

INTERNAL MECHANICAL JOINT SEAL FOR INDUSTRIAL & MUNICIPAL PIPING

PART 1 – GENERAL

1.1 SUMMARY

- A.** The work covered under this specification includes the furnishing of all materials, tools, equipment, and labor related to operations in connection with the repair and rehabilitation of internal pipeline joints utilizing internal joint seals unless otherwise specified in related contract documents.
- B.** This specification shall be used by owners, engineers, designers, pipeline operators, piping and utility contractors, or experienced personnel responsible for specifying the repair of pipe joints.

1.2 PRODUCT APPLICATION

- A.** Internal joint seals are designed to seal leaking joints in most types of pipe including concrete, reinforced concrete, cast iron, ductile iron, steel, vitrified clay, polyethylene, PVC, and corrugated metal.
- B.** The internal seal repairs leaking joints by bridging the joint with a flexible rubber seal which is compressed against the inside diameter of the pipe on either side of the joint with steel bands. The steel retaining bands are expanded in a radial direction and locked in place with a wedge providing an interference fit.
- C.** The internal seal may be interlocked with adjoining seals to provide a continuous interlocking sleeving system.

1.3 SUBMITTALS

A. MATERIAL DOCUMENTATION:

Upon request, proposals to utilize internal joint seals shall be accompanied by the following documentation:

1. List of equipment to be used
2. Technical data for proposed internal joint seal, including applicable instructions, material safety data sheets, product detail drawings.
3. Acknowledgement that products submitted meet the requirements of the standards referenced in this specification.

B. INSTALLATION DOCUMENTATION:

Product qualifications shall be submitted with the proposal and should include the following:

1. List of at least 5 references within the past 2 years.
2. Manufacturers seal must have a minimum of 3,000 seals in place and in service for a minimum of five (5) years.
3. Detailed installation instructions including, if applicable, detailed installation drawings.

C. INSTALLER SAFETY QUALIFICATIONS:

Installer qualifications shall be submitted with the proposal and should include the following:

1. Installer, if different than the seal manufacturer, shall submit certification that all personnel have been properly trained to install the internal joint seal.
2. Installer shall provide certification that all personnel participating in the installation of internal seals has completed the proper safety training programs required for installation of internal seals.

1.4 QUALITY CONTROL

A. Materials used in the fabrication, assembly and installation of internal seals shall comply with the following ASTM (American Society of Testing and Materials) Standards:

- D395; Standard Test of Rubber Compression Set
- D412; Standard Test Method for Rubber Properties in Tension
- D573; Standard Test Method for Rubber Deterioration in Air Oven
- D1171; Standard Test Method for Rubber Deterioration Surface Ozone Cracking Outdoors or Chamber.
- D2000; Standard Classification System for Rubber Products in Automotive Application
- D2240; Standard Test Method for Rubber Property Durometer Hardness
- D3568; Standard Test Method for Rubber Evaluation for EPDM

B. Materials used in the fabrication, assembly and installation of internal seals that are intended for use in potable water piping shall conform to the following:

- Food & Drug Administration, Title 21 Code of Federal Regulations; Section 177.2600 Rubber Articles Intended for Repeated Use
- ANSI/NSF Standard 61 Drinking Water Components

C. Installer Qualification:

All personnel involved with the direct placement, installation and testing of the internal seal shall have proper training and shall, upon request, provide training certification.

D. Testing:

Internal seals shall have an approved testing device or mechanism to allow pressure (leak) testing after installation.

1.5 STORAGE & HANDLING

A. Internal seals shall remain in manufacturer's original unopened containers until time to be installed.

B. Labels on containers shall indicate contents, lot #, expiration dates and shall be visible at all times during storage.

C. Containers containing seals shall not be stacked or stored in such a manner as to damage rubber membranes or steel components.

D. Containers containing rubber membranes shall be stored in a cool dry environment.

PART 2 – INTERNAL SEAL MATERIALS

2.1 APPROVED MANUFACTURER

1. Subject to compliance with the contract documents, the manufacturer of the internal pipe seals shall be HydraTech Engineered Products LLC.

