Thermal Pak TP2 Expansion Joints

Advanced Thermal Systems, Inc.

1-800-443-9194 I Made in America I www.AdvancedThermal.net

Standard and Custom Designs for use with Steam, Oil, Gas, Hot / Chilled Water, and Other Process Fluids

The ATS **Thermal Pak "TP2"** Slip Type Expansion Joint is the **CORRECT** choice for accommodating the thermal changes that occur in the straight runs of a piping system. The "TP2" is constructed of materials that have strength equal to or greater than the pipeline in which it is installed, therefore, there is never a concern that an unscheduled outage will occur due to the expansion joint. If a leak should occur, additional packing can be **SAFELY** added to the expansion joint through the integral packing cylinders while the system is at full operating pressure.

ATS has been the **INDUSTRY INNOVATOR** since the "TP2" was first introduced in 1968. All Technical improvements to packed slip type expansion joints since 1968 have been introduced by ATS.

Here are a few of the ATS Introduced Improvements:

- Self-Lubricated injectable packing to eliminate maintenance associated with periodic lubrication.
- Packing cylinders welded in place in lieu of threaded in place to maximize personnel safety.
- Sliding slips from heavier wall pipe to preclude slip collapse.
- **"HEEF® 25"** Hard Chrome - Features: Micro cracked deposit minimum 1000 cracks per linear inch. Vickers Hardness 950 – 1150. Increased corrosion resistance. Increased wear resistance, less edge build-up and improved distribution.
- **"HPI®"** - An asbestos-free self-lubricating injectable packing for use up to 1000°F. Currently the only injectable packing with a field record of reliability in installations over 600°F.
- Low Friction guide inserts at integral internal and external guide surfaces to protect sliding slip and prevent binding and/or scoring.
- Packing Cylinders with Integral Safety Valve to allow **SAFE** packing injection to 1000 psig.
- **SAF-T-PACKER®** - the only safe and effective way to loosen or remove impacted injectable packing below the packing cylinder's safety valve without blow back.
- Cycle testing to verify slip movement and packing density.
- Five Year Leak Free Warranty.

Typical Users of Standard and Custom Designs

ENERGY COMPANIES

INSTITUTIONS

MEDICAL FACILITIES

INDUSTRIAL

MILITARY

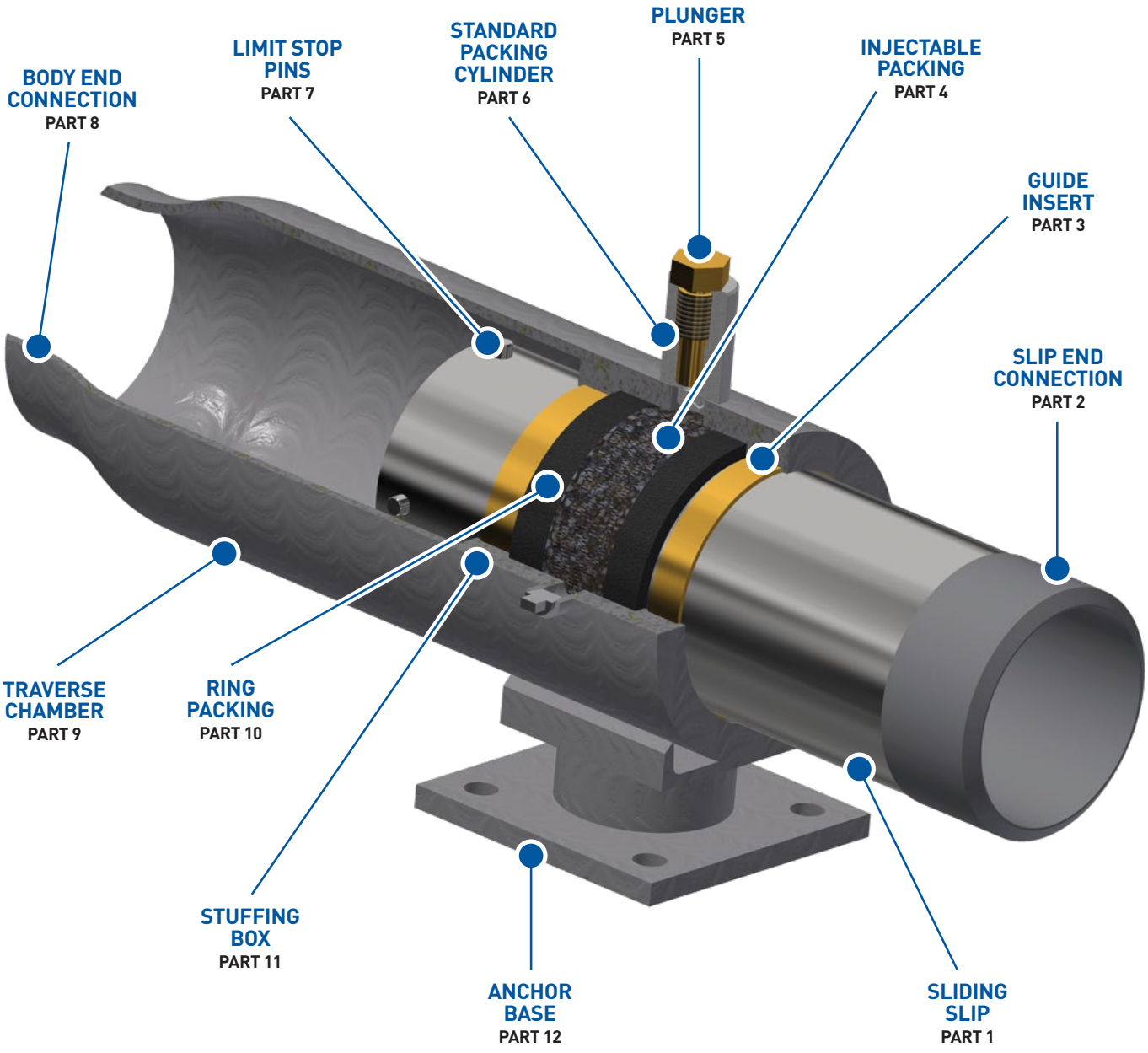
GOVERNMENT MUNICIPALITIES

Proudly Manufactured in the U.S.A.

Companies Whose Business is Selling Steam Depend on Thermal Pak "TP2" Expansion Joints to Keep Their Distribution Systems On-line

Shown are two of the 67 - "TP2" Expansion Joints that were furnished to Northern States Power Company (now a subsidiary of Xcel Energy) in 1984. The units are installed in a 5-1/2 mile long pipeline located in St. Paul, MN, which supplies steam to a paper mill at 875 PSIG - 800°F.

The ATS joints were supplied to replace externally pressurized bellows expansion joints which were furnished with multi-ply Inconel 600 bellows that failed after one year in service. The steam line has not seen an interruption in service caused by the ATS Expansion Joints since their installation in 1984.



"TP2" Expansion Joint Part Guide

Sliding Slip - PART 1:

Machined from heavy wall ASTM A106 Gr B Seamless pipe to prevent slip collapse.

PIPE SIZE (NPS)	PIPE SCHEDULE
1½" to 16"	Schedule 80
18" to 24"	Schedule 60

Heavier wall furnished for larger sizes and pressures above 600 psig. The surface of each slip is machined and ground to obtain a 16 RMS finish before plating. ALL SLIPS are plated with a minimum of 2 mils of hard chrome using the "HEEF® 25" hard chrome plating system. Following Plating, the slip is polished a second time to ensure a smooth sliding surface.

Slip End Connection - PART 2:

Weld End: Expansion joints can be furnished with ends beveled for welding to any pipe wall thickness. Unless otherwise specified, the standard weld end prep is for welding to Standard Wall Pipe.

Flanged End: ANSI ASTM A105 Forged Steel Raised Face Slip On Flanges of the specified pressure class.

Guide Inserts - PART 3:

All ATS Expansion Joints have integral internal and external guide surfaces. "Bronzalon®" a low friction non-metallic insert can be furnished for applications to 500°F. For applications above 500°F, metallic inserts of either Aluminum Bronze or Copper-Nickel can be furnished.

