

TECHNICAL SPECIFICATIONS  
FOR  
INSULATED GRAVITY SEWER PIPE AND FITTINGS

***PART 1- GENERAL***

1.1 The contractor shall supply bell and spigot insulated pipe and fittings with heat trace channels for use in gravity sewer applications. The minimum service temperature range of all individual components and final products shall be -40° to 100°F unless otherwise specified. All pipe and fittings shall be capable of withstanding the cyclic freezing of water under its rates service pressure without breaks, leaks, gross deformities or impaired service characteristics. The pipe and fittings shall consist of an HDPE SDR 17 core pipe insulated with polyurethane insulation and protected with an outer jacket of 16-gauge aluminum 5052 marine grade Spir-I-ok Jacket.

**1.2 REFERENCES**

A. The following specifications are referenced in this document and shall be considered integral to this specification:

2004 CSI Master Format No.33 31 00 (public sanitary utility sewerage piping)

ASTM C177	Thermal transmission (guarded hot-plate apparatus)
ASTM C273	Shear properties of sandwich-core materials
ASTM C518	Thermal transmission (heat flow meter apparatus)
ASTM D1248	Polyethylene (PE) extrusion materials -wire and cable
ASTM D1599	Resistance to short-time hydraulic failure pressure of plastic pipe, tubing, and fittings
ASTM 01621	Compressive properties of rigid cellular plastics
ASTM D1621	Apparent density of rigid cellular plastics
ASTM D1784	Rigid PVC Compounds and CPVC Compounds
ASTM D2128	Response of rigid cellular plastics to thermal humid aging (thermal dimensional stability)
ASTM D2657	Heat Joining Polyolefin Pipe and Fittings
ASTM D2837	Obtaining pressure design basis for thermoplastic pipe products
ASTM D2842	Water absorption of rigid cellular plastics
ASTM D3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3350	Specification for Polyethylene Plastic Pipe and Fittings Materials
ASTM E96	Water vapor transmission of rigid cellular plastics
ASTM E398	Water vapor transmission rate of sheet materials (dynamic relative humidity measurement)
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F714	Polyethylene (PE) plastic pipe (SOR-PR) -based on outside diameter
AWWA C901	Polyethylene Pressure Pipe and Tubing, 1/2-inch through 3-inch for Water Service
AWWA C906	Polyethylene-Pressure Pipe and Fittings, 4-inch through 63-inch for Water Distribution And Transmission
PPI TN-42 & ASTM D2657	Butt Fusion Joining Procedure for Polyethylene Water and Sewer
PPI TR-33*	Generic Butt Fusion Joining Procedure for Polyethylene Gas Pipe

(\*A gas pipe specification which is used Industry-wide for municipal and industrial PE pipe applications.)

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- B. Unless otherwise noted herein or on the drawings, all fittings shall be constructed utilizing inner core pipe of the same material, resin, and dimensions as that used for the inner core pipe of the straight lengths.

