

INTERNAL JOINT SEAL: SAMPLE BID SPECIFICATION

1.1 SUMMARY

- A. Sections Includes:
 - 1. Internal pipe repair work.
- B. Work included consists of but is not necessarily limited to internal sealing of pipe joints and all related work.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. A240, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
 - b. C150, Standard Specification for Cement Mortar.
 - c. D395, Standard Test Method of Rubber Compression Set.
 - d. D412, Standard Test Method for Rubber Properties in Tension.
 - e. D573, Standard Test Method for Rubber Deterioration in Air Oven.
 - f. D1171, Standard Test Method for Rubber Deterioration Surface Ozone Cracking Outdoors or Chamber.
 - g. D2000, Standard Classification System for Rubber Products in Automotive Application.
 - h. D2240, Standard Test Method for Rubber Property Durometer Hardness.
 - i. D3568, Standard Test Method for Rubber Evaluation for EPDM (Ethylene Propylene Diene Terpolymers) Including Mixtures with Oils.
 - 2. Food and Drug Administration, Title 21 Code of Federal Regulations:
 - a. Section 177.2600, Rubber Articles Intended for Repeated Use.
 - 3. ANSI/NSF Standard 61 Drinking Water Components - Health Effects.
- B. Qualifications:
 - 1. Installer shall have 5 years experience with the seal to be furnished and in the work described by this section.
 - 2. The seal technology furnished shall have a minimum installed history of five (5) years and require pre-bid approval by the Owner.
 - 3. Only seal technologies having an approved testing mechanism will be approved.

1.3 SUBMITTALS

- A. Installation data to be submitted prior to award.
 - 1. List of equipment to be used.
 - 2. Technical data for proposed internal joint seal, including material safety data sheets, application instructions, and product data.
 - 3. Acknowledgement that products submitted meet requirements of standards referenced.
- B. Proof of Qualifications to be submitted with the bid.
 - 1. List of at least 10 references within the past 5 years.
 - 2. Manufacturer shall have, in place, a minimum of 5,000 seals in service for a minimum of five (5) years.
 - 3. Installer shall have installed a minimum of 5,000 seals of the specific product to be furnished and must include the size ranges specified.
- C. Safety training documentation to be submitted prior to award.

Installer's certification of product safety training, for all personnel participating in pipeline rehabilitation operations, including the names of all personnel, including the trainer; the date, time, and duration of the training; and a statement that all necessary protective gear and equipment appears to be available for the use by personnel on the site.

- D. Copies of joint repair records.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in manufacturer's original unopened containers with labels intact:
 - 1. Rubber membranes shall be individually sealed in plastic bags and packaged in a manner that will not damage or deform them.
 - 2. Labels shall indicate contents and expiration date of material.
 - 3. Rubber membrane shall not be removed from plastic bag until time of use.
- B. Rubber membranes shall be stored in a cool dry environment.

1.5 WARRANTY

- A. Guarantee all work performed under this section for a period of 1 year after the date of the Owner's approval of the Completion Certificate issued by the Engineer.
 - 1. Warranty signed jointly by installer and seal manufacturer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Miller Pipeline Corporation.
 - 2. Pre - approved equal.