Injectable Packing - PART 4:

All ATS Thermal Pak Expansion Joints are furnished with "HPI®", an asbestos-free self-lubricating flake graphite injectable packing. The expansion joints are fully packed at the factory and additional packing plugs are provided for future system maintenance.

Packing Cylinder & Plunger - PARTS 5 & 6:

ATS offers several packing cylinders; refer to Page 6 for a detailed description of the various types offered.

The ATS Type "A" packing cylinder is standard and is machined from 2" Diameter C 1018 carbon steel bar and has internal ACME Threads. The mating plunger, with external ACME Threads is machined from AISI C12L14 bar.

For corrosive and manhole applications, plungers machined from Aluminum Bronze, ATSM B150, are recommended.

Limit Stop Pins - PART 7:

High strength alloy limit stop pins are designed to prevent disengagement of the slip from the stuffing box in the event of an anchor failure. All stop pins are welded in place.

Body End Connection – PART 8:

Weld End: A standard wall concentric reducer meeting ASTM A-234, Gr WPB, or formed from ASTM A106 Gr B Standard Wall Pipe is furnished. Heavier wall reducers or eccentric reducers are available on application.

Flanged End: ANSI ASTM A105 Forged Steel Raised Face Flange attached to the body end connection.

Traverse Chamber - PART 9:

Standard wall ASTM A106 Gr B Seamless Pipe is used for standard sizes and pressure ratings. Heavier wall pipe used when required by specification or pressure rating.

Ring Packing - PART 10:

Inconel wire braided jacket over an extruded core containing glass fibers, graphite binders and corrosion inhibitors with an external coating of a colloidal graphite dispersion, providing a highly lubricated sealing surface and protective coating.

Stuffing Box - PART 11:

Machined from heavy wall seamless mechanical tubing equivalent to ATSM A106 Gr B. or ASTM A105 Forging.

Wall thickness of stuffing box is sized to ensure distortion does not occur due to the internal pressure and the hydraulic forces associated with the injectable packing.

Anchor Base - PART 12:

Fabricated from ASTM A36 or equal steel plate with all bolt holes accessible from one side.

Single Slip Expansion Joint: Base is optional. Designed as a Main Anchor Base when furnished. When expansion joint is furnished with service connection, anchor base is standard.

Double Slip Expansion Joint: Base is standard and is designed as an intermediate anchor. When Expansion joint is furnished with service connection, the anchor base is designed as Main Anchor.

Available Options: SEE PAGES 8 & 9

- **SLIP ADJUSTMENT RODS**
- **INSULATION BLANKETS**
- **SERVICE CONNECTIONS**
- **CYCLE AND FORCE TESTING**
- **DRIP LEG**
- **DRAIN**

Proudly Manufactured in the U.S.A.

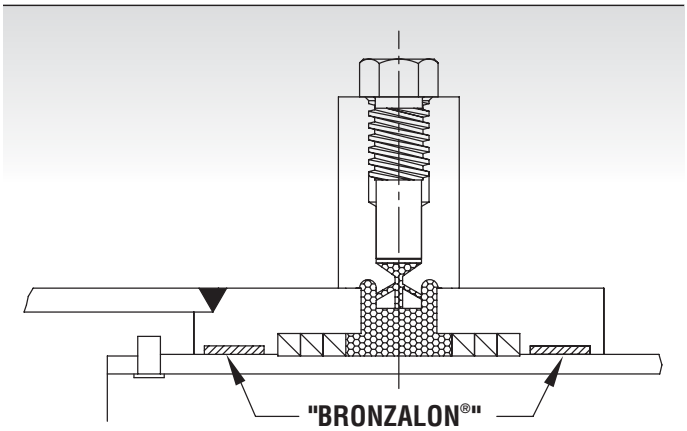
ATS Thermal Pak "TP2" Expansion Joints Include These ATS Innovated Features

5-Year Leak-Free Warranty

Through extensive product testing, and a long-term history of successful field operation, the ATS Thermal Pak "TP2" Expansion Joint has been demonstrated to be the most reliable expansion joint available. Due to this proven track record, ATS offers a 5-Year Leak-Free Warranty on all "TP2" Expansion Joints furnished with Bronzalon® guide inserts and "HPI®" injectable packing (See Back Page for warranty details).

Certified Leak Free For 25,000 Cycles

The ATS Thermal Pak expansion joint has been certified by an independent testing laboratory to be steam leak-free for 25,000 cycles while pressurized at 400 psig saturated steam. Certifications of test results furnished on specification or request.



Performance:

Bronzalon® - GUIDE INSERTS:

The most significant development in providing expansion joint reliability has been the introduction, by ATS, of Bronzalon® as a low friction guide insert. Bronzalon® is a Bronze Filled Teflon® NON-METALLIC material that is inserted into both the internal and external integral guide surfaces. This material provides two prime functions; 1) It provides a low friction - non-scoring guide surface for the slip, which eliminates all metal to metal contact, and 2) It provides the expansion joint with the ability to resist binding due to small amounts of misalignment since the material will deform slightly under high loads and relieve a binding condition. These two functions CANNOT be accomplished by the use of a metal insert such as Brass or Bronze. This is one of the most distinguishing features of the ATS Thermal Pak Expansion Joint. Use of Bronzalon® is limited to applications of 500°F maximum.

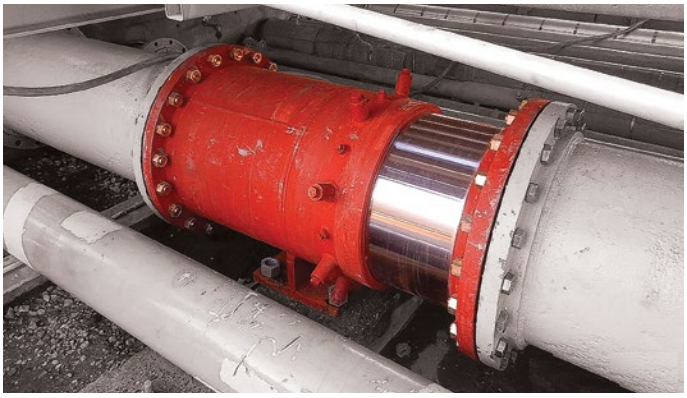
NOTE: Short excursions to 550F

HPI® - HIGH PERFORMANCE INJECTABLE:

All ATS expansion joints are furnished with "HPI®" Injectable Packing "HPI®" is a non-asbestos - self-lubricating - semi-plastic - Flake Graphite packing material that provides superior sealing for all types of service up to 1000°F. This packing was pioneered by ATS and is the only non-asbestos packing that has a long-term history of successful operation.

HEEF® 25 - CHROME:

HEEF® 25 is hard chrome plating system which consists of a minimum of 2 mils of hard chrome. This system offers the best plating combination for achieving both a hard scratch resistant and corrosion resistant surface for the sliding portion of the slip.



Packing Safety - PACKING CYLINDERS WITH INTEGRAL SHUT-OFF VALVE:

The ATS Types "B" and "C" Packing Cylinders offer complete operator safety during the packing operation due to the integral stainless steel shut-off valve. During packing or clean out, the operator can easily close the valve to isolate the pressurized portion of the stuffing box from the packing cylinder chamber. With this accomplished, the plunger can be removed to allow either packing to be added, or the use of the ATS SAF-T-PACKER® (See Page 6 and 7).

High Pressure... High Temperature... High Performance, Plus Safety.

Industry requirements for today's high-pressure steam transmission systems accompanied by higher temperatures have dictated a requirement for a more reliable expansion joint that is designed for safe packing injection full line pressure and not subject to the various types of failures that require system depressurization for replacement.

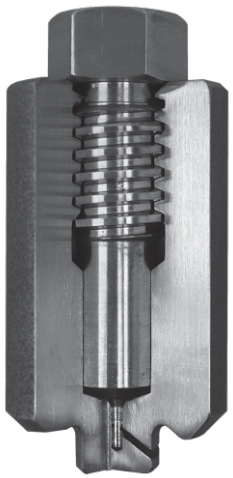
SOLUTIONS TO SAFE AND EFFECTIVE PACKING INJECTION:

ATS offers three (3) packing cylinder designs for use with the "TP2" Thermal Pak Expansion Joint to 1000 psig. Carbon Steel is the standard material of construction for both the packing cylinder and plunger for applications up to 800°F (See Below). For corrosive applications, i.e., salt water and manholes, other materials such as stainless steel packing cylinders and aluminum bronze plungers are available.