**PART 2 – PRODUCTS**

**2.1 CORE PIPE**

- A. All core pipes shall be made of high-density polyethylene (HDPE) that conforms to Plastics PE4710 pipe shall be manufactured from pressure rated PE4710 polyethylene compounds that meet or exceed ASTM D 3350 requirements and Cell Classification PE445574C. Plastics PE4710 compound will meet or exceed ASTM D3350 requirements and Cell Classification PE345464C and material code designations PE3608 and PE3408
- B. Plastics PE4710 polyethylene pipe compounds are listed by PPI in TR-4 and are stress rated for pressure pipe with PPI HDS ratings for water at 73°F (23°C) and PPI HDB ratings at 73°F (23°C) and 140°F (60°C). Plastics PE4710 exceeds PPI TR-3 and ASTM D3350 SCG resistance requirements per ASTM F 1473 (PENT). Plastics PE4710 ductility is substantiated with greater than 438,300 hours (50 years) at 73°F (23°C) before the onset of SCG. Plastics PE4710 black polyethylene compounds shall be certified to NSF-61 all applicable provisions and requirements of the latest revision of AWWA C901 and AWWA C906 and, by inclusion, all appropriate standards referenced therein. All 4710 shall be manufactured from a bimodal resin.
- C. All pipe and fittings shall conform to standard iron pipe size outside dimensions (IPS), have a wall thickness meeting SDR 17, and have a minimum pressure rating of 100 psi according to ASTM 02837 at 73°F with a service rating of 0.5. All HDPE pipe shall be from straight sticks of pipe. Under no circumstances shall any coiled HDPE pipe be used to manufacture products furnished under this specification. All core sewer pipes shall be black, stamped with the appropriate SDR and ASTM designations.
- D. All core HDPE fittings shall be manufactured to be as strong as or stronger than the pipe the fittings will be joined to, and shall maintain identical IPS outside dimension on stub-outs, and shall conform to the minimum pressure rating listed in section 2.1C. All fittings shall be manufactured from NSF-61 approved components. Tees may be fabricated using branch saddle sidewall fusion or molded fittings. All wyes are fabricated therefore must be d-rated. Wyes may be constructed using a higher SDR rated pipe to match the requested pressure rating.
- F. All standard core elbows shall be fabricated using sweep bends. Sweep bends shall be seamless, manufactured in one continuous piece of SDR 11 HDPE pipe, with an angular tolerance of  $\pm 2$  degrees without reversion and a bend radius as specified in the following table. If elbows shall be mitered they must be must be d-rated and may be constructed using a higher SDR rated pipe to match the requested pressure rating. All elbows must maintain normal outside diameters along their entire length within tolerance as per ASTM-F714 and be suitable for butt-welding or electro fusion. The outside surface of the elbows shall exhibit all the specified characteristics of the straight pipe and shall not have any blisters or other surface defects from the manufacturing process. All sweep bends shall be NSF-61 approved after manufacture of the final product. Tight radius elbows shall be constructed with molded fittings rated at minimum pressure listed in sections 2.1C and shall be NSF-61 approved.

Pipe Size (inches dia.)	Centerline Radius (inches)
<u>2</u>	<u>6.0 – 9.0</u>
<u>3</u>	<u>9.0 - 11.0</u>
<u>4</u>	<u>13.0 – 15.0</u>
<u>6</u>	<u>19.0 – 21.0</u>
<u>8</u>	<u>22.0 – 26.0</u>
<u>Long Radius</u>	<u>32.0 – 36.0</u>

*TECHNICAL SPECIFICATIONS FOR INSULATED GRAVITY SEWER PIPE AND FITTINGS (cont.)*

- F. The manufacturer of core fabricated fittings supplied under this specification shall establish and qualify heat fusion procedures conforming to PPI TR-33 and ASTM D2657 and all fusion must be performed by a qualified operator factory-certified in the use of the specific equipment employed to construct the fittings.
- G. Bell ends of all core pipe and fittings shall be fabricated with identical PVC push-on type sewer couplings. All PVC sewer couplings shall be manufactured in one piece of injection molded PVC compound meeting ASTM D1784. Couplings shall be Class 200 and conform to requirements of DR 21. Fittings shall be designed to withstand a minimum of 630 psi quick burst pressure at 73°F, tested in accordance with ASTM D1599. Bells shall be gasketed joints conforming to ASTM D3139 with gaskets conforming to ASTM F477.
- H. The gaskets on push-on couplings shall be elastomeric, non-circular in cross-section, tapered on the inlet edge to prevent rollout when the pipe is coupled, and be not less than 1/4-inch square in the cross-sectional area. The groove in which the gasket is retained shall have sides that are perpendicular to the center line of the pipe.
- I. The spigot end of the core pipe shall be smoothly beveled to a 15 degree angle as shown in the drawings. The bevel shall reduce the wall thickness at the end of the pipe by 50 percent. The bell and spigot ends shall be free from chips, gouges, and other damage. The bell couplings shall not be ground, chipped, gouged, or damaged in any manner.

2.2 INSULATION

- A. Insulation between pipe and outer jacket of all pipe and fittings shall be low-density rigid closed- cell urethane foam with a nominal thickness as shown on the drawings. It shall be applied and cured in strict accordance with the manufacturer's recommendations and good commercial practices such that the resulting cellular insulation completely fills the annular space between inner pipe and outer jacket and is free of defects affecting its intended purpose.
- B. Urethane foam shall exhibit the following properties and characteristics specified by the referenced ASTM tests below:

ASTM C518 or C177	Maximum K-factor, as produced	0.15 to 0.16 btu-in/hr-ft <sup>2</sup> -°F
ASTM D1622	Core Density Range	3.0 to 4.0 lbs/ft <sup>3</sup>
ASTM 01621	Minimum Compressive Strength (Parallel and perpendicular to pipe axis)	35 psi
ASTM D2842	Maximum Water Absorption	0.05 lb/ft <sup>3</sup>
ASTM 02126	Dimensional Stability (Maximum Linear Change)	1% at -20°F 3% at +100°F

