METHOD OF TEST FOR DETERMINATION OF CATHODIC DISBONDMENT OF EPOXY-COATED REINFORCING BARS

1. SCOPE

1.1 This test method determines the resistance to cathodic disbonding of an epoxy coating system applied to reinforcing bars, after the coated bars, each with a damage site, are placed in a 3% NaCl solution at 23°C and the polarized potential of the steel is maintained at –1.5 V for 168 hours.

2. RELEVANT DOCUMENTS

2.1 British Standard 3900: Part F10

2.2 British Standard 3900: Part F11

2.3 ASTM A775M 96: G 8 Test Method

3. APPARATUS

3.1 POWER SUPPLY: Filtered D.C. power supply, with a controlled voltage output of between 0 V and 12 V and a current capacity of 200 mA.

3.2 VOLTMETER: Voltmeter with minimum input impedance of 10 megohms and capable of measuring in the range of 0 V to 2 V to the nearest 1 mV.

3.3 SHUNT RESISTOR: 10 ohm shunt resistor (0.5 watt, 1% tolerance).

3.4 REFERENCE ELECTRODE: Calomel reference electrode.

3.5 ANODE: 150 mm in length, of solid platinum (1.6 mm nominal diameter), platinized wire (3.2 mm nominal diameter), or graphite (Stackpole Grade 6229, or equivalent, 13 mm nominal diameter).

3.6 ELECTROLYTE: 3% NaCl by mass dissolved in distilled water.

3.7 GLASS BEAKER: 1-litre glass beaker with Plexiglas cover.

3.8 THERMOMETER: Thermometer which can be submerged in water.

3.9 UTILITY KNIFE: Utility knife with sharp blade.

4. PREPARATION OF TEST SAMPLE

4.1 Specimens, each 200 mm in length, and free from holidays and bare areas, shall be cut from production coated bars.

4.2 On each bar, drill a 3 mm diameter hole approximately 50 mm from one end. The hole shall be centred between deformations and just deep enough to expose the steel. Seal the end of the bar closest to the hole completely with silicone. Drill a 3 mm hole and attach a self-tapping screw to the other end of the bar for the ground connection.

5. PROCEDURE

5.1 Perform the cathodic disbondment test using the equipment arrangement shown in Figure 1.

5.2 Add approximately 500 mL electrolyte to the beaker. Place the Plexiglas cover on the beaker.

5.3 Insert a bar into the beaker, with the sealed end of the bar resting on the bottom of the beaker. Add the electrolyte until 100 mm of the bar length is submerged. Connect the negative lead from the D.C. power supply to the grounding screw of the bar.

5.4 Insert 75 mm of the anode into the electrolyte (If a platinized wire anode is used, the end of the wire submerged in the electrolyte must be sealed completely with silicon to prevent damage to the copper core). Connect the shunt resistor to the anode and the positive lead from the power supply in series.

5.5 Insert the calomel reference electrode into the electrolyte. Place the porous tip of the electrode within 10 mm of the drilled hole in the coating. Connect the positive lead of the voltmeter to the calomel electrode and the negative lead to the bar.

5.6 Turn on the power supply. Adjust the power supply until the polarized potential of the steel is stabilized at –1500 ± 20 mV with respect to the calomel electrode. Measure the voltage drop across the shunt resistor using the voltmeter and calculate the current flow. Record the time as the start time.

5.7 The bar shall remain in the electrolyte, which shall be maintained at a temperature of 23 ± 2°C, for a period of 168 ± 2 h. At intervals of 2 h, record the potential reading and adjust the voltage to correct any drift from –1500 ± 20 mV during the first 8 h. Check the potential reading again at 24 h and at least twice every 24 h thereafter; adjust the voltage if necessary. Measure the voltage drop across the shunt resistor at each potential measurement and calculate the current flow.

5.8 The calomel electrode shall be removed after each potential measurement to avoid the danger of contamination of the electrode. The calibration of the electrode shall be verified after each cathodic disbondment test.

5.9 Remove the bar from the beaker and store the bar in air at 23 ± 3°C for 1 h before preparing it for adhesion testing.