KEY SAFETY FEATURES OF ALL ATS PACKING CYLINDERS:

- Welded directly to Stuffing Box.
- 2" Diameter to prevent splitting due to hydraulic pressure of packing operation.
- Heavy-Duty 1" - 5 Acme Threads.
- Discharge tip incorporates "Check Valve Effect" design.

TYPE "A"



Type "A" Packing Cylinder:

The ATS Type "A" Packing Cylinder for many years has provided economic and safe provisions for packing injection under full line pressure. Unless otherwise specified all ATS Thermal Pak "TP2" Expansion Joints for service up to 300 psig will be furnished with the ATS Type "A" Packing Cylinder. The design of the discharge tip of the Type "A", and all other Types, is such that a "check valve effect" is created to resist blow back of the packing during the injection process. All ATS Packing Cylinders are machined from C1018 carbon steel and have heavy duty internal Acme Threads. The mating plunger has matching Acme Threads, and is machined from C12L14, a slightly softer material that prevents damage to the internal threads of the packing cylinder.

MAXIMUM PRESSURE: 300 psig
APPLICABLE EJ SIZE: 1½" & Larger

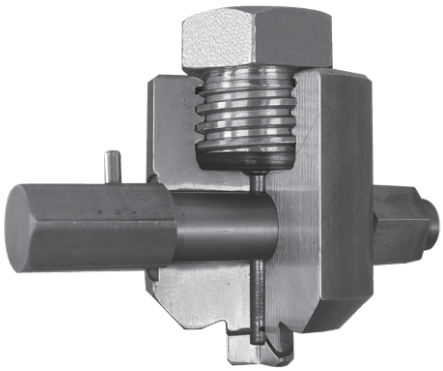
TYPE "B"

Type "B" Packing Cylinder:

The ATS Type "B" Packing Cylinder has an integral Stainless-Steel Safety Valve which provides for positive shut off during the packing injection process. It also contains the same discharge tip design, internal Acme Threads, and is machined from the same materials as the Type "A" Packing Cylinder. The Type "B" Packing Cylinder is provided on all Thermal Pak "TP2" Expansion Joints designed for service over 300 psig. When using the Type "B" Packing Cylinder, the valve is rotated to the closed position, as indicated by the indicator pin, which then provides a positive shut off from the flowing media. The packing plunger can then be removed to allow a packing plug to be inserted into the packing cylinder without operator concern over possible blow back. While this type packing cylinder is required for operating pressures over 300 psig, it will provide the maintenance personnel with a feeling of safety at all service conditions.

MAXIMUM PRESSURE: 850 psig
APPLICABLE EJ SIZE: 1½" & Larger

TYPE "C"



Type "C" Packing Cylinder:

The ATS Type "C" Packing Cylinder is a heavy-duty packing cylinder, designed for use in high pressure/temperature applications, which require maximum reliability. This design is furnished for all applications over 850 psig, and for other applications on specification. The Type "C" Packing Cylinder consists of a retainer welded to the expansion joint, which contains the integral stainless steel safety valve. During normal operation, a cap plug is threaded into the retainer. When packing is to be injected, the cap plug is removed and a packing injector is threaded into the retainer. Packing is accomplished using the same procedure outlined within the Type "B" Packing Cylinder. Upon completion of the packing operation, the packing injector should be removed and the cap plug installed.

MAXIMUM PRESSURE: 1000 psig
APPLICABLE EJ SIZE: 6" & Larger

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ATS SAF-T-PACKER®

THE ONLY SAFE & EFFECTIVE METHOD - TO CLEAN OUT THE PACKING CYLINDER

Due to the integral safety valve of the ATS Types "B" and "C" Packing Cylinders, a long column of impacted packing remains in the packing cylinder above the discharge tip, this column of packing increases the effectiveness of the discharge tip, however, it also increases the amount of torque required to inject packing, especially the first plug.

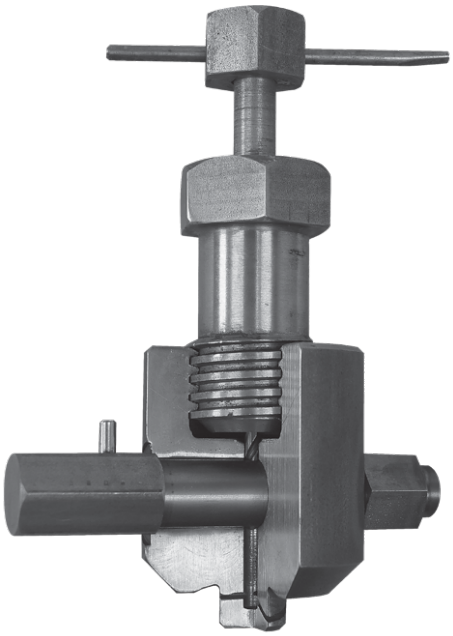
To reduce the effort required to inject packing. This column of packing should be loosened and cleaned out. The only safe and effective method to accomplish this is with the use of an ATS SAF-T-PACKER®. Use of the SAF-T-PACKER® greatly reduces the time and effort required to inject packing into the ATS Types "B" and "C" Packing Cylinders while providing complete operator safety.

TYPE "GB" SAF-T-PACKER®

PATENT NO. 4,711,013

TYPE "GC" SAF-T-PACKER®

PATENT NO. 4,711,013



Use of the SAF-T-PACKER® - BOTH SAFE AND SIMPLE

The SAF-T-PACKER® is normally used when injecting the first plug of packing into either a Type "B" or Type "C" Packing Cylinder. With the safety valve on the packing cylinder in the closed position, the packing plunger is disengaged from the packing cylinder. The SAF-T-PACKER® is then threaded into the packing cylinder. Note: The drill bit on the SAF-T-PACKER® must be fully retracted into the housing. The safety valve on the packing cylinder is then opened, and the handle on the SAF-T-PACKER® rotated clockwise until the bit is fully engaged. The handle is then rotated counter-clockwise to completely disengage the bit. Before the SAF-T-PACKER® is removed from the packing cylinder, the safety valve must be closed. Complete instructions for use of all styles of ATS SAF-T-PACKER®'s are furnished with each SAF-T-PACKER® shipped.

PACKING CYLINDER ORIENTATION

NOTES:

1. The ATS Type "A" Packing Cylinders do not have the integral safety valve and ATS therefore does not recommend the use of a SAF-T-PACKER® with a Type "A" Packing Cylinder when the system is pressurized.
2. SAFETY PRECAUTION: The injection of packing into a fully pressurized expansion joint is a safe operation when it is accomplished using the procedures and instructions furnished with the expansion joint. Personnel doing the packing injection should read and understand the instructions before starting packing injection. ATS offers training seminars for maintenance personnel when requested.

Available Options.... To Simplify & Enhance the Installation and Performance of the ATS Thermal Pak "TP2" Expansion Joint

Slip Adjustment Rods: USED IN REPLACEMENT APPLICATIONS

When installing an expansion joint in a line that will not be at ambient temperature during the installation, it may be necessary to pre-compress the slip an additional amount over the 1" standard factory pre-compression to ensure there is sufficient slip extension when the pipeline is allowed to reach ambient conditions at some later date. During the installation process, the slip may have to be moved in the field to accommodate the opening in the pipeline. Due to the large force required to move the slip, it is often difficult to field improvise a method to efficiently move the slip. ATS can provide the expansion joint with lugs welded to both the expansion joint body and slip. Use of the lugs in conjunction with the threaded rods provided will allow the slip to be conveniently moved in the field.

This option is normally only provided for expansion joints furnished with ends beveled for welding. When the expansion joint is furnished with flanged ends, the slip can typically be moved in the field by use of threaded rods and nuts placed through the bolt holes in the flanges on both ends of the expansion joint.