2.2 MATERIALS

- A. Joint Liner:
 - 1. EPDM Rubber Derivative Membrane manufactured in accordance with ASTM-D2000.
 - a. Material shall be an EPDM polymer where all ingredients are listed in FDA Title 21 Code of Federal Regulations Section 177.2600 with the final material not supporting microbiological growth when used in potable or sea water or in humid aerobic conditions.
 - b. The volume change of the rubber shall not exceed 3 percent after immersion in fresh or sea -water at 100 DegC for 70 hours.
 - c. The stress relaxation shall not exceed 12 percent when tested from a time of 30 minutes to 24 hours.
 - 2. Joint liner splicing.
 - a. The seal splice shall be made using a transfer-molding method with virgin rubber, of the same compound from which the seal is manufactured, with a 1/4 IN minimum width at the interface.
 - b. Vulcanization shall occur at 330 DegF with 2000-psi pressure.
 - c. No adhesive or glue shall be used.
 - d. As a test, the seal shall be gripped at a point 6 inches on each side of the splice and shall be bent in both directions as sharply as possible. The splice shall be capable of passing this bend test without visible separation. No voids or cracks are allowed.
 - 3. All seals used in potable water applications shall comply with ANSI/NSF Standard 61.
- B. Bands, Shims, and Set Screws.
 - 1. Bands, spacers, shims, clips, and set screws for securing rubber membrane across piping joints shall be (*) stainless steel, manufactured in accordance with ASTM-A240 Standard Specifications for heat-resisting chromium and chromium-nickel stainless steel plate, sheet, and strip for pressure vessels.
 - 2. Typical mechanical properties shall include:
 - a. Yield strength greater than or equal to 25,000 pounds per square inch (psi).
 - b. Tensile strength greater than or equal to 70,000 psi.
 - c. Elongation in 2 IN equal to 40 percent.
 - d. Hardness Rockwell B value of 92.
 - e. Finish/condition is annealed.
 - 3. Stainless steel bands manufacturing.
 - a. Bands shall be rolled to the radius of the pipe being renewed.
 - b. Bands shall have minimum dimensions of 1/8" thick x 2" wide for pipe sizes 16"-30", 3/16" thick x 2" wide for pipe sizes 36"-60", 1/4" thick x 2" wide for pipe sizes 66"-120", 3/8" thick x 2" wide for pipe sizes 138" and larger.
 - c. Each band shall be checked on fixed radius gauge.

4. Cleated end.
 - a. To be manufactured from the same manufacturer lot number as the band.
 - b. All shop and field welds to be made by certified welders with a minimum of 2 years experience on this alloy (*). The welds are to be made with stick or wire of (*) alloy. All shop welds to be accomplished in an A-1025-Helium/ CO₂ gas atmosphere when using wire.
 - c. Welding wire to be (*) AWS Class A5.9 (ASME SFA 5.9)
 - d. Field welding to be made with coated electrode (*), AWS class A5.4 (*) AC-DC-16, with tensile strength of 86,000 psi and yield strength of 65,000 psi.
 - e. All material specifications must be certified.
 5. Radiused shims:
 - a. Material specifications 16 to 22 gauge x 2 IN x 6 IN (*)
 - b. Manufactured by rolling to the radius of the pipe.
 - c. All edges to be de-burred.
- C. Cement Mortar.
1. Cement mortar for pipe joint sealing and preparation shall be the fast setting type suitable for sea water, wet/dry conditions. Cement mortar shall be in accordance with ASTM-C150.
- D. Liquid Joint Lubrication.
1. Liquid joint lubricant to assist in installation of the rubber membrane and bands shall be a non-toxic vegetable based lubricating gel.
 2. Required properties:
 - a. Does not deteriorate or decompose while in storage for a minimum of two years.
 - b. A soft pasty consistency suitable for use intended from 0 DegF to 120 DegF.
 - c. Does not have any deteriorating effect on natural or synthetic rubber gaskets.
 - d. Will not impart taste or odor to water.
 - e. Has no objectionable odor.
 - f. Is non-toxic and does not support the growth of bacteria.
 - g. pH - 9.6 minimum - 11 maximum (pH Meter).
 - h. Does not contain any petroleum based oils or grease.

* Select and insert specific type of stainless steel. All bands and associated components shall be manufactured from the same type of steel selected.