5.10 Using a new blade, make 4 cuts through the coating at each damage site, extending outward from the site at 0°, 90°, 180°, and 270°, providing 4 sections of coating for adhesion testing, as shown in Figure 2. Ensure that the cuts extend through the coating such that the metal is visible. Replace the knife blade if it becomes dull or damaged. The length of each cut shall be not less than 5 mm or the distance between adjacent deformations.

5.11 Perform the adhesion test as follows:

Insert a new blade in the knife. Position the knife vertically on the bar so that the point of the blade touches the edge of a section of coating and the plane of the blade aligned midway between the cut lines; rotate the knife so that it makes a shallow (approximately 30°) angle with the bar while maintaining the tip of the blade in contact with the bar as shown in Figures 3 and 4, but without applying force to the coating. Determine the adhesion of the coating by inserting the blade slowly and applying steady force equivalent to approximately 2 kg until the coating resists the insertion. Maintain the force for at least 5 seconds. Do not apply force such that the coating is cut. Use a lever action on the blade to remove any coating which has been disbonded as a result of inserting the blade under the coating.

5.12 Measure the diameter of the disbonded area from the 0° to 180° coating edges and the 90° to 270° coating edges, and average the two values. Subtract the diameter of the original damage site from this average to obtain the test value.

6. REPORT

6.1 The report shall include the following information for each test bar:

(a) date of testing

(b) epoxy powder description

(c) primer description (if any)