CAUTION:

1. **The use of two adjustment rods located 180° apart is always required, and adjustment must be made simultaneously to both rods to prevent the slip from becoming cocked in the stuffing box and binding.**
2. **Once the installation of the expansion joint has been completed, the rods must be removed. If insulation blankets have been provided, or field insulation is to be applied, the lugs should be carefully burned off at both the body and slip locations.**

Service Connections:

ATS expansion joints can be supplied with service connections up to the full line size. Whenever a service connection is provided, the expansion joint will always be supplied with an anchor base designed as a main anchor to take the load forces and moments associated with the service connection. The service connection is incorporated onto the body by use of a Forged Steel Weld-0-Let. The service connection can be furnished with ends machined and beveled to any Pipe Schedule, or with a Forged Steel Flange. Note: The overall length of expansion joints furnished with service connections will be greater than that listed as Dimension "A" on Pages 10 and 11.

Aluminum Bronze, Stainless Steel and Monel Plungers:

In applications where the expansion joints will be in a wet, damp, or corrosive environment, consideration should be given to the use of alternate plunger material in lieu of the standard carbon steel plungers.

Cycle and Force Test:

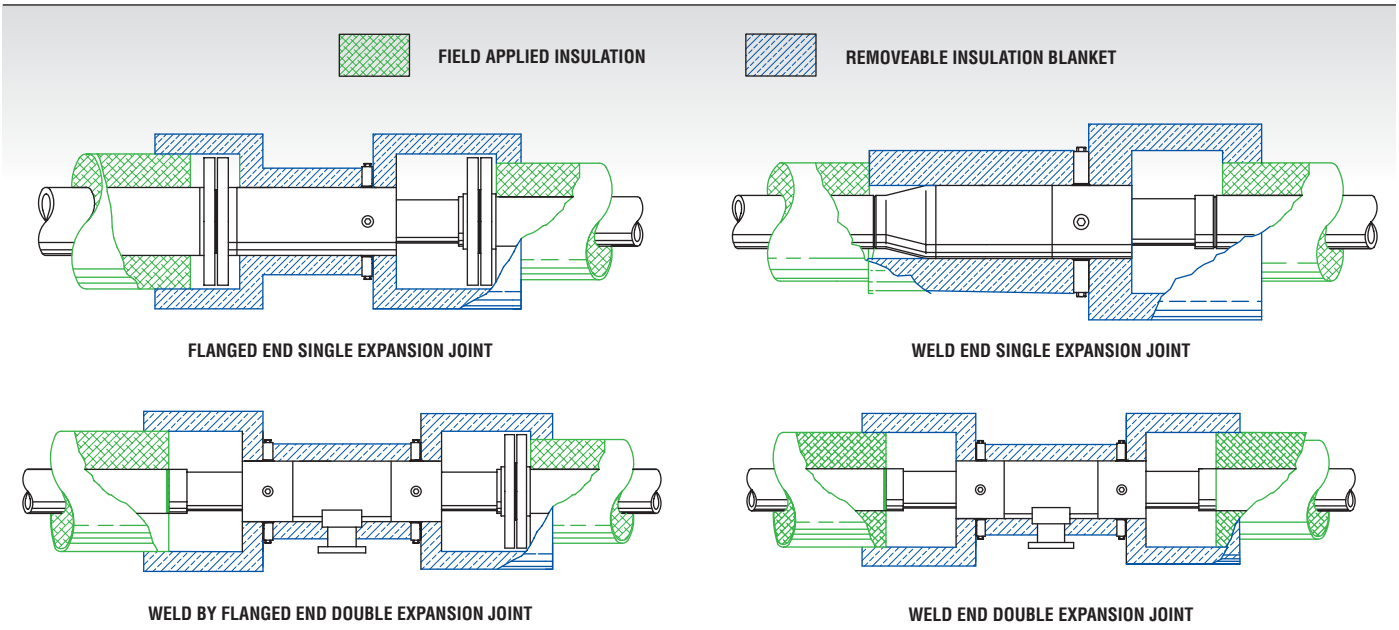
The cycle and force test is a quality enhancement test that can be performed to verify both the free movement of the slip and the force required to move the slip. When proper techniques are employed for factory injection of the packing, the force required to move the slip of a packed slip joint can be used to correlate the density of the packing. Through experience and testing, ATS has been able to establish the minimum packing density required to seal expansion joints at various service conditions.

The cycle and force test performed by ATS requires that the slip be cycled through its full rated traverse three (3) times, and that the force required to move the slip be measured and recorded. This test virtually eliminates leakage of the expansion joint at startup.

Drain Connections:

ATS does not furnish drain connections as standard with the Thermal Pak "TP2" Expansion Joint. Drains will be furnished when specified.

Available Options.... To Simplify & Enhance the Installation and Performance of the ATS Thermal Pak "TP2" Expansion Joint



Insulation Blankets: COST-EFFECTIVE ENERGY SAVINGS

ATS Removable - Reusable Insulation Blankets provide a cost-effective method for insulating the expansion joint. Designs are available for various service conditions.

ATS supplied insulation blankets can be furnished in various configurations dependent upon the user's requirements. Typical configurations include:

TWO PIECE: One piece covers the body and a separate blanket(s) is furnished for the slip(s).

SLIP ONLY: Body covered with same insulation as mating pipeline, blanket(s) furnished for slip(s) only.

All blankets are weather resistant and have a protective cloth cover on both the inner and outer surface. In addition, the inner surface has an Inconel wire mesh screen to further protect the blanket surface. All blankets are custom made to fit the ATS Expansion Joint and have access to the packing cylinders to allow packing injection to be accomplished without requiring the body blanket to be removed. Having the insulation blanket furnished by the expansion joint manufacturer ensures a proper fit.

Dirt Leg:

ATS can supply Thermal Pak "TP2" Expansion Joints with dirt legs in sizes up to full line size. A standard dirt leg consists of a heavy wall pipe section, heavy wall end cap, two (2) side mounted and one (1) bottom mounted threaded connections. The dirt leg is attached to the expansion joint body using a Forged Steel Weld-O-Let. When dirt legs are required in the system, it is normally cost-effective to have ATS include a dirt leg on the expansion joint body.

NPT Threaded Ends:

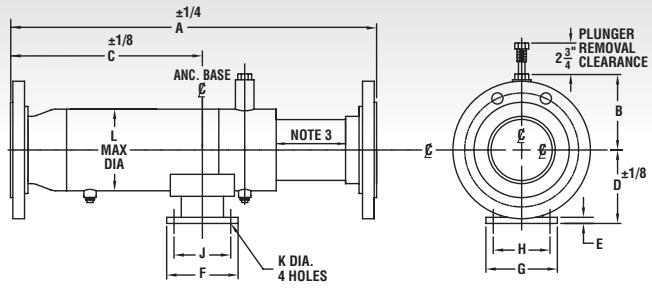
ATS can supply the "TP2" Expansion Joint with NPT Threaded Ends in Sizes 1-1/2" to 3". When threaded ends are specified, the over-all length of the expansion joint will be longer than the dimensions shown for a weld end expansion joint.

Custom Expansion Joints:

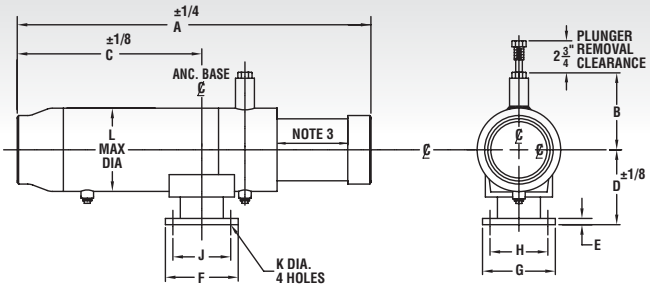
ATS can furnish custom designed expansion joints to meet the need of most projects. Please consult the factory for further information.

