CORRUGATED METALLIC-COATED STEEL CULVERT PIPE, PIPE-ARCHES AND END SECTIONS FIELD SECTION 1020

1020.1 SCOPE. To establish procedures for the inspection, acceptance, and reporting of corrugated metallic-coated steel culvert pipe, pipe-arches, and flared end sections.

1020.2 APPARATUS.

(a) Magnetic or electronic Gauge, reading range 0-40 mils [0-1000 µm].

(b) Micrometer capable of measuring to 0.0001 in. [0.00254 mm] and accurate to within at least 0.001 in. [0.0254 mm].

(c) Rule with suitable graduations to accurately measure the material to be inspected.

1020.3 PROCEDURE. Corrugated metallic-coated steel culvert pipe, pipe-arches, and end sections are to be accepted on the basis of the sheet or coil manufacturer having filed the required documents set forth in the Specifications, identification marking, random sampling, and field inspection.

1020.3.1 Manufacturer's Certified Analysis and Guarantee. Prior to the acceptance of corrugated metallic-coated steel for culvert pipe, pipe-arches and end sections, the sheet or coil manufacturer shall furnish General Headquarters Materials a "Sheet Manufacturer's Certified Analysis" and "Sheet Manufacturer's Guarantee" as required by Specification Sec 1020. A list of those manufacturers who have filed acceptable documents is shown in FS-1020 Table 1 and FS-1020 Table 2 of this manual.

1020.3.1.1 If random sampling results in the rejection of the metal, acceptance on the basis of sheet manufacturer's certified analysis and guarantee shall immediately be discontinued and all culvert metal of that brand and gage shall then be sampled, tested, and approved prior to use until such time as shall be determined by General Headquarters Materials. General Headquarters Materials will advise all districts should acceptance of a brand or gage by sheet manufacturer's certified analysis and guarantee be discontinued. When test results again indicate consistent compliance to specification requirements, the State Project Operations Engineer will notify all districts to reinstate that brand and/or gage to the approved list of manufacturers.

1020.3.2 Identification Markings. Each sheet or coil of corrugated metallic-coated steel is to be marked by the manufacturer with a weather resistant stamp and the marking is to contain the name of the sheet manufacturer, brand, gage number or thickness, specified weight [mass] of coating, type of coating or AASHTO designation number of the coated steel and identification symbols showing heat number and coating lot designation. Only sheets or coils from the manufacturers listed in FS-1020 Table 1 and FS-1020 Table 2 of this manual, are to be accepted.

1020.3.3 Random Sampling. Random samples are to be submitted to the Laboratory for determination of weight [mass] of coating, mechanical properties, and chemical analysis. A lot shall be considered that quantity of material offered for inspection at one time that is of the

same thickness and bears the same heat number and coating lot designation. In addition to sampling, field thickness measurement, and pitch and depth of corrugation measurements shall be made on the same sheets or coils selected for random sampling.

1020.3.3.1 Samples for determination of weight [mass] of coating are to be submitted to the Central Laboratory from 5 to 10 percent of the lots of sheets or coils of each gage presented for inspection and shall be obtained from sheets or coils before fabrication of the culvert pipe, pipe-arch, or end sections except that end sections may be fabricated at a location where inspection is not normally done, in which case the weight [mass] of coating may be determined by magnetic or electronic gauge readings taken on the fabricated units. The magnetic or electronic gauge is to be operated and calibrated in accordance with ASTM E376.

1020.3.3.1.1 A single-spot test by magnetic or electronic gauge is to be comprised of at least five readings in a small area and those readings averaged to obtain a single-spot test result. Three such areas should be tested on each side of the unit being tested. This would yield six single-spot test results for an end section in that lot. Average the six single spot test results to obtain the average coating weight [mass] for that unit. Test each unit selected, in the same manner. Average all single-spot test results from each lot tested to obtain the average coating weight [mass] to be reported. Since the specified coating weight [mass] is for double exposed surfaces, the average coating weight [mass] obtained is to be doubled so the reported test result can be directly applied to the specifications. Also report the minimum coating weight [mass] which would be the lowest average coating found on one unit from a single lot.