- E. Epoxy.
1. Epoxy used shall have the following characteristics:

<u>Description</u>	<u>Method</u>	<u>Result</u>
Flexural Strength	ASTM D790	6,080 psi
Flexural Modules	ASTM D790	550,000 psi
Compressive Strength, Yield	ASTM D695	4,275 psi
Tensile Strength	ASTM D638	3,700 psi
Tensile Ultimate Elongation	ASTM D638	1.4 percent
Hardness, Shore D	ASTM D2583	85
Hardness, Pencil	ASTM D3363	6H
Impact, IZOD	ASTM D256	0.19 FT LB/IN of notch
Temperature Resistance	Steel, unprimed	250 Deg F
	Concrete	250 Deg F
Solids Content		100 percent
Solvents Present		None
Volatile Organic Compounds (VOC)		0.0 grams per liter
Chemical Resistance		Very good resistance to common acids, bases, solvents and oils. For detailed resistance chart ask for Application Bulletin.
Coverage		One gallon will cover 16 sq.ft.

<u>Description</u>	<u>Method</u>	<u>Result</u>
less coverage.		when applied on a smooth surface at a thickness of 100 mils. For rough surfaces figure approximately 25 percent
Cure Time		Approximately 4-8 hours at 70 DegF.
Storage Life		1 year
Air & Water Pollution		None
Service Temperature Range		50 DegF to 200 DegF

- F. Thread Sealing Compound.
 - 1. Thread sealing compound shall be a non-toxic paste type with "Teflon".
 - 2. Teflon components required properties.
 - a. Flash point: 410 DegF closed cup.
 - b. Density: 1.4 - 1.42.
 - c. Viscosity: 200,00 - 275,000 centipoises.
 - d. Temperature range: -50 DegF to 500 DegF.
 - e. Pressure application: Maximum 10,000 psi.
- G. Hydraulic expander for installation of steel and stainless steel expansion bands shall be capable of hydraulic expansion pressures of 6,000 psi.

PART 3 - EXECUTION

3.1 GENERAL

- A. All work and testing shall comply with the applicable Federal, State, and local codes and standards, including:
 - 1. Federal Occupational Safety.
 - 2. Health Act of 1970.
 - 3. Construction Safety Act of 1969 (As Amended).
- B. Prior to fitting, seals should be given a thorough visual examination by a qualified installation technician, paying particular attention to the ribbed (lip seals) sections of the seal. If quality of material construction or condition is in doubt, the seals shall not be used.

3.2 CLEANING

- A. Thoroughly clean the areas in which the joints are to be repaired and sealed of grease, dust, debris, roots and solid or semisolid matter prior to start of sealing procedures.
 - 1. Take care that all materials loosened or removed by the cleaning operations are intercepted and removed at the nearest manhole.
 - 2. Dispose of these materials at a sanitary landfill or other approved location.
- B. Root Removal:
 - 1. Remove roots by mechanical methods.
- C. Damage to Pipeline:
 - 1. Protect pipeline from damage during cleaning and root removal operations.
 - 2. Repair damage, which may occur, at no additional cost to the Owner using methods approved by the Engineer.

3.3 JOINT PREPARATION

- A. The area of pipe either side of the joint where the actual "lip seals" make contact with the pipe must be prepared to a finish which will allow the "lip seals" to interface consistently, and so provide a permanent seal.
 - 1. All high/low surface imperfections running axially through or part way through the sealing surface must be removed before installation of seals. Any joint gaps, deep imperfections, or low areas must be properly filled with approved nontoxic joint filler and rendered smooth to suite the prepared surface of the joint area.
- B. Joints are to be filled to the full depth of the gap and rendered flush with the internal surface of the pipe.

1. The filling material shall be a quick-setting plaster/ cement mortar, which is mixed as required in the pipe.
 2. All surplus material spillage should be removed from the joint area prior to the surface preparation of the seal area.
- C. The extent of the prepared area on either side of the joint are to be compatible with the "lip seals" and at least 1 inch of additional cleaning is recommended on either side of the ribbed section of the seal.
- D. The pipe should be pre-marked with grease chalk to allow the preparation areas and seal position to be clearly defined.
- E. When the pipe is concrete or reinforced concrete, it may be necessary to apply a thin layer of a quick-setting cement mortar to the preparation area where the seal will be placed. This cement will control pipe porosity and irregularities and provide for an effective bubble test on the completed seal.