Single Slip Expansion Joints Meets ASTM F1007

FLANGED END



WELD END



DIMENSIONS - INCHES																		
EXP. JOINT SIZE (NPS)	A (SEE NOTE 3 BELOW) NOMINAL TRAVERSE									B	C								
	150 LB. FLANGED			300 LB. FLANGED			150 & 300 LB. WELD				150 LB. FLANGED			300 LB. FLANGED			150 & 300 LB. WELD		
	4"	8"	12"	4"	8"	12"	4"	8"	12"		4"	8"	12"	4"	8"	12"	4"	8"	12"
1½	23¼	31¼	39¼	23⅜	31⅜	39⅜	22⅜	30⅜	38⅜	5¼	12¾	16¾	20¾	12⅞	16⅞	20⅞	12⅜	16⅜	20⅜
2	23¼	31¼	39¼	23⅜	31⅜	39⅜	22⅜	30⅜	38⅜	5⅝	12¾	16¾	20¾	12⅞	16⅞	20⅞	12⅜	16⅜	20⅜
2½	20⅝	28⅝	36⅝	21⅛	29⅛	37⅛	23⅛	31⅛	39⅛	5⅞	10⅛	14⅛	18⅛	10⅝	14⅝	18⅝	13⅛	17⅛	21⅛
3	21¼	29¼	37¼	22	30	38	23¾	31¾	39¾	6⅛	10¼	14¼	18¼	11	15	19	13¼	17¼	21¼
4	21½	29½	37½	22⅜	30⅜	38⅜	25	33	41	6⅝	10½	14½	18½	11⅜	15⅜	19⅜	14½	18½	22½
5	22¼	30¼	38¼	23⅛	31⅛	39⅛	26	34	42	7¼	11⅛	15⅛	19⅛	12	16	20	15½	19½	23½
6	27½	35½	43½	22¾	30¾	38¾	26½	34½	42½	8⅛	16⅜	20⅜	24⅜	11⅝	15⅝	19⅝	16	20	24
8	28¾	36¾	44¾	23	31	39	27½	35½	43½	9⅛	16¾	20¾	24¾	11	15	19	16¼	20¼	24¼
10	31⅜	39⅜	47⅜	25¼	33¼	41¼	30⅛	38⅛	46⅛	10⅛	18⅝	22⅝	26⅝	12½	16½	20½	18⅛	22⅛	26⅛
12	25½	33½	41½	26¼	34¼	42¼	30⅝	38⅝	46⅝	11⅜	11¾	15¾	19¾	12½	16½	20½	17⅝	21⅝	25⅝
14	25⅞	33⅞	41⅞	27⅛	35⅛	43⅛	31⅜	39⅜	47⅜	11¾	12⅛	16⅛	20⅛	13⅜	17⅜	21⅜	18⅜	22⅜	26⅜
16	26¾	34¾	42¾	27⅝	35⅝	43⅝	31⅝	39⅝	47⅝	12¾	12½	16½	20½	13⅜	17⅜	21⅜	18⅛	22⅛	26⅛
18	28½	36½	44½	29¾	37¾	45¾	33⅜	41⅜	49⅜	13¾	13⅜	17⅜	21⅜	14⅝	18⅝	22⅝	19⅛	23⅛	27⅛
20	30⅛	36⅜	44⅜	31	37¼	45¼	34⅜	40⅝	48⅝	14¾	15	17¼	21¼	15⅞	18⅛	22⅛	20⅛	22⅜	26⅜
24	32	37½	45½	33	38½	46½	35¾	41¼	49¼	16¾	15⅛	16⅝	20⅝	16⅛	17⅝	21⅝	20	21½	25½

EXP. JOINT SIZE (NPS)	ANCHOR BASE DIMENSIONS - INCHES													L
	D	FLANGED AND WELD ENDS												
		150 LB. MWP						300 LB. MWP						
		E	F	G	H	J	K	E	F	G	H	J	K	
1½	4	½	5½	5½	4	4	⅝	½	5½	5½	4	4	⅝	3
2	4¼	½	5½	5½	4	4	⅝	½	5½	5½	4	4	⅝	3⅝
2½	4⅜	½	5½	5½	4	4	⅝	½	5½	5½	4	4	⅝	4¼
3	5	½	6	6	4½	4½	⅝	½	6	6	4½	4½	⅝	4¾
4	5¾	½	7	7	4¾	4¾	¾	½	7	7	4¾	4¾	¾	5¾
5	6½	⅝	8	8	5¾	5¾	⅞	⅝	8	8	5¾	5¾	⅞	7
6	7¼	⅝	8	8	5¾	5¾	⅞	⅝	8	8	5¾	5¾	⅞	8⅝
8	8¾	¾	10	10	7½	7½	1	¾	10	10	7½	7½	1	10¾
10	10½	1	10½	12	9½	8	1⅛	1	10½	12	9½	8	1⅛	12¾
12	11½	1	12	14½	11½	8½	1⅜	1	12	14½	11½	8½	1⅜	15
14	12¼	1	12	15	12	9	1¼	1	14	16	12	10½	1⅜	16
16	13½	1	12½	15¾	12½	9	1⅜	1¼	14	16	12½	10½	1½	18
18	15	1	14	16	12½	10½	1½	1¼	15	17	13	11	1¾	20
20	16¼	1	15	17	13	10½	1½	1¼	18	18	13½	13½	1⅞	22
24	18¾	1¼	18½	18½	14	14	1⅞	1½	19	19	14	14	2⅛	26

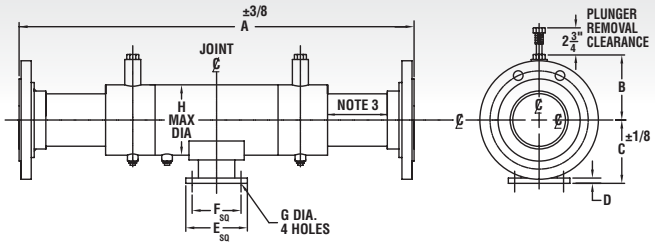
NOTES:

1. Protection: One shop coat of Red Oxide Primer paint is applied to all unfinished exterior surfaces.
2. Sliding surface of slip is a 25 Hard Chrome Plate – minimum 2 mils thick.
3. The overall dimension "A" is the shipped length of the Expansion Joint for hot service, which includes a 1" factory pre-compression of the slip. Allowable movement of each slip is 1" in extension and compression equal to the nominal traverse. Exposed chrome length is equal to the nominal traverse. For cold service, additional pre-compression is required.
4. Weld Ends machined and beveled to match standard wall pipe unless otherwise specified.
5. Drain connection (3000# THD'D Cplg) furnished only if specified.
6. Single Slip Expansion Joints furnished with anchor base only if specified.
7. "B" Dimension is for Type " A" Packing Cylinders.
8. For Type "B" Packing Cylinders, Add 1-1/8" to the "B" Dimension.

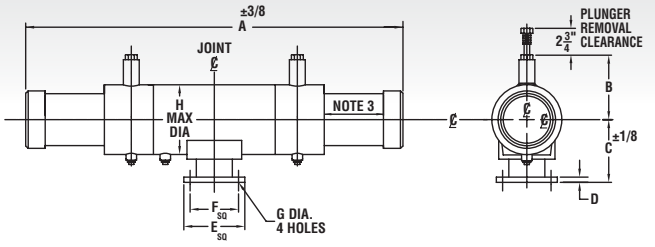
Proudly Manufactured in the U.S.A.

