CITY OF ABILENE

ITEM 460

CORRUGATED METAL PIPE

460.1. DESCRIPTION.

This Item shall govern for the furnishing and installing of all corrugated metal pipe and/or materials for constructing corrugated metal pipe culverts or corrugated metal sewer mains, laterals, stubs and inlet leads. The pipes shall be of the sizes, types, design and dimensions shown on the Plans and shall include all connections and joints to new or existing pipes, sewer, manholes, inlets, headwalls and other appurtenances as may be required to complete the work.

460.2. MATERIALS.

Unless otherwise specified on the Plans or herein, corrugated metal pipe may be galvanized steel, aluminized steel, aluminum or precoated galvanized steel conforming to the following:

Galvanized Steel	AASHTO M218
Aluminized Steel	AASHTO M274
Aluminum	AASHTO M197
Precoated Galvanized Steel	AASHTO M246

Corrugated metal pipe for sewers shall be Type 1A and the smooth liner shall be polymer coated with a minimum thickness of ten mils on each side. The outer liner shall be galvanized, unless otherwise shown on the Plans.

Where reference is made to gage of metal, the reference is to U.S. Standard Gage for uncoated sheets. Tables in AASHTO M218 and AASHTO M274 list thicknesses for coated sheets in inches. Tables in AASHTO M197 list thicknesses in inches for clad aluminum sheets.

460.3. FABRICATION.

Corrugated metal pipe of all types may be fabricated with annular corrugations, lap joint construction with riveted seams or may be fabricated with helical lock seams. Steel corrugated metal pipe may also be fabricated with resistance spot welded seams or helical continuous welded seams. All corrugated metal pipe shall be Type I (circular), Type 1A (circular, smooth-lined) or Type II (arch) as specified on the Plans.

(1) Steel Pipe. Galvanized or aluminized steel pipe shall conform to the requirements of AASHTO M36.

(2) Aluminum Pipe. Aluminum pipe shall conform to the requirements of AASHTO M196.

(3) Precoated Galvanized Steel Pipe. Precoated galvanized steel pipe shall conform to the requirements of AASHTO M245. Unless otherwise noted on the Plans, both the inside and outside coating shall be a minimum thickness of ten (10) mils.

460.4. SELECTION OF GAGES.

The Plans will provide a summary indicating the location and length for all pipe. For full circle pipe, the diameter, permissible corrugations and required gages will be shown. Pipe arch design size and permissible corrugations will be shown on the Plans. The shape and minimum gage for pipe arch shall be

as designated in Tables A, B or C for the specified design size and corrugation for steel pipe, and in Table D for aluminum pipe.

All dimensions are measured from the inside crests of the corrugations. A tolerance of plus or minus one (1) inch or two (2) percent of the equivalent circular diameter, whichever is greater, will be permissible in span and rise.

TABLE A
STEEL PIPE ARCH
2 2/3-INCH BY 1/2-INCH CORRUGATIONS
H-20 LOADING

Design Size	Span Inches	Rise Inches	Minimum Cover Inches *	Minimum Gage Required	Coated Thickness Inches	Equivalent Diameter Full Circle Pipe Inches
1	17	13	12	16	0.064	15
2	21	15	12	16	0.064	18
3	28	20	12	16	0.064	24
4	35	24	12	16	0.064	30
5	42	29	12	14	0.079	36
6	49	33	12	14	0.079	42
7	57	38	12	12	0.109	48
8	64	43	12	12	0.109	54
9	71	47	12	10	0.138	60

*The fill heights for all sizes of pipe arch are limited to a maximum of seven (7) feet.

TABLE B
STEEL PIPE ARCH
3-INCH BY 1-INCH CORRUGATIONS
H-20 LOADING

Design Size	Span Inches	Rise Inches	Minimum Cover Inches *	Minimum Gage Required	Coated Thickness Inches	Equivalent Diameter Full Circle Pipe Inches
7	53	41	12	14	0.079	48
8	60	46	12	14	0.079	54
9	66	51	12	14	0.079	60
10	73	55	12	14	0.079	66
11	81	59	12	14	0.079	72
12	87	63	12	14	0.079	78
13	95	67	12	12	0.109	84
14	103	71	18	12	0.109	90
15	112	75	18	12	0.109	96
16	117	79	18	12	0.109	102
17	128	83	24	10	0.138	108
18	137	87	24	10	0.138	114
19	142	91	24	10	0.138	120

*The fill heights for all sizes of pipe arch are limited to a maximum of ten (10) feet.

