coating surfaces.

782 **2. REFERENCED DOCUMENTS**

783 2.1. ASME

784 2.1.1. B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

785 2.2. ASTM

786 2.2.1. A1124 Standard Specification for Textured Epoxy-Coated Steel Reinforcing Bars

787 2.2.2. D7127 Test Method for Measurement of Surface Roughness of Abrasive Blast Cleaned Metal Surfaces Using  
788 a Portable Stylus Instrument (Withdrawn 2021)

789 **3. EQUIPMENT**

790 3.1. A portable profilometer capable of recording the  $R_z$  over the range specified by ASTM A1124 for textured coating.

791 **4. MATERIALS**

792 4.1. A steel reinforcing product coated with textured coating of sufficient length to complete the required number of tests.

793 **5. PROCEDURE**

794 5.1. Calibrate the profilometer in accordance with the manufacturer's instructions.

795 5.2. Set the profilometer's parameter selectors as follows:

796 5.2.1. Units: inches

797 5.2.2. Cutoff length (LC or  $\lambda_c$ ): Such that the profile measurement is taken over the minimum length defined in  
798 ASTM A1124.

799 5.3. Measure the maximum roughness depth,  $R_z$ , according to the profilometer manufacturer's recommendations along  
800 the longitudinal deformation or other continuous surface, if there is no longitudinal deformation on the product.

801 5.4. Take a minimum of five readings for each tested product with the readings representing different areas and both  
802 sides of the product.

803 **6. RESULTS**

804 6.1. Record each individual reading and determine the average  $R_z$  from the readings.  
805



**TM-6 – Surface Profile Measurements Using Replica Tape**

806  
807  
808  
809  
810  
811  
812  
813  
814  
815  
816  
817  
818  
819  
820  
821  
822

**1. INTRODUCTION**

1.1. This standard describes a standard test method to determine the depth of the surface profile of abrasive blast-cleaned steel.

**2. REFERENCED DOCUMENTS**

2.1. ASTM D 4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

**3. MATERIALS**

- 3.1. Replica tape, such as Testex Press-O-Film or equivalent
- 3.2. A sufficient length of uncoated, recently abrasive blast-cleaned, steel reinforcing product.
  - 3.2.1. Do not handle directly or otherwise contaminate the area of specimen to be tested.

**4. PROCEDURE**

- 4.1. As set forth in ASTM D 4417 Method C.
- 4.2. Determine maximum surface roughness at three locations.

**5. RESULTS**

5.1. Record individual maximum roughness readings and determine the average of the three results.

823

**TM-7 – Sieve Analysis of Blast Abrasive**

824

**1. INTRODUCTION**

825

1.1. This standard describes a standard test method to determine abrasive working mix particle size gradation.

826

**2. REFERENCED DOCUMENTS**

827

2.1. ASTM International

828

2.1.1. STP-447B, Guidelines for Establishing Sieve Analysis Procedures

829

**3. EQUIPMENT**

830

3.1. A set of sieve screens meeting ASTM STP-447B

831

3.2. 50 cm<sup>3</sup> volumetric measure

832

3.3. Calibrated scale with precision of +/-0.1 gram

833

**4. MATERIALS**

834

4.1. A sample of the abrasive blast cleaning abrasive from the working mix.

835

4.1.1. The abrasive shall be taken at the hopper at the top of the elevator.

836

**5. PROCEDURE**

837

5.1. Measure out a 50 cm<sup>3</sup> (approximately a 250 gram) sample.

838

5.2. Weigh and document individual screens.

839

5.3. Stack the screens together with the coarser screens at the top of the stack.

840

5.4. Pour the abrasive sample onto the top screen and shake by hand or using a mechanical shaker the whole stack for 3 minutes.

841

842

5.5. Weigh and document the amount retained on each screen or measure the volume in a graduate beaker.

843

**6. RESULTS**

844

6.1. Convert the weight or volume into percentages of the total.

845

846



847  
848  
849  
850  
851  
852  
853  
854  
855  
856  
857  
858  
859  
860  
861  
862  
863  
864

**TM-8 – Abrasive Oil Contamination Test**

**1. INTRODUCTION**

1.1. This standard describes a standard test method to detect the presence of oil in the blasting abrasive.

**2. EQUIPMENT**

- 2.1. Distilled water.
- 2.2. A clean, clear, 1-pint mixing bottle.

**3. MATERIALS**

3.1. An 8-ounce volume of blasting abrasive taken from the working mix.

**4. PROCEDURE**

- 4.1. Fill the mixing bottle with the abrasive sample.
- 4.2. Add distilled water until the abrasive is covered by at least one inch of water.
- 4.3. Shake the bottle for at least 10 seconds.
- 4.4. Allow to sit undisturbed for at least 1 minute.

**5. RESULTS**

- 5.1. Observe top surface of water/blast mixture for presence of oil or other immiscible contaminants
  - 5.1.1. Oil or any other immiscible contaminants will separate and rise.
- 5.2. Document observation

865  
866  
867  
868  
869  
870  
871  
872  
873  
874  
875  
876  
877  
878  
879  
880  
881  
882  
883  
884  
885  
886  
887

## TM-9 – Steel Temperature

### 1. INTRODUCTION

- 1.1. This standard describes a standard test method to determine the steel surface temperature as they enter the epoxy powder spray booth.