Double Slip Expansion Joints Meets ASTM F1007

FLANGED END



WELD END



DIMENSIONS - INCHES																			
EXP. JOINT SIZE (NPS)	A (SEE NOTE 3 BELOW) NOMINAL TRAVERSE (EACH SLIP)												B	BASE DIMENSIONS (ALL PRESSURES)					H
	150 LB. FLANGED			300 LB. FLANGED			150 LB. WELD			300 LB. WELD				C	D	E	F	G	
	4"	8"	12"	4"	8"	12"	4"	8"	12"	4"	8"	12"							
1½	38¾	54¾	70¾	38¾	54¾	70¾	37¾	53¾	69¾	37¾	53¾	69¾	5¼	4	½	5½	4	⅝	3
2	38¾	54¾	70¾	38¾	54¾	70¾	37¾	53¾	69¾	37¾	53¾	69¾	5⅝	4¼	½	5½	4	⅝	3⅝
2½	39¼	55¼	71¼	39½	55¼	71¼	38¼	54¼	70¼	38¼	54¼	70¼	5⅞	4⅜	½	5½	4	⅝	4¼
3	40½	56½	72½	40½	56½	72½	39½	55½	71½	39½	55½	71½	6⅛	5	½	6	4½	⅝	4¾
4	41	57	73	41	57	73	40	56	72	40	56	72	6⅝	5¾	½	7	4¾	¾	5¾
5	46¼	58¼	74¼	46¼	58¼	74¼	45	57	73	45	57	73	7¼	6½	⅝	8	5¾	⅞	7
6	46¼	58¼	74¼	46¼	58¼	74¼	45	57	73	45	57	73	8⅛	7¼	⅝	8	5¾	⅞	8⅝
8	46½	58½	74½	46½	58½	74½	45	57	73	45	57	73	9⅛	8¾	¾	10	7½	1	10¾
10	49¾	61¾	77¾	49¾	61¾	77¾	48¼	60¼	76¼	48¼	60¼	76¼	10⅛	10½	¾	10	7½	1⅛	12¾
12	50¾	62¾	78¾	50¾	62¾	78¾	49¼	61¼	77¼	49¼	61¼	77¼	11⅜	11½	1	12	9	1¼	15
14	52¼	64¼	80¼	52¼	64¼	80¼	50¾	62¾	78¾	50¾	62¾	78¾	11¾	12¼	1	12	9	1¼	16
16	52¾	64¾	80¾	52¾	64¾	80¾	51¼	63¼	79¼	51¼	63¼	79¼	12¾	13½	1	14	10½	1⅜	18
18	54½	66½	82½	54½	66½	82½	52¾	64¾	80¾	52¾	64¾	80¾	13¾	15	1	14	10½	1⅜	20
20	60½	68½	84½	60½	68½	84½	58¾	66¾	82¾	58¾	66¾	82¾	14¾	16¼	1	16	12½	1½	22
24	61¾	69¾	85¾	61¾	69¾	85¾	59½	67½	83½	59½	67½	83½	16¾	18¾	1	18	13½	1⅞	26

NOTES:

1. Protection: One shop coat of Red Oxide Primer paint is applied to all unfinished exterior surfaces.
2. Sliding surface of slip is a Hard Chrome Plate – minimum 2 mils thick.
3. The overall dimension "A" is the shipped length of the Expansion Joint for hot service, which includes a 1" factory pre-compression of each slip. Allowable movement of each slip is 1" in extension and compression equal to the nominal traverse. Exposed chrome length is equal to the nominal traverse. For cold service, additional pre-compression is required.
4. Weld Ends machined and beveled to match standard wall pipe unless otherwise specified.
5. Drain connection (3000# THD'D Cplg) furnished only if specified.
6. Anchor base is standard on double expansion joints.
7. "B" Dimension is for Type " A" Packing Cylinders.
8. For Type "B" Packing Cylinders, Add 1-1/8" to the "B" Dimension.

Expansion Joint Order Information

To insure correct and efficient production of Expansion Joint Orders, use full catalog number designation as described in example below

10" TP2-SWW-1 2 1-8-400H-BRZ-A

1. 2. 3. 4. 5. 6. 7. 8. 9. 10.

Field Number: CATALOG NUMBER

1. PIPE SIZE

2. EXPANSION JOINT DESIGN: **TP2** = Thermal Pak.

3. END PREPARATION:

SWW = Standard Wall, Weld Ends
EHW = Extra Heavy Wall, Weld Ends
15F = 150 lb. Flanged
30F = 300 lb. Flanged
XXX = Other or Combination

SINGLE JOINTS ONLY:
FxW = Flange at body end, weld at slip end
WxF = Weld at body end, flange at slip end

4. TYPE OF EXPANSION JOINT:

1 = Single slip Expansion Joint.
2 = Double slip Expansion Joint.

5. PRESSURE CLASS:

2 = 150 lb. pressure class.
3 = 300 lb. pressure class.
4 = 400 lb. pressure class.
6 = 600 lb. pressure class.
8 = 800 lb. pressure class.
9 = 900 lb. pressure class.

6. AVAILABLE OPTIONS:

1 = Without anchor base.
2 = With anchor base (double joints are furnished with an intermediate anchor base).
4 = With service connection. Size and type (weld, flanged, threaded) of service connection and its location must be specified. If service connection is at side of Single Expansion Joint, specify which side when facing the slip. Anchor base required for all Expansion Joints with service connections.
5 = With Drip/Dirt leg. Specify size and max. length.
6 = With service connection and Drip/Dirt leg.
7 = With Drip/Dirt leg and anchor base specify size and max length.

7. TRAVERSE:

Nominal traverse per slip. Traverse furnished in 4" increments, i.e., 4", 8", 12". Consult Factory where traverse exceeds 12".

8. PACKING DESIGNATION: (Refer to Table 2)

400H

Table 2: Packing Codes:

PACKING CODE (Field 8)	BRAIDED RING PACKING	INJECTABLE PACKING	SERVICE	MAX. TEMP. (°F)
400H	Reinforced Graphite	"HPI®" Flake Graphite	Steam	800

9. OPTIONAL LOW FRICTION INSERTS FOR INTERNAL AND EXTERNAL GUIDES:

Specify Bronzalon® (BRZ) for temperature to 500°F or the HC800 series number for higher temperatures to 800°F. Omit if not required.

10. TYPE PACKING CYLINDER:

Table 1

TYPE	MAXIMUM PRESSURE	APPLICABLE EJ SIZE
"A"	300 psig	1½" & larger
"B"	850 psig	1½" & larger
"C"	1000 psig	6" & larger

OTHER DATA:

1. If ends are to be beveled for welding to other than standard wall pipe, specify wall thickness or pipe schedule of weld ends.
2. Always advise design service conditions, i.e., fluid, pressure and temperature, for nameplate data.
3. If other than standard 1" factory slip pre-compression is required, specify requirements.
4. All Expansion Joints are normally furnished without a drain connection unless otherwise specified. Specify DRAIN if required.
5. Bases for single joints are designed as an axial load main anchor base unless otherwise specified and are drilled accordingly. If base is to be used as a sliding support base, so state so base plate will not be drilled to avoid field error of anchoring the base.
6. Specify any unusual conditions or length requirements to fit existing conditions, etc.
7. Aluminum Bronze Plungers (ASTM B150), where required. must be specified separately.
8. Slip adjustment rods, where required, must be specified separately. (Recommended for weld end joints only).
9. Insulation blankets, where required, must be specified separately. Specify thickness of insulation on mating pipe and maximum operating temperature.

Expansion Joint Approximate Shipping Weight (lbs.)

150 & 300 LB. Weld Ends

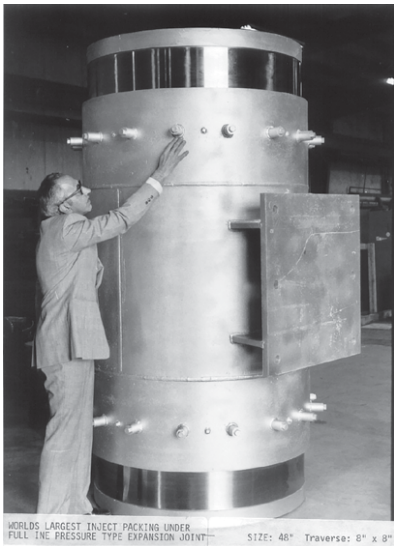
EJ SIZE (NPS)	TP2-SWW-121 or 131 SINGLE WITHOUT BASE			TP2-SWW-122 or 132 SINGLE WITH BASE			TP2-SWW-222 or 232 DOUBLE WITH BASE		
	4" TR.	8" TR.	12" TR.	4" TR.	8" TR.	12" TR.	4" + 4" TR.	8" + 8" TR.	12" + 12" TR.
1½	17	20	23	23	26	29	40	46	52
2	23	27	31	30	34	38	47	55	63
2½	30	35	40	37	42	47	60	70	80
3	38	45	52	49	56	63	75	89	103
4	65	75	85	76	86	96	110	130	150
5	75	88	101	95	108	121	150	176	202
6	130	149	168	150	169	188	246	284	322
8	170	198	226	205	233	261	350	406	462
10	225	262	299	285	322	359	422	496	570
12	320	367	414	400	447	494	575	669	763
14	375	431	487	470	526	582	660	772	884
16	456	525	594	556	625	694	853	991	1,129
18	465	536	607	580	651	722	960	1,102	1,244
20	590	673	756	715	798	881	1,200	1,386	1,572
24	850	960	1070	990	1,100	1,210	1,670	1,890	2,110