3.4 SURFACE PREPARATION

- A. Immediately prior to fitting the seal, the area must be cleaned with a dry brush and coated with lubricant.
1. Lubricant shall be a nontoxic vegetable soap compatible with the composition of the seal.
 2. The lubricant shall be hand applied (using a brush) over the prepared area.
 3. Care must be taken not to acquire debris from the surrounding unprepared surface into the lubricant and thereby reintroducing debris to the prepared surface.

3.5 POSITIONING THE SEAL

- A. The seal shall be checked that it is undamaged and that the test unit is tight before fitting the seal in place.
- B. Place seal in position to bridge the joint gap, guided by the chalk marks indicating seal position.
1. Position seal accurately on the prepared areas.
 2. Locate the test unit in the seal at either the 9 o'clock or 3 o'clock position.
 3. The seal must be positioned parallel to the joint gap.

3.6 POSITIONING RETAINING BANDS

- A. Before the stainless steel bands are placed in the grooves, provided in the seal, two stainless steel radiused shims, 6 inches long by 18-22 gauge, are placed underneath the wedge area in the grooves. This provides a bridge that will transmit the radial load evenly to the seal as the bands are expanded.
- B. Since retaining bands can be of one-piece, two-piece, or three-piece construction depending on pipe diameter, a retainer clip is to be used to restrain band movement during expansion. In certain design applications, (two-piece and three piece band construction in larger diameters) a special mechanical locking device shall be used to temporarily restrain the bands before expansion.
- C. EXPANDING THE SEAL INTO POSITION
- D. A hydraulic expander is used to apply a set pressure to the retaining bands of the seal.
1. When positioning the expander in line with the retaining band, care must be taken to ensure that the band remains in the groove of the seal, and does not become moved or dislodged.
 2. Care should also be taken to ensure the expander is positioned correctly on the band.
 3. The set pressure is to be held for a minimum of two minutes.
- E. A radiused-locking piece called a "wedge" is fitted between the exposed gap of the expanded band ends.
1. Select a size of wedge having a slight interference fit between the band ends.
 2. The radius of the wedge is equal to the radius of the pipe.
- F. Tap the wedge (leading edge first) into position, locking in the compression of the seal.
- G. Release the pressure from the expander.
- H. Repeat procedure (steps A-D) on the second retaining band of the seal.
- I. Repeat this entire operation (steps A-E) not before 30 minutes have elapsed after the first expansion. This allows for any seal relaxation that may take place and usually a slightly larger wedge may be fitted.
- J. Once the expanding procedure is completed, the mechanical locking device, if required, for the wedge shall be tightened down to a torque of 15 inch – pounds.

3.7 PRESSURE TESTING

- A. Internally sealed areas are to be individually pressure - tested, by Test 1 and Test 2, prior to completion of work.
 - 1. Test 1:
 - a. To be applied after each section has been completed and not before 30 minutes have elapsed after the final fitting of the seal.
 - b. A pressure of 10 psig is applied to the seal through the test valve and maintained with a regulated air supply, while a soap and water solution is applied to the outer edge and entire body of the seal to detect leakage.
 - c. A restraining device is to be locked in its expanding position during testing to prevent excessive ballooning to the center membrane of the seal (that may occur at this pressure).
 - 2. Test 2:
 - a. A pressure of 5 psig is applied to the seal through the test valve and maintained with a regulated air supply, while a soap and water solution is applied to the outer edge and entire body of the seal to detect any leak.
- B. Test Valve Assembly.
 - 1. Following Test 2, the test valve of the seal is sealed with a counter sunk hex head completion plug using a nontoxic thread sealing compound on the threads.
- C. The pass/fail criteria may be adjusted by the Engineer as conditions warrant.

END OF SECTION