### 2. EQUIPMENT

- 2.1. Non-sulfurous, temperature-sensitive crayons that cover the recommended application temperature range specified by the epoxy powder manufacturer.
  - 2.1.1. Crayons that target the minimum, target, and maximum temperatures acceptable for application of the coating shall be available.
    - 2.1.1.1. Note: if the process plan indicates that the nominal temperature of the steel for the epoxy that is being applied is between 450° and 475°F, then the target is 463°F and the crayons used should be 450°F, 463°F, and 475°F.

### 3. PROCEDURE

- 3.1. Apply the first temperature-rated crayon to the heated product surface in a light tapping motion. This crayon shall have a melting temperature below the manufacturers recommended epoxy powder application temperature.
- 3.2. If the first crayon does not melt, use lower temperature-rated crayons to determine product temperature.
- 3.3. If the first crayon melts, apply successively higher temperature-rated crayons to the heated product surface and determine temperature ranges where crayons do and do not melt.

### 4. RESULTS

- 4.1. If the first crayon does not melt and discolor, corrective action is required to increase the product temperature.
- 4.2. Document product surface temperature range by recording the temperatures of the highest temperature crayon that melts and the lowest temperature crayon that does not melt, so the actual temperature is bracketed.

888

**TM-10 – Coating Discontinuity (Holiday) Test**

889

**1. INTRODUCTION**

890

- 1.1. This standard describes a standard test method to determine the presence and number of discontinuities in a coating film on reinforcing steel.

891

892

**2. REFERENCED DOCUMENTS**

893

- 2.1. ASTM

894

- 2.1.1. G62 - Standard Test Methods for Holiday Detection in Pipeline Coatings

895

**3. DEFINITIONS**

896

- 3.1. holiday—discontinuity in a coating that is not discernible to a person with normal or corrected vision

897

- 3.2. wetting agent—material that lowers the surface tension of water allowing it to penetrate more effectively into small discontinuities in the coating giving a more accurate indication of the holiday count

898

899

**4. EQUIPMENT**

900

- 4.1. A 67.5-V, 80,000-ohm wet-sponge type or similar direct-current hand-held holiday detector.

901

**5. MATERIALS**

902

- 5.1. A full, stock-length of epoxy-coated steel reinforcing product.

903

**6. PROCEDURE**

904

- 6.1. Testing shall be conducted according to ASTM G62, Standard Test Methods for Holiday Detection in Pipeline Coatings

905

906

- 6.2. For hand-held measurements, a wetting agent shall be used regardless of product size or coating thickness.

907

- 6.3. The ground shall be determined by holding probe in air and turn detector on and then place probe on bare substrate or earth connection.

908

909

**7. RESULTS**

910

- 7.1. Document number of holidays in epoxy-coated reinforcing steel.

911



912  
913  
914  
915  
916  
917  
918  
919  
920  
921  
922  
923  
924  
925  
926  
927  
928  
929  
930

## TM-11 - Coating Film Thickness

### 1. INTRODUCTION

1.1. This standard describes a standard test method to determine coating film thickness

### 2. REFERENCED DOCUMENTS

2.1. SSPC

2.1.1. SSPC-PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements

### 3. EQUIPMENT

3.1. Electronic gage meeting SSPC-PA 2

3.2. Calibration system meeting gage manufacturer's recommendations

### 4. MATERIALS

4.1. Coated reinforcing steel

### 5. PROCEDURE

5.1. Electronic gages shall be calibrated in accordance with the gage manufacturer's recommendations at least once per production shift.

5.1.1. The QI shall document the electronic gage calibration.

5.2. Take coating thickness readings according to methods defined by electronic gage manufacturer.

### 6. RESULTS

6.1. Determine and document the thickness relative to the requirements of the applicable standard

## 931 **TM-12 – Coating Flexibility Test for Epoxy-Coated Steel Reinforcing**

932  
933  
934  
935  
936  
937  
938  
939  
940  
941  
942  
943  
944  
945  
946  
947  
948  
949  
950  
951  
952  
953  
954  
955  
956  
957  
958  
959  
960  
961  
962  
963  
964  
965

### **1. INTRODUCTION**

- 1.1. This standard describes a standard test method to determine the adequacy of surface preparation, powder cure, flexibility, and adhesion of the coating.
- 1.2. The test also provides an indication of the suitability of the coated products for fabrication.

### **2. DEFINITIONS**

- 2.1. Crack – a discontinuity in the coating that extends through the thickness of the coating to the underlying steel.

### **3. EQUIPMENT**

- 3.1. A steel reinforcing bending machine with suitable mandrels (pins).

### **4. MATERIALS**

- 4.1. A suitable length of coated steel reinforcing product with surface temperature between 68 °F (20 °C) and 86 °F (30 °C).