150 LB. Flanged Ends

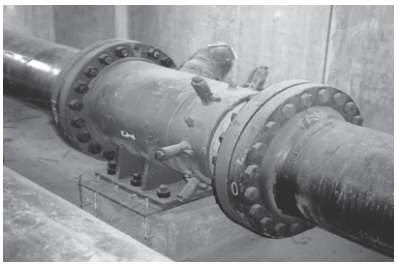
EJ SIZE (NPS)	TP2-15F-121 SINGLE WITHOUT BASE			TP2-15F-122 SINGLE WITH BASE			TP2-15F-222 DOUBLE WITH BASE		
	4" TR.	8" TR.	12" TR.	4" TR.	8" TR.	12" TR.	4" + 4" TR.	8" + 8" TR.	12" + 12" TR.
1½	23	26	29	29	32	35	46	52	58
2	33	37	41	40	44	48	57	65	73
2½	41	46	51	48	53	58	74	84	94
3	50	57	64	61	68	75	91	105	119
4	84	94	104	95	105	115	134	154	174
5	97	110	123	117	130	143	180	206	232
6	168	194	220	188	214	240	284	322	360
8	208	236	264	243	271	299	410	466	522
10	309	346	383	369	406	443	506	580	654
12	415	462	509	495	542	589	703	797	891
14	508	564	620	603	659	715	830	942	1,054
16	602	671	740	702	771	840	1,041	1,179	1,317
18	658	729	800	773	844	915	1,200	1,342	1,484
20	842	925	1,008	967	1,050	1,133	1,510	1,696	1,862
24	1,206	1,316	1,426	1,346	1,456	1,566	2,090	2,310	2,530

300 LB. Flanged Ends

EJ SIZE (NPS)	TP2-30F-131 SINGLE WITHOUT BASE			TP2-30F-132 SINGLE WITH BASE			TP2-30F-232 DOUBLE WITH BASE		
	4" TR.	8" TR.	12" TR.	4" TR.	8" TR.	12" TR.	4" + 4" TR.	8" + 8" TR.	12" + 12" TR.
1½	31	34	37	37	40	43	52	58	64
2	37	41	45	44	48	52	61	69	77
2½	47	52	57	54	59	64	80	90	100
3	60	67	74	71	78	85	101	115	129
4	104	114	124	115	125	135	154	176	196
5	123	136	149	143	156	169	206	233	259
6	195	214	233	215	234	253	324	362	400
8	264	292	320	299	327	355	466	522	578
10	357	394	431	417	454	491	586	660	734
12	517	564	611	597	644	691	805	899	993
14	664	720	776	769	825	881	986	1,098	1,210
16	854	923	992	974	1,043	1,112	1,293	1,431	1,569
18	978	1,049	1,120	1,103	1,174	1,245	1,520	1,662	1,804
20	1,182	1,265	1,348	1,332	1,415	1,498	1,850	2,016	2,182
24	1,770	1,880	1,990	1,940	2,050	2,160	2,654	2,874	3,094



48" TP2-SWW-282-8-400H-HC800-B Designed for mid-west refinery for flare gas service.



Single Flanged End Expansion Joint with a gusseted base and service connection for steam service system.

Engineering Information...

Thermally Induced Changes of Pipelines:

Pipelines will always change in length as the temperature of the pipeline changes. This change must be accommodated by some method, either by natural flexibility of the pipeline or by use of an expansion device. The Thermal Pak "TP2" Expansion Joint is the ideal selection when long straight runs of pipe are involved.

Table 3 is used to determine the total change in length of the pipe run based upon the maximum and minimum temperatures of the system. The net change in length of the pipe run per 100 ft. of piping is the algebraic difference between the expansion constant at the highest temperature and the expansion constant at the lowest temperature. This difference is then multiplied by the total length of the pipe run divided by 100.

NOTE: The minimum temperature may not be the installation temperature.

EXAMPLE: Determine the total change in length of a 250 feet long run that is for 300 psig saturated steam (422°F) and is being installed outside where the ambient temperature may reach 20°F.

3.44 - 0.15 x ($^{250}/_{100}$) = 8.23 in.

Traverse Selection & Pre-Compression:

Traverse is normally supplied in 4" increments, with 4", 8" and 12" nominal traverse considered standard. Once the total growth of the pipe run is determined, a safety factor of 10% should be added (See Table 3 foot notes), and a standard expansion joint traverse larger than the total growth should be selected. Assuming a single slip expansion joint is to be used for the example above, a 12" traverse expansion joint should be selected.

All ATS expansion joints for hot service are shipped with the slips pre-compressed 1" and are capable of moving the nominal traverse in compression and 1" in extension. For cold service, the slips are pre-compressed the nominal traverse, and are capable of moving the nominal traverse in extension and 1" in compression. Consult the factory whenever the installation temperature of the expansion joint is going to be abnormal, i.e., installing the expansion joint in a hot line, or installing the expansion joint on an exceptionally hot day in a normally cold location.

Expansion Joint Packing Friction Force:

The packing friction force of a slip type expansion joint is the force required to move the slip due to the injectable packing acting on the slip inside the stuffing box. ATS has determined from testing that for expansion joints properly packed for service up to 300 psig, this force is equal to approximately 1,000 lbs. per inch of expansion joint nominal diameter, i.e., a 6" expansion joint will require 6,000 lbs. of force to move the slip. Packing friction forces are tabulated in Table 4, (Page 15).

PRESSURE THRUST:

The pressure thrust associated with a packed slip type expansion joint can be calculated by multiplying the design pressure of the system by the thrust area of the expansion joint. The thrust areas for the ATS expansion joints are listed in Table 4, (Page 15). The pressure thrust is a very important component in the calculation of anchor loading, which must be accounted for and properly calculated.

Table 3: Thermal Expansion of Steel Pipe - (inches per 100 ft.)

SATURATED STEAM VACUUM IN HG BELOW 212°F, PRESSURE, PSIG ABOVE 212°F	TEMP. °F	CARBON & CARBON MOLYBDENUM STEEL
	0	0.00
	20	0.15
	40	0.30
29.39	60	0.45
28.89	80	0.58
27.99	100	0.75
26.48	120	0.91
24.04	140	1.06
20.27	160	1.20
14.63	180	1.36
6.45	200	1.52
0.0	212	1.61
2.5	220	1.68
10.3	240	1.84
20.7	260	2.02
34.5	280	2.18
52.3	300	2.35
74.9	320	2.53
103.3	340	2.70
138.3	360	2.88
150.0	366	2.93
180.9	380	3.06
232.4	400	3.23
293.7	420	3.42
300.0	422	3.44
366.1	440	3.60
451.3	460	3.78
500.0	470	3.87
550.3	480	3.96
664.3	500	4.15
795.3	520	4.34
945.3	540	4.53
1115	560	4.73
1308	580	4.93
1525	600	5.13
1768	620	5.33
2041	640	5.53
2346	660	5.75
2705	680	5.95
3080	700	6.16
	720	6.36
	740	6.57
	780	7.00
	800	7.23
	820	7.45
	840	7.66
	880	8.10
	900	8.34

NOTES:

Add a minimum of 10% to the calculated expansion for selection of the expansion joint nominal traverse (1) discrepancies in minimum or installation temperatures, (2) job site necessity to relocate anchor points, and (3) temperature surges.

Engineering Information – Anchors

Anchors:

All piping systems must be divided into individual expanding segments by means of anchors which are attached to the piping and in turn to a support structure. Machinery and equipment, such as turbines and pumps are also considered anchors, since their bases are fixed and resist all forces and moments imposed upon them. The installation of slip type expansion joints, like any other axial motion type expansion joint, introduces forces, which must be resisted by the anchors. Anchors can be categorized as either main or intermediate type, depending upon the forces they must withstand.