2.2 MATERIALS & EQUIPMENT

1. EPDM Rubber

The EPDM Rubber membrane shall be manufactured in accordance with ASTM-D2000, ASTM-D3900 and ASTM-D3568 and comply with the following:

- A. Ingredients of the EPDM polymer 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 212°F for 70 hours.
- C. The stress relaxation shall not exceed 12 percent when tested from a time of 30 minutes to 24 hours.
- D. No voids, cracks, or similar defect shall be witnessed during visible inspection.
- E. Physical Properties:

Durometer ASTM D 2240	65 +/- 5
Tensile (psi) ASTM D 412	1450 min
Elongation (%) ASTM D412	350 min.

Heat Aged: 70 hours @ 70°C ASTM D-573

Durometer	+/- 15
Tensile change (%)	+/- 30
Elongation change (%)	-50 max.

Compression set: 22 hours 70°C ASTM D-395B

Permanent Set (%)	25 max.
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Ozone Resistance (%)	85 min.
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2. EPDM Joint Splicing

- A. The splice in the EPDM rubber seal shall be made using compression molding method with virgin rubber of the same compound which the seal is manufactured. A minimum width of ¼ inch shall be maintained at the interface.
- B. The joint shall be vulcanized at 330°F minimum temperature.
- C. The joint shall not be manufactured with any glue, adhesive or equivalent.
- D. Gripping the seal at approximately 6" on each side of the spliced joint and bending around a 3" min. diameter mandrel should not produce any visible separation. No voids, cracks, or similar defect shall be witnessed during this bend test.
- E. The number of joint splices shall be minimized per the manufacture's equipment capabilities.

3. Bands, Shims and Wedges

A. Stainless Steel Materials

1. The stainless steel retaining bands UNS S30400 (type 304), UNS S31603 (type 316L), or UNS N08367 (AL-6XN) shall conform to ASTM A240. The weld wire E308, E316L shall conform to AWS A5.4 – 92 and alloy 625 (ERNiCrMo-3) shall conform to AWS A5.14-89.
2. All materials such as push tabs, shims, and wedges shall be made compatible with the base metal.
3. In the process of selecting the base metal for your retaining band, it is important that the chemical properties are compatible with the weld wire, such as the table listed below.

Retaining Band	Weld Wire
UNS S30400	E308
UNS S31603	E316L
UNS N08367	ERNiCrMo-3

4. The retaining bands shall be rolled to the radius of the pipe that is being repaired. The radius shall be taken from the measurement data collected from the inspection report and each retaining band shall be checked on the fixed radius gauge.
5. The push tabs shall be manufactured from the same manufacturer lot number as the band. All shop and field welds shall be made by certified welders with a minimum of 2 years experience on this alloy (T-304). The welds shall be made with a stick or wire of T-308 alloy as mentioned above in the table.
6. Welding shall be accomplished by using either gas metal arc welding or shielded metal arc welding.
7. All material specifications shall be certified.
8. Shims shall be manually radiused and all edges shall be deburred.
9. The retaining bands shall be made of stainless steel, or it can be modified on a project-to-project basis to meet a wide variety of requirements, or custom made to meet your special needs.

Physical Requirements

Physical Properties	Type 304	Type 316L	Type AL-6XN
UNS Designation	S30400	S31603	N08367
Tensile Strength (min.)	75,000 psi	70,000 psi	100,000 psi
Yield Strength (min.)	30,000 psi	25,000 psi	45,000 psi
Elongation in 2 in. (min.)	40%	40%	30%
Brinell Hardness (max.)	201	217	233
Weld Wire TS	80,000 psi	70,000 psi	110,000 psi

Design Consideration

The HydraTite™ Internal Joint Seal undergoes loading imparted during both installation and normal system operation. The following parameters are considered as applicable.