### **5. PROCEDURE**

- 5.1. Bend the product using the bending machine with pin diameter, bending time, and bend angle shown in the following tables: Table TM-12.1 for Steel Reinforcing Bar and TM-12.2 for Wire and Welded Wire Reinforcement.
  - 5.1.1. Pins of smaller diameter than that shown may be used.
  - 5.1.2. Longitudinal deformations shall be placed perpendicular to the radius of the mandrel.
- 5.2. Visually examine the coating on the test specimen for cracking or disbonding.
- 5.3. If a fracture or partial failure of the product occurs, or the cracking or disbonding of the coating was caused by an imperfection in the product surface that is visible after performing the test, the test shall be considered invalid and shall be repeated on a new specimen.
- 5.4. Should cracking or debonding of the coating be observed, an additional two tests shall be conducted on randomly selected product coated with the same lot of epoxy and within the same bundle or heat number in accordance with the requirements of the applicable standard or the purchaser's specification.

### **6. RESULTS**

- 6.1. Document the following:
  - 6.1.1. time the sample was obtained
  - 6.1.2. diameter of the pin
  - 6.1.3. temperature of test specimen
  - 6.1.4. time to bend
  - 6.1.5. degree of bending
  - 6.1.6. the presence or absence of observed cracking or disbonding of the coating
  - 6.1.7. whether the performance is compliant with the applicable standard.



966  
967

**Table TM-12.1: Coating Flexibility Test Requirements for Bars**

ASTM Steel Reinforcing Standard				ASTM Epoxy Coating Standard			
A615M, A706M, A1035M		A615, A706, A1035		A775/A775M -Flexible (and A1124 with A775)		A934/A934M – Nonflexible (and A1124 with A934)	
Custom Product Number	Mandrel Diameter, mm	Custom Product Number	Mandrel Diameter, inch	Bend Angle (after rebound) Degrees	Maximum Time to Bend, Seconds	Bend Angle (after rebound) Degrees	Maximum Time to Bend Seconds
10	75	3	3	180	15	9	5
13	100	4	4	180	15	9	5
16	125	5	5	180	15	9	5
19	150	6	6	180	15	6	5
22	175	7	7	180	45	6	5
25	200	8	8	180	45	6	5
29	230	9	9	180	45	6	5
32	250	10	10	180	45	6	5
36	280	11	11	180	45	6	5
43	430	14	17	90	45	6	5
57	580	18	23	90	45	6	5

968  
969  
970

**Table TM-12.2: Coating Flexibility Test Requirements for Wire  
with ASTM A884/A884M Type 1 Coating**

Wire Size Number	Wire Size No. W or D, inch	Mandrel Diameter mm (inch)	Time to complete Seconds	ASTM A884/A884M - Type 1 Bend Angle After Rebound
6.5 to 39	1 to 6	Twice the diameter	15	180
>39	> 6	Four times the diameter	45	180

971  
972  
973

974

975

**TM-13 – Cathodic Disbondment Test**

976

**1. INTRODUCTION**

977

- 1.1. This standard describes a standard test method to measure the coating's ability to resist loss of adhesion under an applied voltage at ambient temperature.

978

979

**2. REFERENCED DOCUMENTS**

980

- 2.1. ASTM International

981

- 2.1.1. G8 Standard Test Methods for Cathodic Disbonding of Pipeline Coatings

982

- 2.1.2. A775/ A 775M (Section A1.3.2) Standard Specification for Epoxy-Coated Steel Reinforcing Bars

983

**3. EQUIPMENT**

984

- 3.1. A filtered D.C. variable power supply, with a controlled voltage output of between 0 and 12 V and a current capacity of 200 mA.

985

986

- 3.1.1. Independent voltage control shall be provided for each sample.

987

- 3.2. A voltmeter with a minimum input impedance of 10 mega-ohms and capable of measuring in the range of 0 to 2 V to the nearest 1 mV.

988

989

- 3.3. A calomel reference electrode.

990

- 3.4. A solid platinum anode or platinized wire of sufficient length

991

- 3.4.1. This anode shall be of sufficient length such that it is within 0.4 in. [10 mm] of the drilled hole in the coating during testing.

992

993

- 3.5. Electrolyte solution — 3% Solution of Sodium Chloride (NaCl) by mass dissolved in distilled water:

994

- 3.5.1. 3 g NaCl mixed with 100 ml water.

995

- 3.6. A non-metallic beaker sufficiently tall for 4 inches [100 mm] of the test sample to be immersed in electrolyte solution such as a 1-quart [1-liter] beaker. A cover shall be placed over the beaker.

996

997

- 3.7. A thermometer.

998

- 3.8. A utility knife with a sharp blade.

999

**4. MATERIALS**

1000

- 4.1. Test specimens, each approximately 8 inches [200 mm] in length and free from holidays and bare areas, shall be randomly cut from production-coated products.

1001

1002

- 4.2. The coating thickness shall comply with the applicable standard or as specified by purchaser.

1003

**5. PROCEDURE**

1004

- 5.1. On each specimen drill a 0.125-inch [3 mm] diameter hole approximately 2-inches [50 mm] from one end.

1005

- 5.1.1. The hole shall be centered between deformations and deep enough to expose 0.125-inch [3 mm] diameter of the steel.

1006

1007

- 5.2. Seal the cut surface of the product closest to the hole completely with silicone.