- C. Exposed insulation faces at pipe end fitting ends shall be coated to protect against physical abuse, UV exposure during shipping and storage, and against water intrusion in service. The coating shall be suitable for direct application over the insulation with no deleterious effects to the insulation or coating. The coating shall be formulated for long-term service and retained flexibility over extended periods of exposure to sunlight, heavy precipitation, and saltwater spray within the service temperature range specified in Part 1. The strength of the coating's adhesive bond to the insulation shall be greater than the tensile strength of the coating. In the event the coating is nicked or an edge is rolled up in handling, the coating that has been dislodged shall tear free from the coating still adhering to the insulation rather than pull the balance of the coating off as a sheet.

*TECHNICAL SPECIFICATIONS FOR INSULATED GRAVITY SEWER PIPE AND FITTINGS (cont.)*

D. The end coating shall be applied and cured in strict accordance with the manufacturer's recommendations and good commercial practice such that the finished product is free of defects affecting its intended purpose.

E. The coating material shall exhibit the following properties and characteristics:

ASTM E398 or E96	Maximum Water Vapor Permeance	1.0 perm
	Dry Film Thickness Range	15 to 63 mils

### 2.3 OUTER JACKET

A. Metal outer jackets for pipe and fittings shall be constructed of 16-gauge internal helical lock-seam corrugated Aluminum pipe with an outside diameter as shown on the drawings. Aluminum alloy material shall be 5052-H32. All helical seams shall be continuous, tightly locked and folded. The outer jacket of all pipe and fittings shall be watertight under a five –five head of water and the outside of the jacket shall present a relatively smooth, flat overall appearance. Standard corrugated culvert pipe is not acceptable.

B. The outer jacket corrugations shall be 3/16-inch and 3/8-inch deep, as measured from the flat area between corrugations to the bottom of the corrugations on the outside of the jacket and shall be spaced no more than 2-2/3-inches apart and formed diagonally around the pipe, resulting in not less than 2 nor more than 10 complete corrugations crossing the pipe's circumference at a given cross-section.

C. The nominal diameter shall be inside diameter as measured between the innermost portion of the corrugations, with a dimensional tolerance of  $\pm 1/2''$ .

D. All joints in the aluminum outer jacket fabricated around fittings shall be welded with a continuous bead, resulting in a finished jacket that is watertight per the requirements of section 2.3A.

E. The Contractor shall provide company name date (month and year) on the outer jacket of each pipe and fitting. Information shall be stamped onto the jacket within 8" of one end of the jacket.

F. All surfaces of the outer jacket, including end-cuts and welds, shall be finished such that no jagged edges exist that could cause personal injury.

G. The interior of the jacket shall be free of oils, grease, or other residue that could interfere with the adhesion of insulation tot the outer jacket.

### 2.4 HEAT TRACE CHANNEL

A. Heat trace channels shall be fully enclosed, in direct contact with the Inner core pipe for its entire length, and there shall be no intrusion of foam between the heat trace channel and the core pipe unless otherwise specified. Spacers shall be used to offset the channel at the spigot ends, as shown in the drawings. All channel spacers shall be constructed from HDPE sheet stock.

*TECHNICAL SPECIFICATIONS FOR INSULATED GRAVITY SEWER PIPE AND FITTINGS (cont.)*

- B. Heat trace channels for all straight lengths of pipe shall be made of PE or ABS material and shall be half-moon shaped with inside dimensions of 1-1/2-inches to 1-3/4-inches wide by 3/4-inches to 1-inch high within the finished product after insulation is cured. Heat trace channels shall be installed as shown on the drawings. The heat trace channel shall be flush with the insulation face of the pipe with a tolerance of -1/8-inch, with ends cleanly cut, square, smooth, and free from burrs or other protrusions that could interfere with installation of the heat trace in the field.
- C. Heat trace channels installed along angular bends of fittings shall be constructed with 1"-inch diameter PVC Liquid tight flexible, non-metallic conduit. Conduit material shall be non-conductive and non-corrosive, with a smooth interior surface that will maintain the internal diameter in tight radius bends. Conduit material shall be UL listed for outdoor use and sunlight resistance. A transition fitting shall be installed on all ends of heat trace channel that results in a half-moon channel flush with the insulation face as specified for straight pipe channel. All transition fittings shall be constructed with smooth interiors, free from burrs or other protrusions that could interfere with installing the heat trace in the field, as shown in the drawings.