TABLE C
STEEL PIPE ARCH
5-INCH BY 1-INCH CORRUGATIONS
H-20 LOADING

Design Size	Span Inches	Rise Inches	Minimum Cover Inches *	Minimum Gage Required	Coated Thickness Inches	Equivalent Diameter Full Circle Pipe Inches
11	81	59	12	12	0.109	72
12	87	63	12	12	0.109	78
13	95	67	12	12	0.109	84
14	103	71	18	12	0.109	90
15	112	75	18	12	0.109	96
16	117	79	18	12	0.109	102
17	128	83	24	10	0.138	108
18	137	87	24	10	0.138	114
19	142	91	24	10	0.138	120

*The fill heights for all sizes of pipe arch are limited to a maximum of ten (10) feet.

TABLE D
ALUMINUM PIPE ARCH
2 2/3-INCH BY 1/2-INCH CORRUGATIONS
H-20 LOADING

Design Size	Span Inches	Rise Inches	Minimum Cover Inches *	Minimum Gage Required	Coated Thickness Inches	Equivalent Diameter Full Circle Pipe Inches
1	17	13	12	16	0.060	15
2	21	15	12	16	0.060	18
3	28	20	12	14	0.075	24
4	35	24	12	14	0.075	30
5	42	29	18	12	0.105	36
6	49	33	18	12	0.105	42
7	57	38	18	10	0.135	48
8	64	43	18	10	0.135	54
9	71	47	18	8	0.164	60

*The fill heights for all sizes of pipe arch are limited to a maximum of seven (7) feet.

460.5. COUPLING BANDS.

Except as otherwise required herein, coupling bands and other hardware for galvanized or aluminized steel pipe shall conform to the requirements of AASHTO M36 for steel pipe and AASHTO M196 for aluminum pipe. Field joints for each type of corrugated metal pipe shall maintain pipe alignment during construction and prevent infiltration of side material during the life of the installation.

Coupling bands shall be not more than three (3) nominal sheet thicknesses lighter than the thickness of the pipe to be connected and in no case lighter than 0.052 inch for steel or 0.048 inch for aluminum.

Coupling bands shall be made of the same base metal and coating as the pipe.

Coupling bands shall lap equally on each of the pipes being connected to form a tightly closed joint after installation.

Coupling bands with annular corrugations shall be used only with pipe with annular corrugations, or helical pipe in which the ends have been rerolled to form annular corrugations. The corrugations in the band shall have the same dimensions as the corrugations in the pipe end, or may be of a special design to engage only the first or second corrugation from the end of each pipe. The band may also include a U-shaped channel to accommodate upturned flanges on the pipe.

Helical pipe without annular end corrugations will be permitted only when it is necessary to join a new pipe to an existing pipe having helical end corrugations. Pipe furnished with helical end corrugations shall be field joined with either helically corrugated bands or with bands with projections (dimples).

Coupling bands with projections (dimples) may be used with pipe having either annular or helical corrugations. The bands shall be formed with the projections in annular rows with one projection for each

corrugation of helical pipe. Bands 10-1/2 or 12 inches wide shall have two (2) annular rows of projections and bands 16-1/4 or 22 inches wide shall have four (4) annular rows of projections.

The coupling band width shall not be less than as shown in Table E. The bands shall be connected in a manner approved by the Engineer with suitable galvanized devices such as angles, integrally or separately formed and attached flanges, bolted with galvanized bolts and nuts; bars and straps; wedge lock and straps or lugs. Other types of coupling systems designated in AASHTO M36 may be used, when authorized by the Engineer.

TABLE E
COUPLING BAND WIDTH REQUIREMENTS

Nominal	Nominal	Coupling Band Width Inches, min.		
Corrugation Size* Inches	**Pipe Inside Diameter** Inches**	**Annular Corrugated Bands**	**Helically Corrugated Bands**	**Bands With Projections**
2 2/3 by 1/2	12 to 36 42 to 72 78 to 84***	7 10 1/2 10 1/2	12 12 12	10 1/2 10 1/2 16 1/4
3 by 1	36 to 72 78 to 120	12 12	14 14	10 1/2 16 1/4
5 by 1	36 to 72 78 to 120	20 20	22 22	12 22

* For helically corrugated pipe with re-rolled ends, the nominal size refers to the dimensions of the end corrugations in the pipe.
** Equivalent circular diameter for Type II pipe.
*** Diameter through 120 in. for annular corrugated bands used on re-rolled ends of helically corrugated pipe.