1008

- 5.3. Ground the test specimen by drilling a 0.125-inch [3 mm] hole in the other cut surface of the bar and attaching a self-tapping screw for the ground connection.

1009

1010

- 5.4. Perform the cathodic disbondment test using the equipment arrangement shown in Figure TM-13.

1011

- 5.5. Insert the specimen into the beaker, with the sealed end of the bar resting on the bottom of the beaker.

- 1012 5.6. Add the electrolyte solution until 4-inches [100 mm] of the bar length is submerged. Connect the negative lead from  
1013 the D.C. power supply to the grounding screw of specimen.
- 1014 5.7. Insert the wire anode into the electrolyte.
- 1015 5.7.1. Note: If a platinized wire anode is used, the end of the wire submerged in the solution must be completely  
1016 sealed with silicone to prevent damage to the copper core.
- 1017 5.8. Place the anode within 0.4 in. [10 mm] of the drilled hole in the coating.
- 1018 5.9. Connect the anode to one end of the 10-ohm resistor.
- 1019 5.10. Connect the other end of the 10-ohm resistor to the positive lead from the power supply.
- 1020 5.11. Insert the calomel reference electrode into the electrolyte. Place the porous tip within 0.4 in. [10 mm] of the drilled hole  
1021 in the coating.
- 1022 5.12. Connect the positive lead of the voltmeter to the calomel electrode and the negative lead to the specimen.
- 1023 5.13. Turn on the power supply and adjust the power supply until the polarized potential is stabilized at  $-1500\text{ mV} \pm 20\text{ mV}$   
1024 ( $1.48\text{ V}$  to  $1.52\text{ V}$ ) with respect to the calomel electrode.
- 1025 5.14. Record the time as the start time. Total test time is 168 hours.
- 1026 5.15. Keep the specimen in the electrolyte during the testing period.
- 1027 5.16. Maintain the electrolyte at a temperature of  $75\text{ }^{\circ}\text{F} \pm 3.6\text{ }^{\circ}\text{F}$  [ $24\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ ].
- 1028 5.17. During the first eight hours of testing record the potential readings at two hour intervals and adjust the voltage to correct  
1029 any drift from  $-1500\text{ mV} \pm 20\text{ mV}$ .
- 1030 5.18. Check the potential again at 24 hours and at least twice every 24 hours for at least two days. Thereafter, check the  
1031 potential at least once every 48 hours and preferably every 24 hours.
- 1032 5.19. Remove the calomel electrode after each potential measurement to avoid contamination of the electrode.
- 1033 5.20. Verify the calibration of the electrode before each cathodic disbondment test.
- 1034 5.20.1. This may be done by comparing the calomel electrode to another stored calomel electrode.
- 1035 5.21. Remove the specimen from the beaker and store it in air at  $75\text{ }^{\circ}\text{F} \pm 3.6\text{ }^{\circ}\text{F}$  [ $24\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ ] for 1 hour before preparing it  
1036 for adhesion testing.
- 1037 5.22. After the test has been completed, properly dispose of the used electrolyte.
- 1038 5.23. Using a new blade in the utility knife, make 4 cuts through the coating at the intentionally drilled hole, extending outward  
1039 from the site at  $0^{\circ}$ ,  $90^{\circ}$ ,  $180^{\circ}$ , and  $270^{\circ}$ , providing four sections of coating for adhesion testing.
- 1040 5.24. Ensure that the cuts extend through the coating such that the metal is visible. Replace the knife blade if it becomes  
1041 dull or damaged. The length of each cut shall not be less than 0.20 in. [5 mm] or the distance between adjacent  
1042 deformations.
- 1043 5.25. Wearing safety glasses, insert the tip of the utility knife under the coating at a section. Lift the blade. Insert the tip of  
1044 the blade and lift again.
- 1045 5.26. Perform the procedure in a gentle manner to avoid cutting the coating.
- 1046 5.27. Continue until the coating resists the lifting action.
- 1047 5.28. Repeat the procedure on all four sections.
- 1048



1049 CAUTION: Some flexible epoxy coatings may fail cohesively in which case the blade may actually “tear” the coating from the  
1050 surface, giving an inaccurate indication of coating disbondment. Any discolored area on the steel should be considered  
1051 to be a disbonded area. Use of a magnifying glass is required.  
1052

1052

## 1053 6. RESULTS

- 1054 6.1. Measure and document diameters in mm of the resulting circle at the vertical (0° and 180°) and horizontal (90° and  
1055 270°) positions ( $a + b = c$ ).
- 1056 6.2. Subtract 6 from this value ( $c - 6 = d$ ). Divide the result ( $d$ ) by 4 to obtain the average disbondment radius ( $d / 4 = \text{average}$   
1057 disbondment radius).
- 1058 6.3. The following information shall be reported for each test specimen:
- 1059 6.3.1. Date and time of sampling and testing
  - 1060 6.3.2. Epoxy powder description
  - 1061 6.3.3. Primer description (if any)
  - 1062 6.3.4. Bar batch number
  - 1063 6.3.5. Potential at different time intervals
  - 1064 6.3.6. Coating thickness in test area
  - 1065 6.3.7. Disbondment radius in mm