**PART 3 - EXECUTION**

**3.1 MANUFACTURING AND DIMENSIONAL TOLERANCES**

- A. Allowable offset of the centerline of the outer jacket and core pipe shall be not more than 1/4-inch at the pipe ends. Elsewhere along pipe lengths the centerline off-set shall not be greater than 3/8-inch.
- B. The minimum temperature of all components used to manufacture pipe end fittings shall be 50° F at the start of fabrication. The fabricated pipe shall be placed in a facility maintained at a temperature of 50° F or greater for a minimum of 12 hours after fabrication.
- C. All elbows shall have a bend radius as specified in the table in section 2.1E with a tolerance of  $\pm 2$  degrees without reversion. All elbows must maintain normal outside diameters along their entire length without tolerance as per ASTM-F714.
- D. All branches of fabricated fittings must lie in a single plane with a maximum deviation of  $\pm 2$  degrees.
- E. The spigot end of the core pipe shall extend beyond the face of the insulation a distance of 1-3/4-inches plus the insertion depth of the push-on coupling  $\pm 1/4$ -inch. The insertion depth shall be defined as the distance between the outside edge of the coupling and the coupling center stop.
- F. The outer jacket shall be cut in one pass perpendicular to the length of the jacket  $\pm 1$  degree and flush with the jacket end with a tolerance of -1/8-inch. No part of the coupling shall protrude beyond the end of the jacket as determined by placing a straight-edge across the jacket at any two points. The bell end of the coupling shall be flush with the insulation and outer jacket. Before coating, the plane of the exposed insulation face at bell end spigot ends shall be perpendicular to the centerline axis of the outer jacket  $\pm 1/8$ -inch. The insulation profile of the coated ends shall not exceed the relief deviance of  $\pm 1/4$ -inch across the face.

**3.2 FABRICATED FITTINGS**

- A. All fusion joints in fabricated fittings shall be documented by a computer that records pressure and temperature applied at each fused joint. Computer printouts and electronic data for each fitting shall be made available to the

*TECHNICAL SPECIFICATIONS FOR INSULATED GRAVITY SEWER PIPE AND FITTINGS (cont.)*

owner upon request The contractor shall ensure that each joint is fused at the temperature and pressure recommended by the pipe manufacturer in order to achieve the maximum pressure for that joint.

- B. All fittings for each project shall be labeled with a unique identifier that corresponds with the fusion computer printouts for each fitting.
- C. All manufactured fittings shall have all internal fusion beads removed in such a manner as to result in a continuously smooth flow path inside the pipe per the requirements of the International Plumbing Code Section 704.2 and 706.2, and the Alaska Department of Environmental Conservation 18 AAC 72.040(b)(4)(C).

### 3.3 INSULATING

- A. All Federal and State regulations governing the type of insulation and its use shall be strictly adhered to.
- B. Insulation shall be placed into the pipe by a single injection application. Fittings only (not straight pipe) may be manufactured using one insulation injection for each open end of the fitting. In no case shall the jacket of either straight pipe or fittings be drilled to perform, monitor, or inspect the injection.
- C. The maximum allowable void size is 0.05 in<sup>3</sup> (for reference, as 3/8-inch cube is 0.05in<sup>3</sup>).
- D. Insulation and chemicals shall be prevented from coming in contact with the end or inside of the exposed core pipe.
- E. The heat trace channel shall be secured to the outside of the core pipe, parallel to the pipe axis, and prior to the insulating. The channel shall be flush with the insulation faces at each end of the pipe with a tolerance of -1/8-inch, be free of insulation residue and foreign substances, and open to the minimum cross section specified. A longer cutback can be offered upon request.

### 3.4 CORE PIPE/INSULATION BOND

- A. Core pipe and fittings shall be bonded to the insulation with minimum shear bond strength of 15 psi, or in such a manner to produce insulation-to-insulation separation when a sample is tested in shear as described in section 2c1.
- B. The core pipe surface preparation will be performed in a manner that does not leave foreign material imbedded in the plastic. Gouges or scratches in the pipe surface that exceed 10% of the minimum wall thickness shall be cause for rejection.