The minimum diameter of bolts for coupling bands shall be three-eighths (3/8) inch for pipe diameters 18 inches and less and one-half (1/2) inch for pipe diameters 21 inches and greater. Bands 12 inches wide or less will have a minimum of two (2) bolts, and bands greater than 12 inches wide shall have a minimum of three (3) bolts.

Galvanized bolts, nuts, washers, angles and other hardware shall be galvanized in accordance with TxDOT Item 445, “Galvanizing”.

460.6. DESIGNATION OF TYPE.

The types of pipe will be indicated on the Plans by the following descriptions:

Pipe Type: CMP or CMP ARCH
Type of Material: (Galvanized Steel, Aluminum Coated or Aluminum)
Pipe Coating: (Bituminous Coated or Polymer Coated)
Special Requirements: (Paved Invert or Smooth Lining)
Pipe Size: (Diameter or Design No.)

When designated as Corrugated Metal Pipe without a type or coating designation, the Contractor may furnish any of the above types.

460.7. PROTECTIVE COATING.

(1) Bituminous Coated. Bituminous coated pipe or pipe arch shall conform to this specification both as to base metal and fabrication, and shall be coated inside and out with a bituminous coating meeting the requirements herein and in AASHTO M190. The pipe shall be uniformly coated inside and out to a minimum thickness of 0.05 inch, measured on the crests of the corrugations.

When specified as smooth lining, the pipe shall receive additional bituminous material applied to the full inner circumference, to form a smooth inside lining, with a minimum thickness of one-eighth (1/8) of an inch above the crest of the corrugations.

The bituminous coating shall tightly adhere to the metal; shall not chip off in handling; and shall protect the pipe from deterioration as evidenced by samples prepared from the coating material successfully meeting the Shock Test and Flow Test in accordance with Test Method Tex-522-C.

(2) Paved Invert. When a paved invert is specified, the pipe or pipe arch, in addition to the fully coated treatment described above, shall receive additional bituminous material, of the same specification as above, applied to the bottom quarter of the interior surface to form a smooth pavement with a minimum thickness of one-eighth (1/8) of an inch above the interior crests of the corrugations.

460.8. CONSTRUCTION METHODS.

The location of private driveway and side road pipe shall be constructed at locations shown on the Plans or as directed by the Engineer.

Corrugated metal pipe shall be installed in accordance with the Plans and requirements herein.

(1) Excavation. All excavation shall be in accordance with the requirements of Item 400, "Excavation and Backfill for Structures", except where tunneling or jacking methods are shown on the Plans or permitted by the Engineer.

(2) Shaping and Bedding. All shaping and bedding shall be in accordance with Item 400, "Excavation and Backfill for Structures".

Cement stabilized materials for bedding or backfill will not be permitted to come into contact with any uncoated aluminum or aluminized pipe surface.

(3) Laying Pipe. Unless otherwise authorized by the Engineer, the laying of pipes on the bedding shall be started at the outlet end, the separate sections firmly joined together, outside laps of annular joints pointing upstream and longitudinal laps on the sides. Any metal in joints which is not protected by galvanizing or aluminizing shall be coated with a suitable asphaltum paint. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trench without damaging the pipe or disturbing the bedding and the sides of the trench. Any pipe which is not in alignment or which shows any undue settlement after laying shall be taken up and re-laid without extra compensation.

Multiple installation of corrugated metal pipe and pipe arches shall be laid with the centerlines of individual barrels parallel. Unless otherwise indicated on the Plans, the following clear distances between outer surfaces of adjacent pipes shall be maintained:

Diameter of Pipe	Clear Distance Between Pipes - Full Circle and Pipe Arch	Pipe Arch Design No.
18”	1’-2”	2
24”	1’-5”	3
30”	1’-8”	4
36”	1’-11”	5
42”	2’-2”	6
48”	2’-5”	7
54”	2’-10”	8
60”-84”	3’-2”	9
90”-120”	3’-5”	10 & over

(4) Culvert Connections. Where new structures are constructed as extensions to structures in place or are joined to existing structures, the construction shall include all work necessary to provide a proper connection between the new structure and the existing structure as indicated on the Plans, including coating of the connection with bituminous material when required.