1066

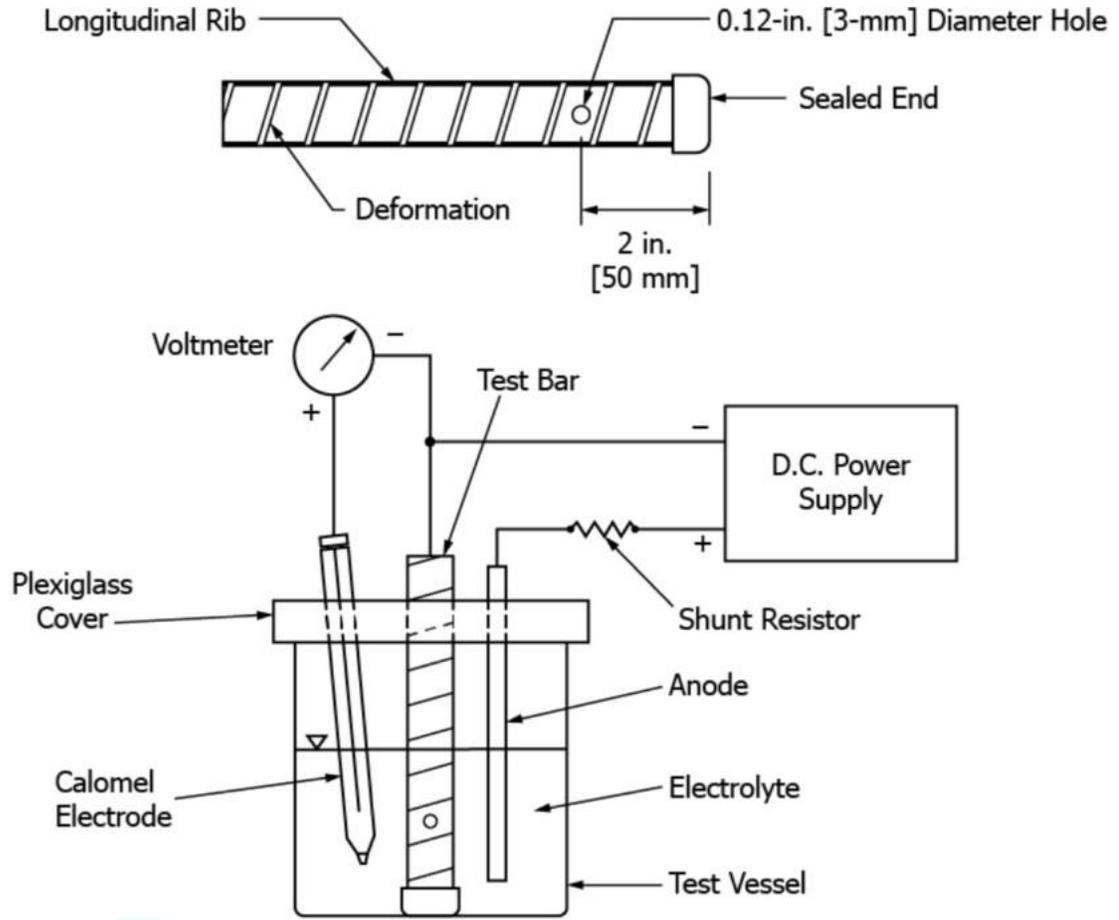


Figure TM-13

1067  
1068  
1069

1070 **TM-13A – Accelerated Cathodic Disbondment Test**

1071 **1. INTRODUCTION**

- 1072 1.1. This standard describes a standard accelerated test method to measure the coating's ability to resist loss of adhesion  
1073 under an applied voltage at ambient temperature.

1074 **2. REFERENCED DOCUMENTS**

- 1075 2.1. ASTM International  
1076 2.1.1. G8 Standard Test Methods for Cathodic Disbonding of Pipeline Coatings  
1077 2.1.2. A775/ A 775M (Section A1.3.2) Standard Specification for Epoxy-Coated Steel Reinforcing Bars

1078 **3. EQUIPMENT**

- 1079 3.1. A filtered D.C. variable power supply, with a controlled voltage output of between 0 and 12 V and a current capacity of  
1080 200 mA.  
1081 3.1.1. Independent voltage control shall be provided for each sample.  
1082 3.2. A voltmeter with a minimum input impedance of 10 mega-ohms and capable of measuring in the range of 0 to 4 V to  
1083 the nearest 1 mV.  
1084 3.3. A calomel reference electrode.  
1085 3.4. A solid platinum anode or platinized wire  
1086 3.4.1. This anode shall be 6-in [150-mm] long solid platinum electrode (0.06-in [1.6-mm] nominal diameter) or  
1087 platinized wire (0.12-in [3-mm] nominal diameter).  
1088 3.5. 10-ohm shunt resistor.  
1089 3.6. Electrolyte solution — 3% Solution of Sodium Chloride (NaCl) by mass dissolved in distilled water:  
1090 3.6.1. 3 g NaCl mixed with 100 ml water at  $150 \pm 3.6^{\circ}\text{F}$  [ $65 \pm 2^{\circ}\text{C}$ ].  
1091 3.7. A non-metallic beaker sufficiently tall for 4 inches [100 mm] of the test sample to be immersed in electrolyte solution  
1092 such as a 1-quart [1-liter] beaker. A cover shall be placed over the beaker.  
1093 3.8. A thermometer.  
1094 3.9. A utility knife with a sharp blade.