1020.3.3.1.2 Material may be accepted or rejected for metallic coating on the basis of magnetic or electronic gauge results. If a test result on an individual unit or the average test result on all units fails to comply with the requirements of the specifications, that lot should be resampled at double the original sampling rate. If any of the resample specimens fail to comply with the specifications, the material may be rejected or samples may be submitted to the Central Laboratory.

1020.3.3.1.3 Corrugated metallic-coated steel sheets are to be sampled for weight [mass] of coating at the rate shown in Table 3 of this Section. Three specimens from one sheet comprise one sample. Each specimen shall not be less than 3 x 6-in. [75 x 150 mm] in size, or equivalent area. Each specimen shall be taken so no part includes metal closer than 2 in. [50 mm] from an edge or 4 in. [100 mm] from an end of the sheet. Samples are to be taken from the selected sheets in accordance with one of the following patterns:

(a) One specimen shall be obtained from the center of the sheet and the other two from diagonally opposite corners.

(b) The specimens shall be taken from one end of a sheet, one from the middle portion and one from near each edge. Instead of three specimens, the sample as submitted to the Laboratory may consist of one piece not less than 3 in. [75 mm] wide by the full width of the sheet.

1020.3.3.1.4 The sample for testing weight [mass] of coating of coils shall consist of three specimens taken from one end of a coil. One specimen not less than 3 x 6 in. [75 x 150 mm] shall be cut from the middle of the width and one from each side not closer than 2 in.[50 mm] from the side edge or 4 in. [100 mm] from the end. Instead of three specimens, the sample as submitted to the Laboratory may consist of one piece approximately one foot [300 mm] in length by the as coated width, taken at least 4 inches from the end of a sheet or coil.

1020.3.3.1.5 If laboratory test results show the metal fails to meet the requirements for coating, the lot shall be resampled using pattern (a) unless one of the specimens has less than 1.80 ounces 550 gm/m^2] of galvanizing per square foot [meter] of double exposed surface or 0.90 ounce [275 gm/m^2] of aluminum coating per square foot [meter] of double exposed surface in which case the lot shall be rejected without re-sampling. Samples for retest of coils shall be obtained in the same manner as for the original test.

1020.3.3.2 Samples for chemical analysis of the base metal of sheets or coils before fabrication are to be taken at approximately one year intervals for each brand and kind of metal presented for inspection. Each specimen shall not be less than 3 x 6 inch [75 x 150 mm] in size, or equivalent area and each specimen shall be cut from different sheets in a lot. The number of sheets from which specimens are to be taken for chemical analysis shall be as shown in Table 4 of this Section. Samples of coils shall consist of three specimens from a coil or if more than one mill [25 µm] lift or coil is involved three specimens shall be selected from each of at least two different coils.

1020.3.3.3 Samples for determination of mechanical properties of the base metal of sheets or coils are to be taken at approximately one year intervals for each brand and kind of metal presented for inspection. Two specimens, each 4 x 14 inches (100 x 355 mm), shall be taken from one end of the cut length or coil. The 14 inch dimension shall be in the longitudinal direction of the steel sheet. No specimen shall be taken closer than two inches (50 mm) from the edge or 4 inches (100 mm) from the end of a sheet or coil.

1020.3.3.4 Field measurements for gage, pitch and depth of corrugations are to be made on the same sheets or coils selected for random sampling. A minimum of five gage thickness measurements shall be taken across the width of the sheet or coil at an end at least 3/8 in. [10 mm] from the edge of the metal and on the tangents of corrugations. Two of these measurements shall be on the outermost full corrugations, or within two inches [50 mm] of each side edge of coils. If any single measurement is found deficient more than the specified tolerance, that sheet or section of coil is to be rejected. Additional sheets or sections of coil are to be measured until it is established the remainder of the metal is of satisfactory thickness or until it is evident that a substantial portion (approximately ten percent of the measured sheets or ten percent of the length of the coil) of the lot is deficient, in which case the lot shall be rejected. Rejection and retesting for corrugation pitch or depth is the same as for field thickness.

1020.3.4 Field Inspection. Field inspection is to include checking of identification markings and inspection of fabrication.