The retaining band shall not buckle under installation loading.
 The maximum stress in the push tab welds shall conform with AWS D1.6:99.
 The maximum stress in the push tab welds shall not exceed the ultimate tensile strength in the weld wire or stick.
 The compressive force created in the retaining band due to thermal expansion shall not buckle under installation loading.
 The hydrodynamic pressure shall not exceed the minimum friction force created by the hydraulic expander under installation loading.

B. Carbon Steel Materials

1. The carbon steel retaining bands UNS G10180 (grade 1018) and UNS G10200 (grade 1020) in accordance with AISI shall conform to ASTM A 29-93a and "Marks' Standard Handbook for Mechanical Engineering". The carbon steel retaining band UNS K02600 (grade A36) shall conform to ASTM A36-96. The weld wire E7018 shall conform to AWS A5.1-91
2. All materials such as push tabs, shims, and wedges shall be made compatible with the base metal.
3. In the process of selecting the base metal for your retaining band, it is important that the chemical properties are compatible with the weld wire, such as the table listed below.

Retaining Band	Weld Wire
UNS G10180	E7018
UNS G10200	E7018
UNS K02600	E7018

4. The retaining bands shall be rolled to the radius of the pipe that is being repaired. The radius shall be taken from the measurement data collected from the inspection report and each retaining band shall be checked on the fixed radius gauge.
5. The push tabs shall be manufactured from the same manufacturer lot number as the band. All shop and field welds shall be made by certified welders with a minimum of 2 years experience on this alloy (grade 1020).
6. The welds shall be made with a stick or wire of E7018 alloy as mentioned above in the table.
7. Welding shall be accomplished by using either gas metal arc welding or shielded metal arc welding.
8. All material specifications shall be certified.
9. Shims shall be manually radiused and all edges shall be deburred.
10. The retaining bands shall be made of carbon steel, or it can be modified on a project-to-project basis to meet a wide variety of requirements, or custom made to meet your special needs.

Physical Requirements

Physical Properties	Carbon Steel 1018	Carbon Steel 1020	Carbon Steel A36
UNS Designation	G10180	G10200	K02600
Tensile Strength (min.)	73,000 psi	75,000 psi	58,000 psi
Yield Strength (min.)	62,000 psi	63,700 psi	36,000 psi
Elongation in 2 in. (min.)	22%	20%	23%
Brinell Hardness (max.)	152	156	-
Weld Wire TS	70,000 psi	70,000 psi	70,000 psi

Design Consideration

The HydraTite™ Internal Joint Seal undergoes loading imparted during both installation and normal system operation. The following parameters are considered as applicable.

- The retaining band shall not buckle under installation loading.
- The maximum stress in the push tab welds shall conform with AWS D.1.1-88.
- The maximum stress in the push tab welds shall not exceed the ultimate tensile strength in the weld wire or stick.
- The compressive force created in the retaining band due to thermal expansion shall not buckle under installation loading.
- The hydrodynamic pressure shall not exceed the minimum friction force created by the hydraulic expander under installation loading.

4. Test Valve

A test valve shall be installed in the rubber seal to enable pressure test after seals have been installed. The test valve shall be stainless steel UNS S31603 (type 316), or UNS N08367 (AL-6XN) and shall conform to ASTM A240. The test valve shall be equipped with a means to seal or plug the valve after testing. Means of sealing with a threaded plug or equivalent shall include a non-toxic Teflon thread sealant (NSF approved for potable water applications).

5. Joint Lubrication

The use of a joint lubrication may be necessary to assist in the installation of the rubber membrane and steel bands. The joint lubrication shall:

1. Be non-toxic and shall not support the growth of bacteria.
2. Does not have any deteriorating effect on natural or synthetic rubber.
3. Will not impart taste or odor to water
4. Does not contain any petroleum based oils or greases
5. When applicable, must be able to be used on potable water systems, NSF 61 approved.
6. Temperature range of 0°F to 120°F.
7. Acceptable lubrication products include J.C. Whitlam Mfg. Co. "Blue Lube", Seacord Corp. "Ease-On", or an equivalent.