### 3.5. PRODUCTION TESTING AND INSPECTION

- A. Only finished pipe length and fittings that meet the requirements of these specifications and drawings shall be used for destructive testing. Only those products that meet all visual quality control specifications shall be considered final products suitable for receipt by the Owner or for laboratory or other destructive testing.

#### 1. VISUAL QUALITY CONTROL

- a. FUSION JOINTS: All fusion joints on core elbow and fitting extensions shall be examined before

*TECHNICAL SPECIFICATIONS FOR INSULATED GRAVITY SEWER PIPE AND FITTINGS (cont)*

the core pipe assembly is foamed into the outer jacket. Elbow and fitting extension fusion joints shall meet all the requirements of the pipe manufacturer and the following minimum requirements:

- b. On both sides, the double bead shall be rolled over to the surface and be uniformly rounded and consistent in size throughout the entire circumference of the joint
- c. The gap between the two beads must not be below the fusion surface throughout the entire circumference of the joint.
- d. The displacement (perpendicular to the pipe center line) between the fused ends must not exceed 10% of the pipe minimum wall thickness.
- e. The width of the combined two beads for SDR 17 pipe shall be as follows:

<u>Pipe Dia.</u>	<u>Minimum Bead Width</u>	<u>Maximum Bead Width</u>
4"	3/16-inch	3/8-inch
6"	1/4-inch	1/2-inch
8"	15/16-inch	9/16-inch

- f. Both beads of each fusion joint shall be of a uniform size and shape. The ratio of the difference in individual bead widths divided by the total width of both beads shall not exceed 10%.
- g. DIMENSIONAL TOLERANCE: Each length of pipe and each fitting will be examined by the Contractor for off-set tolerances, insulation cut-back distances, exposed insulation face alignment and relief profile, and alignment and smoothness of core pipe ends.
- h. INSULATION INTEGRITY: Completed pipe and fitting ends shall be inspected for voids in excess of 0.05 in<sup>3</sup> or discontinuities by the Contractor prior to coating. Any glazing left on the uncoated pipe end from the forms used during the foaming operation shall be removed before coating.
- i. HDPE CARRIER PIPE: The surface of the HDPE carrier pipe shall be free of nicks, cuts, or gouges as outlined in Part 2.1, "Inner Core Pipe."

2. LABORATORY TESTING

- a) Laboratory testing as identified in section 2.2B shall be conducted to verify the quality of the finished product. The density and K-factor shall be measured on insulation specimens of the appropriate size and under the specified conditions as set forth in the applicable ASTM test. Insulation specimens shall be retrieved by cutting a 12-inch section of insulated pipe from a production sample. The remaining length shall be trimmed and finished per the specifications in this document to allow Owner use of that pipe section.
- b) Should the Contractor choose to test the "K" factor as outlined in ASTM C518, the testing apparatus shall be calibrated within 24 hours of the test using a calibration standard certified accurate by the National Bureau of Standards (NBS). The "K" factor test sample shall be removed from the insulated pipe, prepared for testing, and left open to the atmosphere at 70°F for a minimum of 24 hours prior to testing.
- c) In addition to the testing identified in section 2.2B, the following when requested tests shall be performed

*TECHNICAL SPECIFICATIONS FOR INSULATED GRAVITY SEWER PIPE AND FITTINGS (cont.)*

to verify the quality of the finished product:

- 1) Core pipe/insulation bond:
  - a) Two 6-inch lengths of cured insulated pipe shall be cut from one uncoated insulation face end of completed pipe length. The remaining length shall be trimmed according to the dimensional tolerances of this specification and coated to allow owner use of that pipe section.
  - b) One specimen shall be tested at +70°F. The other specimen shall be brought to -60°F in 4 hours or less, and remain there for at least 24 hours before testing. Acceptance will be indicated by a minimum shear bond strength of 15psi and insulation-to-insulation (or insulation-to-insulation pipe surface film) separation or tearing.
  - c). Testing shall be conducted as indicated on the attached drawing labeled “Core pipe/insulation bond test setup.”