1020.3.4.1 Fabricated metallic-coated steel pipe or end sections are to be marked as defined in Specification Sec 1020. The brand of base metal is to be checked to verify that it is on the list of prequalified brands, FS-1020 Table 1 and FS-1020 Table 2 of this manual. The markings on end sections may not appear in a uniform manner since the sheets are cut and formed before assembling the unit, however, the markings can usually be determined through careful inspection. Due to the frequency of sheet metal brand marking, particularly small end sections may occasionally be fabricated without any indication of the original marking. It is satisfactory to accept those occasional units when the fabricator has re-marked the sheet indicating its origin, providing it is reasonable and consistent with the other comparable units being furnished and inspected, and meets all other specifications.

1020.3.4.2 Field inspection of fabrication includes random spot-checking for weight [mass] of coating and thickness in accordance with ASTM E376, checking diameter, length, shape, width

of lap, rivet size, rivet or spot weld spacing, integrity of lock seams and weld seams, end finish - if required, workmanship, and methods of riveting or qualification of welding machine and operator if resistance spot welding is being used, inspection of tests performed by the manufacturer on helical weld seams and tension tests on helical lock seams if performed by the manufacturer. The tolerances and requirements are described in detail in Specification Sec 1020(per ASTM E376 one ounce per square foot equals 1.7 mils). For galvanized coating, if any single spot is found to be lower than 1.0 mils on a single side or the average of all singles spots on a single side is found to be lower than 1.5 mil, that pipe is to be rejected. For aluminized coating, if any single spot on a single side is found to be lower than 0.43 mils on a single side or the average of all single spots on a single side is found to be lower than 0.77 mils, that pipe is to be rejected. Additional pipe should be measured until it is established that the remainder of the pipe is of satisfactory fabrication and workmanship or until it is evident that a substantial portion of the lot is deficient (approximately ten percent of the measured pipe), in which case the entire lot or shipment shall be rejected.

1020.3.4.3 Samples for visual examination of lock seam pipe shall be triangular sections taken from one end of a length of pipe so as to show the cross section normal to the seam. The base of the triangular sample shall be of sufficient width to show the complete lock seam profile. This sample shall meet the profile as described in AASHTO T249.

1020.3.4.4 Samples for tension tests of lock seam pipe shall be taken from pipe representing each sheet thickness and diameter the first time that sheet thickness and diameter is offered for inspection. Approximately 10 percent of the shipments of each sheet thickness thereafter shall be sampled for tension testing of the seam. The sample shall consist of a 4 x 8 inch [100 x 200 mm] strip taken from the end of a fabricated pipe. A 1 x 8 inch [25 x 200 mm] coupon perpendicular to the lock seam will be saw-cut from the sample. The edges of the coupon will be parallel. No reformed corrugations will be allowed in the sample. The length perpendicular to the lock seam shall be a minimum of 8 inches [200 mm]. Tension test specimens may be sent to the Central Laboratory for testing or they may be tested at the plant providing proper equipment is available. The sample shall meet the tension requirements noted in Sec 1020 of the Standard Specifications.

1020.4 SAMPLE RECORD.

1020.4.1 SiteManager shall be used when submitting samples to the Laboratory. The inspector is to show the following information for each lot sampled:

(a) Type of coating, galvanized or aluminum.

(b) Complete identification shown on the sheet or coil.

(c) Sampling pattern used.

(d) Results of field sheet thickness measurements (minimum and average) for each lot sampled.

(e) Whether corrugation dimensions comply with specification requirements.

1020.4.2 Field inspection reports of fabricated pipe, pipe-arches, and end sections shall be made using SiteManager and should include the coating lot designation, size of corrugation, and type of fabrication (riveted, spot welded, helical lock seam, or helical welded seam). Pipe

quantity shall be shown in feet. End sections shall be shown as quantity each. The length of barrel of the end sections shall be included in the remarks and shall not be counted toward the materials summary unless the length contributed is necessary to eliminate a significant summary deficiency. The sample record is to indicate acceptance or rejection. If the sample record indicates rejection, the reason for rejection shall be stated in the remarks of the sample record. If the sample record indicates acceptance, the basis of acceptance of the metal shall be on results of Laboratory tests or the approved brand and an examination of the material, and because fabrication is satisfactory.

1020.4.3 Random spot-checking for weight [mass] of coating or thickness, visual examination of helical lock sears or weld seams, and tension testing of lock seams performed by the manufacturer, is to be recorded in the inspector's diary and need not be recorded on the inspection report.