(5) Reuse of Existing Appurtenances. When existing appurtenances are specified on the Plans for reuse, the portion to be reused shall be severed from the existing culvert and moved to the new position previously prepared, by approved methods.

Connections shall conform to the requirements for joining sections of pipes as indicated herein or as shown on the Plans. Any headwalls and any aprons or pipe attached to the headwall that are damaged during moving operations shall be restored to their original condition at the Contractor's expense. The Contractor, if he so desires, may remove and dispose of the existing headwalls and aprons and construct new headwalls at his own expense, in accordance with the pertinent specifications and design indicated on the Plans or as furnished by the Engineer.

(6) Sewer Connections and Stub Ends. Connections of pipe sewer to existing sewers or sewer appurtenances shall be as shown on the Plans or as directed by the Engineer. Portions of aluminum pipe that are to be in contact with concrete or metal other than aluminum shall be insulated from these materials by a coating of bituminous material meeting the performance requirements set forth in Article 460.7. The coating applied to the pipe or pipe arch to provide insulation between the aluminum and other material shall extend a minimum distance of one (1) foot beyond the area of contact. The bottom of the existing structure shall be mortared or concreted if necessary, to eliminate any drainage pockets created by the new connection. Where the sewer is connected into existing structures, which are to remain in service, any damage to the existing structure resulting from making the connection shall be restored by the Contractor to the satisfaction of the Engineer. Stub ends, for connections to future work not shown on the Plans, shall be sealed by installing watertight plugs into the free end of the pipe.

(7) Backfilling. Backfilling for the metal pipe structure is a critical phase of the construction and shall be in accordance with Item 400, “Excavation and Backfill for Structures”. Special emphasis is placed upon the need for obtaining uniform backfill material and uniform compacted density throughout the length of the structure so that equal pressure will be provided. Care is to be taken to insure proper backfill under the structure.

(8) Protection of Pipe. Unless otherwise shown on the Plans or permitted in writing by the Engineer, no heavy earth moving equipment will be permitted to haul over the structure until a minimum of four (4) feet of compacted fill (permanent or temporary) has been placed over the top of the structure.

Prior to adding each new layer of loose backfill material, until a minimum of 12 inches of cover is obtained, an inspection will be made of the inside periphery of the structure for local or unequal

deformation caused by improper construction methods. Evidence of such will be reason for such corrective measures as may be directed by the Engineer.

Pipe damaged by the Contractor shall be removed and replaced by the Contractor at no additional cost to the City.

460.9. MEASUREMENT.

This Item will be measured by the linear foot. Such measurements will be made between the ends of the barrel along its flow line, exclusive of safety end treatments. Safety end treatments shall be measured in accordance with TxDOT Item 467, "Safety End Treatment". Where spurs, branches or connections to existing pipe lines are involved, measurement of the spur or new connecting pipe will be made from the intersection of its flow line with the outside surface of the pipe into which it connects. Where inlets, headwalls, catch basins, manholes, junction chambers, or other structures are included in lines of pipe, that length of pipe tying into the structure wall will be included for measurement but no other portion of the structure length or width will be so included.

For multiple pipes, the measured length will be the sum of the lengths of the barrels, measured as prescribed above.

This is a Plans quantity measurement Item and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contact Plans, except as may be modified by General Conditions of Contract Documents. If no adjustment of quantities is required, additional measurements or calculations will not be required.

460.10. PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Corrugated Metal Pipe", "Corrugated Metal Pipe Arch", "Corrugated Metal Pipe (Sewer)" or "Corrugated Metal Pipe Arch (Sewer)" of the type, size and coating specified. This price shall be full compensation for furnishing, hauling, placing and joining of pipes; for all connections to new or existing structures; for moving and reusing headwalls where required; for removing and disposing of portions of existing structures as required; for cutting of pipe ends on skew or slope; and for all labor, tools, equipment and incidentals necessary to complete the work.

Excavation, bedding and backfill will be paid for in accordance with Item 400, "Excavation and Backfill for Structures".

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