### 3.6. PACKING

- A. The core pipe spigot ends of all pipe and fittings shall be capped with PE pipe caps (Caplugs, or approved equal). Duct tape shall not be used to secure the PE pipe caps to the pipe spigot ends.
- B. Pre-Insulated pipe shall be packed in bundles with a maximum gross weight of 4,000 pounds per bundle unless otherwise specified by the owner. The end geometry of each bundle shall be rectangular. Each layer of pipe within the bundle including the bottom layer shall rest upon a minimum of 3 each 2-inch x 4-inch cross cleats banded to that individual layer using 1-1/4-inch steel strapping. All cleats shall feature a 45-degree stop block at least nominal 4-inches high by 4-inches long fastened securely to both ends of the cleats to prevent the pipe from rolling off the cleat when the banding is cut. The outer cross cleats shall be installed between 1 to 2-feet from the insulation face of the pipe ends with the middle cleat centered on the bundle. In addition, 1 1/4-inch steel straps shall securely fasten all the layers together to form a complete bundle. Bundles 5 pipes wide by 5 pipes high are recommended.
- C. All fittings and couplings shall be packaged in crates sheathed with minimum 1/2-inch sheathing not to exceed 4 ft x 4 ft x 8 ft. Minimum nominal 2-inch x 3-inch framing members shall be installed in all corners of the crate and fastened securely to the sheathing. On crates longer than 6-feet, framing members shall be installed along the shorter center line of all the 4 long panels. The framing members shall be securely fastened to each other and to the sheathing. For crates 4-feet long or less, 2 each 2- inch x 4-inch cleats shall be installed on the bottom edges of the crate to provide for forklift handling. For crates longer than 4-feet, 3 cleats shall be installed, with the middle cleat centered on the crate. These cleats shall be fastened through the bottom sheathing and also banded to the crate with 3/4-inch wide steel bands that wrap around the entire crate. The crates shall be designed to stack 3 crates high, provide protection to the contents during rough oceans, air freight transport, and on-site handling without damage.
- D. All bundles and crates will be clearly marked:

### 3.7. FINAL INSPECTION

- A. After completion of the quantity of pipe and fittings contracted for, the owner may perform a final inspection at the fabrication point. The certified results of all required laboratory tests made during production by the Contractor shall be made available in report form at this time. During the final inspection, the product packing will be inspected to see that all specifications listed in section 3.5 have been met. Should any of the packing fail to meet the specifications, the Contractor shall re-pack the pipe to meet the specifications.



3.8 IN FIELD OPERATIONS.

- A. All fusion joints preformed in the field shall be documented by a computer that records pressure and temperature applied at each fused joint. Computer printouts and electronic data for each fusion shall be made available to the owner upon request. The contractor shall ensure that each joint is fused at the temperature and pressure recommended by the pipe manufacturer in order to achieve the maximum pressure rating for that joint.
- B. All persons performing the fusion process shall have been trained and qualified by a company that has been trained in the correct method of butt fusion and electro fusion in accordance to ASTM F 2620-06 PPI TN-42 / TR-33. All persons shall be trained, and qualified annually. The fusion operator shall be thoroughly familiar with and trained on the equipment being used.
- C. All fusion equipment (butt fusion and electro fusion) used on this project shall have been certified to show that it is in good working order. All butt fusion equipment shall have an annual certification sticker and all electro fusion equipment shall have been recalibrated and tested every two years. The sticker will show the certification date and location and company that preformed the certification. The selected butt fusion equipment shall be capable of meeting all parameters of the job. The equipment shall have jaws or reducing inserts designed to properly hold the size of the pipe being fused, it shall be able to generate enough force to reach the required fusion pressure during all fusion conditions.
- D. A minimum of one fusion sample shall be preformed and tested upon each shift start-up, and or upon each new fusion operator's shift. Each sample will be tested and logged in to the fusion sample log. If the test sample does not pass another sample will be taken 180 degrees from the first sample and re-tested, if this test sample also fails all butt fusion activities shall be stopped until a passing test has been preformed. Acceptable methods of testing will be bend back test, In field tensile tester, guided side bend tester, and or a qualified testing facility that performs these test as part of there normal operation. A hand operated fusion unit and electro fusion test log shall be kept and turned in upon the completion of the project.

END OF SPECIFICATION

This publication is intended for use as a insulated piping system guide. It should not be used in place of a professional engineer's judgment or advice and it is not intended as installation instructions. The information in this publication does not constitute a guarantee or warranty for piping installations and cannot be guaranteed because the conditions of use are beyond our control. The user of this information assumes all risk associated with its use. Arctic Insulation and Manufacturing LLC. Has made every reasonable effort to ensure accuracy, but the information in this publication may not be complete, especially for special or unusual applications. Changes to this publication may occur from time to time without notice. Contact Arctic Insulation and Manufacturing LLC. To determine if you have the most current edition. Publication duplication permitted.