1095 **4. MATERIALS**

- 1096 4.1. Test specimens, each approximately 8 inches [200 mm] in length and free from holidays and bare areas, shall be  
1097 randomly cut from production-coated products.  
1098 4.2. The coating thickness shall comply with the applicable standard or as specified by purchaser.

1099 **5. PROCEDURE**

- 1100 5.1. On each specimen, drill a 0.125-inch [3 mm] diameter hole approximately 2-inches [50 mm] from one end.  
1101 5.1.1. The hole shall be centered between deformations and deep enough to expose 0.125-inch [3 mm] diameter  
1102 of the steel.  
1103 5.2. Seal the cut surface of the product closest to the hole completely with silicone.  
1104 5.3. Ground the test specimen by drilling a 0.125-inch [3 mm] hole in the other cut surface of the bar and attaching a self-  
1105 tapping screw for the ground connection.  
1106 5.4. Perform the cathodic disbondment test using the equipment arrangement shown in Figure TM-13A.  
1107 5.5. Insert the specimen into the beaker, with the sealed end of the bar resting on the bottom of the beaker.



- 1108 5.6. Add the electrolyte solution until 4-inches [100 mm] of the bar length is submerged. Connect the negative lead from  
1109 the D.C. power supply to the grounding screw of specimen.
- 1110 5.7. Insert the wire anode into the electrolyte.
- 1111 5.7.1. Note: If a platinized wire anode is used, the end of the wire submerged in the solution must be completely  
1112 sealed with silicone to prevent damage to the copper core.
- 1113 5.8. Place the anode within 0.4 in. [10 mm] of the drilled hole in the coating.
- 1114 5.9. Connect the anode to one end of the 10-ohm resistor.
- 1115 5.10. Connect the other end of the 10-ohm resistor to the positive lead from the power supply.
- 1116 5.11. Insert the calomel reference electrode into the electrolyte. Place the porous tip within 0.4 in. [10 mm] of the drilled hole  
1117 in the coating.
- 1118 5.12. Connect the positive lead of the voltmeter to the calomel electrode and the negative lead to the specimen.
- 1119 5.13. Turn on the power supply and adjust the power supply until the polarized potential is stabilized at - 3000 mV  $\pm$  20 mV  
1120 (2.98 V to 3.02 V) with respect to the calomel electrode.
- 1121 5.14. Record the time as the start time. Total test time is 24 hours.
- 1122 5.15. Keep the specimen in the electrolyte during the testing period.
- 1123 5.16. Maintain the electrolyte at a temperature of 150  $\pm$  3.6° F [65  $\pm$  2° C].
- 1124 5.17. During the first eight hours of testing record the potential readings at two-hour intervals and adjust the voltage to correct  
1125 any drift from -3000 mV  $\pm$  20 mV.
- 1126 5.18. Check the potential again at 24 hours.
- 1127 5.19. Remove the calomel electrode after each potential measurement to avoid contamination of the electrode.
- 1128 5.20. Verify the calibration of the electrode before each cathodic disbondment test.
- 1129 5.20.1. This may be done by comparing the calomel electrode to another stored calomel electrode.
- 1130 5.21. Remove the specimen from the beaker and store it in air at 75° F  $\pm$  3.6° F [24° C  $\pm$  2° C] for 1 hour before preparing it  
1131 for adhesion testing.
- 1132 5.22. After the test has been completed, properly dispose of the used electrolyte.
- 1133 5.23. Using a new blade in the utility knife, make 4 cuts through the coating at the intentionally drilled hole, extending outward  
1134 from the site at 0°, 90°, 180°, and 270°, providing four sections of coating for adhesion testing.
- 1135 5.24. Ensure that the cuts extend through the coating such that the metal is visible. Replace the knife blade if it becomes  
1136 dull or damaged. The length of each cut shall not be less than 0.20 in. [5 mm] or the distance between adjacent  
1137 deformations.
- 1138 5.25. Wearing safety glasses, insert the tip of the utility knife under the coating at a section. Lift the blade. Insert the tip of  
1139 the blade and lift again.
- 1140 5.26. Perform the procedure in a gentle manner to avoid cutting the coating.
- 1141 5.27. Continue until the coating resists the lifting action.
- 1142 5.28. Repeat the procedure on all four sections.

1144 CAUTION: Some flexible epoxy coatings may fail cohesively in which case the blade may actually “tear” the coating from the  
1145 surface, giving an inaccurate indication of coating disbondment. Any discolored area on the steel should be considered  
1146 to be a disbonded area. Use of a magnifying glass is required.