6. Pipe Filler and Pipe Prep

It may be required to fill low areas of the pipe on each side of the joint where the seating surface/ band location of the seal is to be located. The filler material shall:

For steel, cast iron, ductile iron, polyethylene, and PVC piping, an epoxy and/or metallic polymer based system may be used and shall have the following characteristics.

For concrete piping an epoxy or hydraulic cement system may be used and shall have the following characteristics.

1. Be non-toxic and shall not support the growth of bacteria.
2. Does not have any deteriorating effect on natural or synthetic rubber.
3. Will not impart taste or odor to water
4. Does not contain any petroleum based oils or greases
5. When applicable, must be able to be used on potable water systems, NSF 61 approved.
6. Minimum Compression Strength (ASTM C-109) = 3,000 psi after 1 day.
7. Minimum Shore D Hardness (ASTM D2240) = 80
8. Acceptable filler products include, but not limited to, the following:
 - HydraTech Engineered Products STD HydraWrap Primer #4134 (for defects and imperfections < .125") or PW HydraWrap Primer #8001 for potable water applications
 - Belzona 1211 (for deep imperfections in steel or iron substrates > 0.125")
 - Unitex Hydraulic Cement (for spalding and deep imperfections in concrete piping)

7. Hydraulic Expander

Hydraulic expanders shall be capable of providing 6,000 psi of hydraulic expansion pressure for installation of carbon steel and stainless steel retaining bands. Two hydraulic expanders should be on site, one for use as a spare.

PART 3 – INSTALLATION

3.1 GENERAL

- A.** All work associated with the installation and testing of internal seals shall comply with the applicable Federal, State, and local codes and standards.
- B.** All workers shall be properly trained in the hazards and risk associated with working in confined spaces.
- C.** Prior to installation, seals should be visually inspected by a qualified installer to assure seal material is free of defects. If quality or condition of material is in doubt, the seals shall not be used.

3.2 SITE PREP WORK.

- A.** Installation work shall be performed with pipe lines removed from service and an adequate safety boundary has been established and approved by all parties. All pipelines shall have been dewatered (if applicable) and are maintained at atmospheric pressure throughout the duration of the installation work.
- B.** All permits, as required by the local and state codes, or by owner of pipeline and as agreed to in the contract shall have been processed and received and shall be available for review.
- C.** All seals, material, consumables and tools required for completion of work shall be verified as in good working condition. All equipment and tools required for installation and testing shall be calibrated as required.
- D.** Means of providing continuous forced air ventilation must be provided and maintained to establish a safe level for confined space entry.
- E.** Diversion Pumping:
 - 1.** Means of providing by-pass piping (if applicable) with sufficient capacity shall be established as required by contract.
 - 2.** A spare pump(s) shall be on-site and ready for use as a back-up to address breakdowns.
 - 3.** Failure of the by-pass piping, resulting in spills or overflow, shall result in the ceasing of by-pass piping operation and providing corrective action to remedy and clean-up of overflow prior to continuing.

3.3 CLEANING

- A.** Remove all dirt, scale and other debris from pipe walls in area where seals are to be installed. The extent of the cleaned area should extend a minimum of 1" beyond sealing area. Cleaning operations shall be accomplished by hand brushing and scraping, pneumatic wire brushes, and/or oil-free air jet.
- B.** All materials removed by the cleaning operation shall be intercepted and removed at the nearest manhole and disposed of at an approved location.
- C.** All roots in the location of the seal installation or hinder access to the seal location shall be removed by mechanical means.
- D.** Roots in the seal area shall be removed to a minimum of 1" behind inside face of pipe joint.
- E.** During cleaning and root removal, protect pipeline from damage. Any damage that may occur during the cleaning process must be repaired at no cost to owner by an acceptable and approved method.

3.4 JOINT PREPARATION

Joint preparation shall be performed in accordance with the manufacturer's installation instructions. The following steps are general installation guidelines any are not intended to be inclusive of all procedures for joint preparation.

- A.** The pipe should be pre-marked with a grease chalk to properly define the seal position and the area of pipe to be surface prepared.