(d) bar batch number

(e) potential and current measurements at different time intervals

(f) disbondment radius in mm

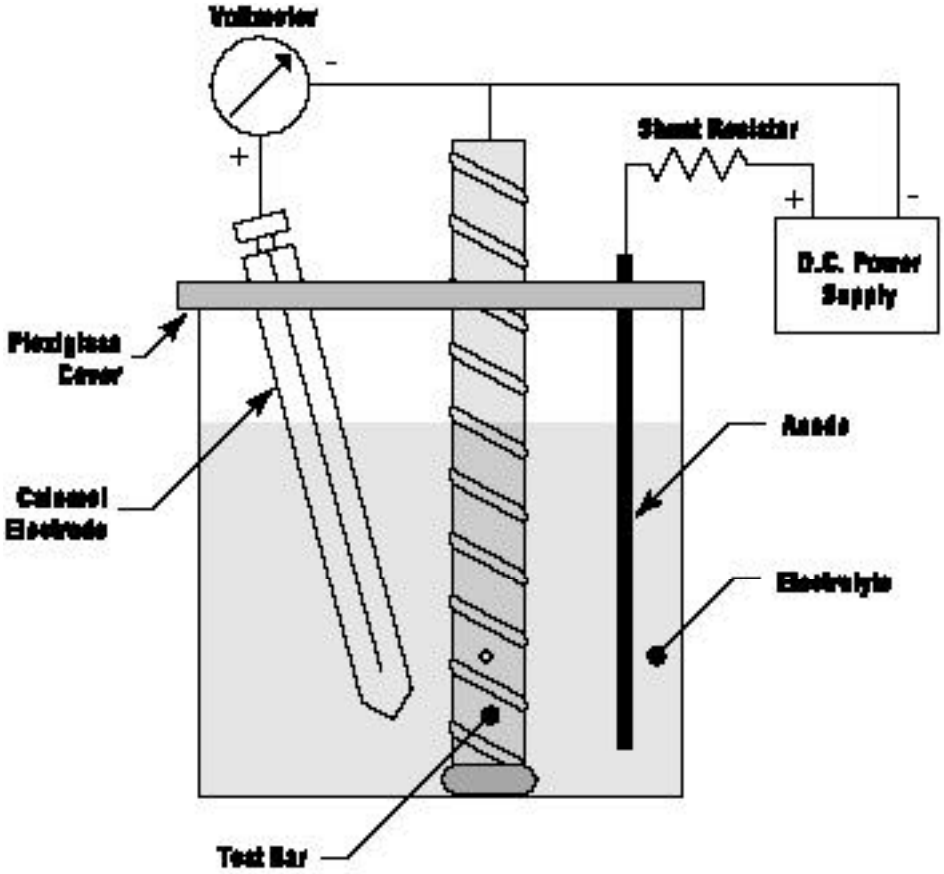

FIGURE 1

ARRANGEMENT FOR CATHODIC DISBONDMENT TEST

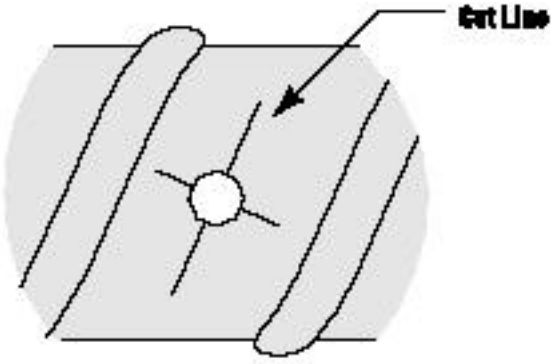

FIGURE 2

PREPARATION OF CUT LINES AT DAMAGE SITE FOR ADHESION TESTING

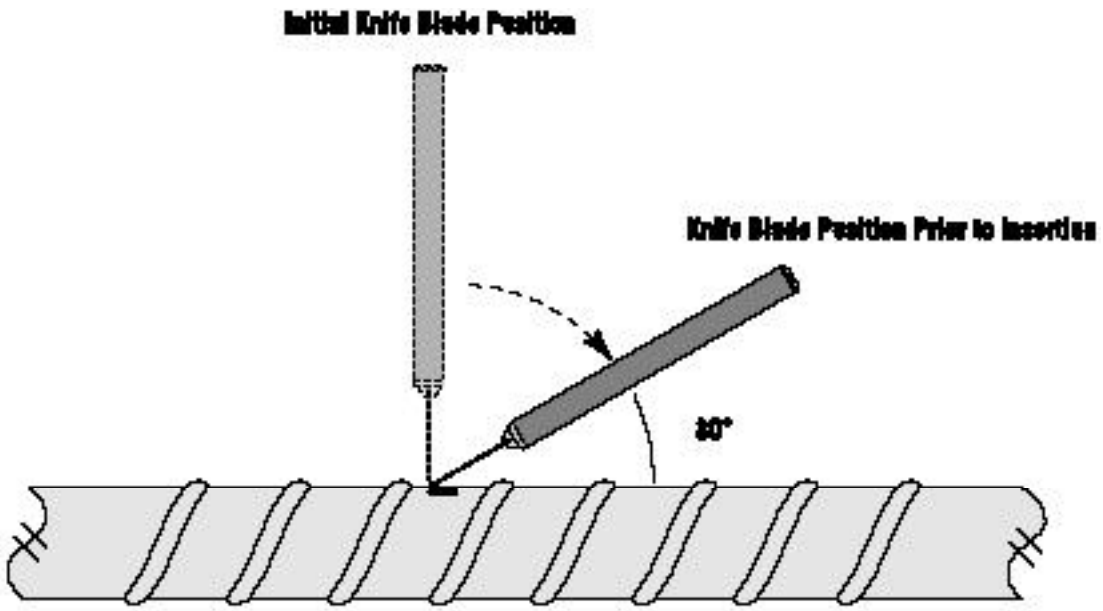

FIGURE 3

KNIFE BLADE - INITIAL PLACEMENT

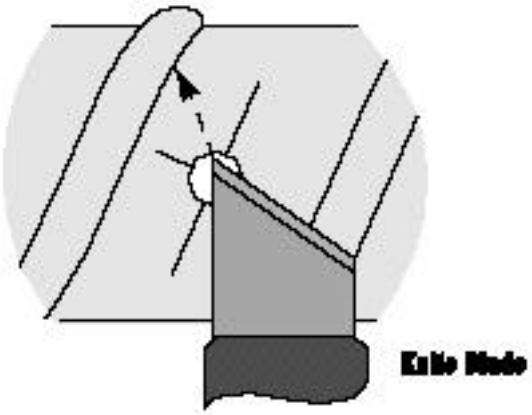

FIGURE 4

KNIFE BLADE - ORIENTATION PRIOR TO INSERTION