1147

1148

**6. RESULTS**

1149

1150

1151

1152

1153

1154

1155

1156

1157

1158

1159

1160

1161

- 6.1. Measure and document diameters in mm of the resulting circle at the vertical (0° and 180°) and horizontal (90° and 270°) positions ( $a + b = c$ ).
- 6.2. Subtract 6 from this value ( $c - 6 = d$ ). Divide the result ( $d$ ) by 4 to obtain the average disbondment radius ( $d / 4 = \text{average disbondment radius}$ ).
- 6.3. The following information shall be reported for each test specimen:
  - 6.3.1. Date and time of sampling and testing
  - 6.3.2. Epoxy powder description
  - 6.3.3. Primer description (if any)
  - 6.3.4. Bar batch number
  - 6.3.5. Potential at different time intervals
  - 6.3.6. Coating thickness in test area
  - 6.3.7. Disbondment radius in mm

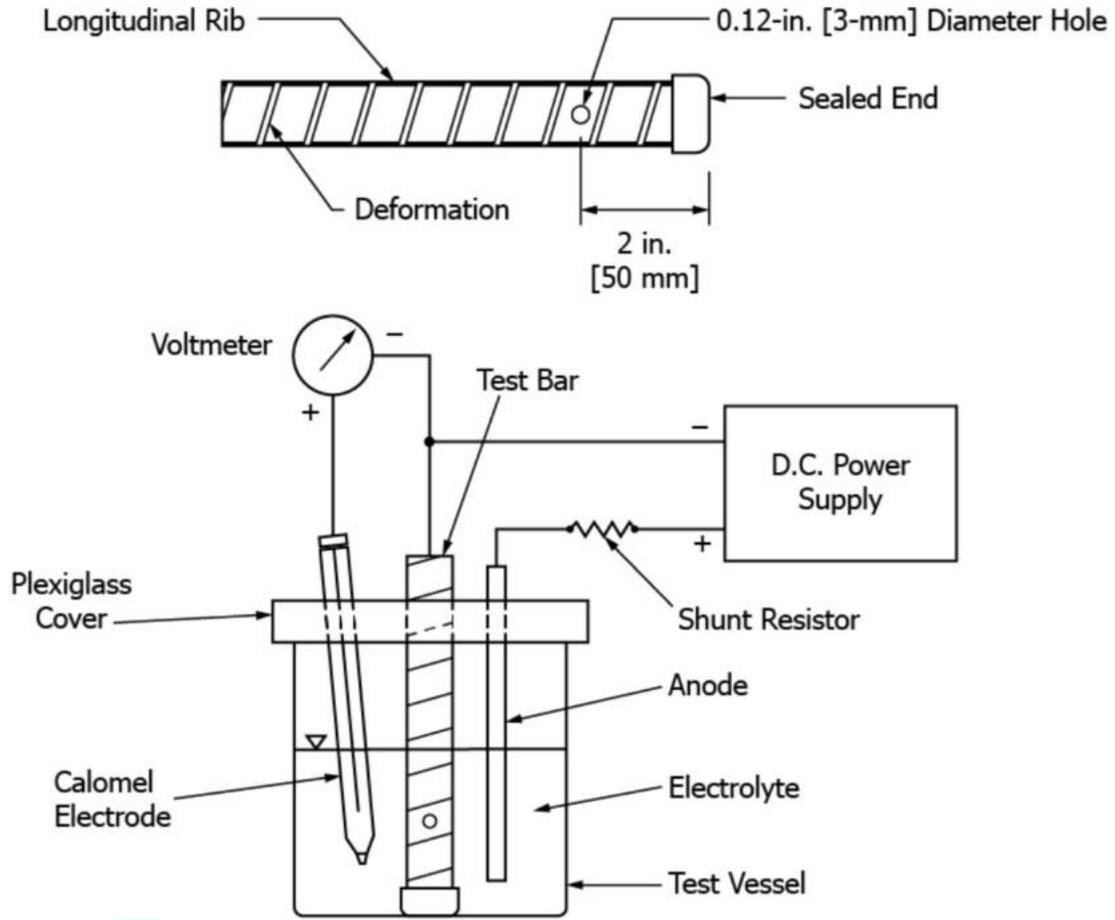


Figure TM-13A

1162  
1163



1164 **SECTION VI. ANNEX 2 – CRITICAL SECTIONS**

1165

1166 The following sections are judged to be critical sections relative to CRSI's Procedures for the Development and  
1167 Maintenance of Manufacturing Certification Programs.

1168

1169 **1. Common Requirements**

1170 1.1. The following sections are critical for all lines.

- 1171 • 4.1 Coating Quality Manual
- 1172 • 5.3 Abrasive Blast Cleaning
- 1173 • 5.4 Anchor Profile

1174

1175 **2. Straight Bar Lines**

1176 2.1. The following sections are also critical for straight bar lines.

- 1177 • 9.1 Continuity of Coating (Holiday Monitoring)
- 1178 • 9.2 Thickness of Coating
- 1179 • 9.3 Flexibility of Coating

1180

1181 **3. Custom Lines**

1182 3.1. The following sections are also critical for custom lines.

- 1183 • 9.1 Continuity of Coating (Holiday Monitoring)
- 1184 • 9.2 Thickness of Coating
- 1185 • 9.3 Flexibility of Coating

1186

1187 **4. Textured Coating Lines**

1188 4.1. The following sections are also critical for textured coating lines.