- B. The area of the pipe on either side of the joint, where the lip seal makes contact with the pipe must be prepared to a finish which will allow the lip seal to interface consistently as to provide a tight and permanent seal.
- C. High and low surface imperfections in the areas of the sealing surface must be removed. Low areas must be filled with a suitable non-toxic filler material as described in this specification.
- D. Gaps at the joints that are produced by offset, separated or misaligned pipes shall be filled to the full depth and rendered flush with the surface of the pipe with a suitable non-toxic filler material as described in this specification.

3.5 SEAL INSTALLATION

Installation of the seal shall be performed in accordance with the manufacturer's installation instructions. The following steps are general installation guidelines any are not intended to be inclusive of all installation procedures.

- A. Lubricate the prepared seal area with an approved lubricant. The lubricant functions as an aid in fitting the seal as is not credited with seal tightness.
- B. Verify that the seating surface of the rubber seal is free of any dirt, scale or other debris..
- C. Position the seal such that the lip seals run parallel with the joint and are located per the markings on the pipe. The pressure test valve should be located at either the 9:00 or 3:00 position.
- D. Install metal radiused shims underneath the wedge area in the seal grooves for each band prior to installing the metal retaining bands in the seal. These shims enable radial loads to be transmitted evenly to the rubber seal as the bands are expanded.
- E. Position the retaining bands in the seal grooves.
- F. Position the seal expander in line with the retaining band and ensure that the retaining band remains in the groove. Expand the bands using the hydraulic expander.
- G. Install a radiused locking piece (wedge) in the exposed gap between the expanded band ends. The wedge size shall be selected so as to provide interference fit.
- H. Repeat "E" through "G" for subsequent bands on the same seal.
- I. Perform a second expansion of each of the retaining bands a minimum of 30 minutes after the first expansion using the same pressure range as the first expansion. Replace wedge piece with larger size if required to provide interference fit.

3.6 SEAL TESTING

Testing of the seal shall be performed in accordance with the manufacturer's installation instructions. The following steps are general installation guidelines any are not intended to be inclusive of all testing procedures.

- A. A pressure test shall be performed to assure the seal has been installed correctly. After a minimum of 30 minutes has elapsed, the test shall be conducted.
- B. Pressurize to 10 psig (± 2 PSIG) through the seal test valve. Apply an approved soap test solution to the seal ends and inspect for leakage.

- C. If the pressure test indicated leakage, determine cause and repeat installation steps B through I in Section 3.5 (Seal Installation).
- D. In the event a second pressure test fails, notify manufacturer for evaluation and direction before additional work on the failed seal.
- E. Depressurize the seal and isolate the test port.
- F. Remove all installation hardware, pressure gauges, consumables from the pipe.

3.7 QUALITY CONTROL AND DOCUMENTATION

- A. The seal manufacturer shall provide to installer documentation detailing seal installation and forms to be used as a checklist that all steps required for proper seal installation and testing have been completed.
- B. The installer shall appoint a qualified technician the responsibility of recording all data associated with seal installation and testing including, but not limited to, the following:
 - 1. Pipe sealing surface condition has been properly prepared and all voids have been filled and high areas removed.
 - 2. The sealing surface area of the seal is free of debris.
 - 3. The seal has been properly located over the joint.
 - 4. Record the time that each band is installed.
 - 5. Record the pressure of hydraulic expander for each band installed and confirm expander is maintained at correct pressure.
 - 6. Record the time of second expansion of each band and confirm that 30 minutes has elapsed between the first and second expansion.
 - 7. Record the pressure of hydraulic expander for each band installed and confirm expander is maintained at correct pressure during second expansion.
 - 8. Record whether larger wedge was installed for each band.
 - 9. Record 30 minutes has elapsed from second expansion to begin pressure test.
 - 10. Record time and pressure for first pressure test.
 - 11. Record status of first pressure test.
 - 12. Record seal is depressurized and test plug has been plugged.
 - 13. Record that all tools, equipment, hardware, consumables have been removed from piping.
- C. The installer shall present a copy of a signed and dated "Installation and Testing Verification" form to the owner for each seal installed.