- 1189 • 9.3 Flexibility of Coating
- 1190 • 9.5 Thickness of Textured Coating
- 1191 • 9.6 Profile of Textured Coating Surface

1192

1193 **SECTION VII. ANNEX 3 – APPLICATION OF THIS STANDARD FOR PLANT CERTIFICATION**

1194 This annex lays out the types of certifications available for Manufacturing Facilities that coat reinforcing products.  
1195 Manufacturing Facilities that voluntarily participate in the CRSI program may select to apply for one or both of the  
1196 following basic certification types for corrosion-resistant (i.e., non-textured) coating:

- 1197 • **Straight Bar Line** (Based on ASTM A775, A1078, or similar standard specifications)
- 1198 • **Custom Line** (Based on ASTM A775, A934, A884, or similar standard specifications)

1199 These basic certification types can be supplemented with a **Textured Coating Line** certification, based on ASTM  
1200 A1124.

1201  
1202 This standard is organized into Common and Type-specific sections. Manufacturing Facilities being certified to either  
1203 basic certification type shall comply with the Common requirements laid out in the standard as well the type-specific  
1204 requirements for the type of certification for which they have applied. Certification for **Textured Coating** requires that  
1205 a plant additionally comply with the requirements of the textured coating section of the standard.

1206  
1207 Audits are conducted by an independent, third-party inspection agency to verify conformance with the applicable  
1208 requirements of the standard. During audits for the basic certification types, the Manufacturing Facility and their  
1209 quality program staff shall be asked to:

- 1210 • Demonstrate their production methods (note: the coating line shall be operated for at least part of the audit);
- 1211 • Demonstrate quality control procedures, including all quality control process inspections and tests;
- 1212 • Provide access to quality documentation; and
- 1213 • Provide access to uncoated (incoming) and coated product storage

1214  
1215 For Manufacturing Facilities pursuing **Textured Coating Line** certification, the demonstration of quality control  
1216 procedures shall include procedures applicable to both corrosion-resistant (i.e., non-textured) coating and textured  
1217 coating products. It is not intended that Manufacturing Facilities pursuing the Textured Coating Line certification will  
1218 be required to switch over the type of coating during the audit; however, the plant shall have sufficient coated  
1219 reinforcing product samples available to permit demonstration of quality control procedures for the sections of the  
1220 standard identified as Critical in Annex 2 of this standard. At minimum, this shall include three 4-ft products coated  
1221 within the last year. Further, for a manufacturing facility to be audited for **Textured Coating Line** certification, this  
1222 facility must have completed quality documentation for at least 5 different textured coating production shifts within the  
1223 last year.

1224  
1225 At the conclusion of the audit, the findings of the inspection agency will be communicated to facility management,  
1226 quality staff and any other personnel designated by plant management through an exit meeting. This will be followed-  
1227 up with a written report.

1228

1229

**DISCLAIMER**1230  
1231  
1232  
1233  
1234

Concrete Reinforcing Steel Institute (“CRSI”) standards, of which the document contained herein is one, are developed through a voluntary consensus standards development process. This process brings together volunteers and/or seeks out the views of persons who have an interest in the topic covered by this Standard. Consensus does not necessarily mean that there is a unanimous agreement among every person participating in the development of this Standard.

1235  
1236  
1237  
1238  
1239

The information in this Standard was considered technically sound by the consensus of persons engaged in its development and approval at the time it was developed. While CRSI administers the process and establishes rules to promote fairness in the development of consensus, it does not write the document and it does not independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in its standards publications.

1240  
1241  
1242  
1243  
1244

CRSI disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, application, or reliance on this Standard. CRSI disclaims and makes no guaranty or warranty, expressed or implied, as to the accuracy or completeness of any information published herein, and disclaims and makes no warranty that the information in this Standard will fulfill any of your particular purposes or needs.

1245  
1246  
1247  
1248  
1249  
1250  
1251  
1252

CRSI does not undertake to guarantee the performance of any individual manufacturer or seller’s products or services by virtue of this Standard. In publishing and making this Standard available, CRSI is not undertaking to render professional or other services for or on behalf of any person or entity, nor is CRSI undertaking to perform any duty owed by any person or entity to someone else. Anyone using this Standard should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstance. Information and other standards on the topic covered by this Standard may be available from other sources, which the user may wish to consult for additional views or information not covered by this Standard.

1253  
1254  
1255  
1256

CRSI has no power, nor does it undertake to police or enforce compliance with the contents of this Standard. CRSI does not certify, test, or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health or safety-related information in this Standard shall not be attributable to CRSI and is solely the responsibility of the certifier or maker of the statement.

1257  
1258  
1259

CRSI takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this Standard. Users of this Standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

1260  
1261  
1262  
1263  
1264  
1265

This Standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and, if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this Standard or for additional standards and should be addressed to CRSI Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the CRSI Committee on Standards, at the address shown below.

1266  
1267  
1268

This Standard is copyrighted by CRSI, 933 North Plum Grove Road, Schaumburg, IL 60173, United States. Individual reprints (single or multiple copies) of this Standard may be obtained by contacting CRSI at the above address or at 847-517-1200 (phone), 847-517-1206 (fax), (e-mail), or through the CRSI website ([www.crsi.org](http://www.crsi.org)).

1269

1270

1271