The main anchors must resist forces, which involve the internal pressure of the system, as well as the frictional forces associated with the pipe supports and expansion joint packing friction. Intermediate anchors usually involve only the frictional forces of the system.

Anchor Moments:

In addition to the moments imposed upon anchors from the normal axial forces described above, consideration must also be given to additional moments due to branch connections, anchors located some distance from a change in direction, i.e., a 90° elbow, or other external forces. Anchor design calculations must include all forces and moments.

Anchor Forces:

Anchor forces are calculated by adding the three components listed below, refer to Table 4:

PRESSURE THRUST, (FP) = (p x a)
(ATS Primer on Pressure Thrust bulletin furnished upon request).

EXPANSION JOINT PACKING FRICTION, (FC) = (K x D)

PIPE SUPPORT FRICTION, (FS) = (μ x Fn{w} x 100 ft.)

TOTAL PIPE SUPPORT FRICTION = (Fs x (L / 100))

In addition to the static forces listed above, there are also dynamic forces that sometimes need to be considered. For steam service the dynamic forces are quite low and can be accounted for by adding a 5% minimum load factor to the total calculated force. For high density fluids, the dynamic forces can be quite significant due to the effect of the moving fluid impinging upon an elbow and can result in a substantial force on the elbow anchor. The magnitude of this force can be calculated by using the following formula: (See sample anchor load calculations on Page 18).

$$F\rho = \frac{2A\rho V^2}{g} X \frac{Sin\theta}{2}$$

Table 4: Anchor Calculation Values

PIPE SIZE (NPS)	THRUST AREA (in2)	FORCE TO COMPRESS Fc, (lbs.)	PRESSURE THRUST Fp, (lbs.)		SUPPORT FRICTION Fs, (lbs./100 ft.)	
			150 psi	300 psi	STD	XS
1½	2.8	1,500	420	840	126	154
2	4.4	2,000	660	1,320	179	221
2½	6.5	2,500	975	1,950	276	333
3	9.6	3,000	1,440	2,880	458	554
4	15.9	4,000	2,385	4,770	572	700
5	24.3	5,000	3,645	7,290	816	1,005
6	34.5	6,000	5,175	10,350	1,104	1,398
8	58.4	8,000	8,760	17,520	1,761	2,215
10	90.8	10,000	13,620	27,240	2,617	3,053
12	127.7	12,000	19,155	38,310	3,455	3,941
14	153.9	14,000	23,085	46,170	4,007	4,543
16	201.0	16,000	30,150	60,300	4,967	5,586
18	254.5	18,000	38,175	76,350	6,023	6,723
20	314.0	20,000	47,100	94,200	7,174	7,956
24	452.0	24,000	67,000	135,600	9,762	10,707

NOTES:

1. The packing friction forces shown, Fc, are applicable for an operating pressure up to 300 psig. Consult factory for values at pressures greater than 300 psig.
2. Tabulated values of Fs are based upon the following:
   a) Carbon steel standard wall pipe.
   b) Mean Static Coefficient of friction of 0.35 (μ).
3. For piping systems utilizing graphite on graphite guides and supports, multiply the tabulated Fs values by 0.45.

Engineering Information – Guides

General Guidelines for Guiding when using ATS Thermal Pak "TP2" Expansion Joints:

1. Table 5 shows the recommended location for the primary guide, and the recommended spacing for the intermediate guides and supports. The Primary guide spacing's shown are for use with standard wall pipe and are satisfactory for above ground and tunnel installations. They are applicable to the following:

a. Single Expansion Joints **with integral anchor base** or Single Expansion Joints installed immediately adjacent to an anchor.

b. Double Expansion Joints.

2. When a Single Expansion Joint **without base** is installed in the center, or approximate center, of a pipe run, the primary guide spacing must be modified as follows:

a. Sizes 1-1/2" to 4" inclusive: Primary guides should be located six (6) pipe diameters from each end of the expansion joint.

b. Sizes 5" to 24" inclusive: Primary guides should be located three (3) pipe diameters from each end of the expansion joint.

c. To preclude the possibility of cocking the slip on heavier expansion joints, 6" and larger, a sliding support under the expansion joint is recommended.

3. Whenever possible, valves or other heavy accessories should not be installed in the pipe run between the slip and the first guide. Where this is not possible, the valve or accessory must be supported on a sliding support.

4. Installations using a buried conduit system with expansion joints installed in manholes or vaults, require guiding at the manhole wall. Properly sized and installed gland and link seals are considered adequate guiding. In addition, consideration should be given to installation of a "moment" guide within 10 ft. of the manhole wall. Moment guides should not be attached to the manhole wall. "BRONZALON®" low friction guide inserts should be used with all expansion joints used in buried conduit systems.

5. PIPE GUIDE/SUPPORT SELECTION: Refer to the ATS" Pre-Engineered Supports, Guides & Anchor" catalog for detailed information concerning guides and supports.

PRIMARY GUIDE: The preferred design for primary guides are those that guide the pipe to allow only axial movement, such as the ATS "GA" Radial Pipe Guide, or the ATS Fig 101 and Fig 100 Low Friction Pipe Guide.

INTERMEDIATE GUIDES: The ATS Fig 101 and Fig 100 Low Friction Pipe Guide are recommended for intermediate guides.
Supports: The ATS Fig 201 and Fig 200 Low Friction Pipe Supports are recommended for all pipe support locations.

NOTE: Roller supports should not be considered low friction supports. While rollers almost always roll when first installed, normally after a period of time the rolling mechanism will corrode, greatly increasing the friction force transmitted back to the pipe anchor.

6. The pipe support spacing shown in Table 5 is the maximum span as specified by the ASME/ANSI Power Piping Code B31.1, and is applicable for horizontal straight runs of pipe, without concentrated loads such as valves or heavy fittings between supports. The span distance applies to standard weight or heavier pipe operating at a maximum temperature of 750°F (400°C).

7. LATERAL FORCES ON GUIDES: Pipe alignment guides and their support structures may be subjected to lateral forces in addition to the frictional forces along the longitudinal axis of the pipe. It is recommended that both the pipe guide and support structure be designed to resist a lateral load force equal to 250 lb. /inch of nominal pipe diameter.

Table 5: Pipe Alignment Guide and Support Spacing - (per B 31 piping code) (for expansion joints with base)

NOMINAL PIPE SIZE (NPS)	PRIMARY (1st) GUIDE FROM END(S) OF SLIP (feet)	INTERMEDIATE GUIDE SPACING (feet)				PRE-SUPPORT SPACING (feet)	
		PRESSURE (psig)					
		100	150	300	400	WATER	STEAM
1½	1½	8	8	7	7	8	10
2	2	9	9	8	8	10	13
2½	2	12	12	11	11	11	14
3	3	15	15	12	12	12	15
4	4	20	20	18	16	14	17
5	6	28	27	25	22	16	18
6	6	35	33	30	27	17	21
8	8	48	45	40	35	19	24
10	8	65	60	55	50	22	27
12	12	75	70	60	55	23	30
14	12	80	75	65	60	25	32
16	16	90	85	75	70	27	35
18	20	100	95	85	80	28	37
20	20	110	105	95	90	30	39
24	25	130	125	110	100	32	42

Sample Pipe Layout

On the Page 18 is a sample pipe layout showing locations of expansion joints, pipe anchors, pipe guides and pipe supports. The formulas for calculating the forces on each anchor are given. A more detailed example of the same model layout is available from ATS.
Ask for **Engineering Bulletin EJ-1091.**

Key To Symbols:

F - Anchor Force, lbs.

NOTE: This force acts along the longitudinal axis of the pipe run.

P - System Design Pressure, psig.

NOTE: The test pressure should be considered when designing the anchors. The stresses for steel components at the test pressure should not exceed 80% of the materials' minimum yield strength.

a - Effective Thrust Area of the expansion joint, in^2
See Table 4, (Page 15).

K - Packing Friction Constant, 1000 lbs.

NOTE: For systems with an operating pressure above 300 psig, consult the factory for the appropriate packing friction constant.

D - Nominal Pipe Size, in.

L - Length of Pipe Run, ft.

A - Internal Area of Pipe, $ft.^2$

ρ - Fluid Density, $lbs./ft.^3$

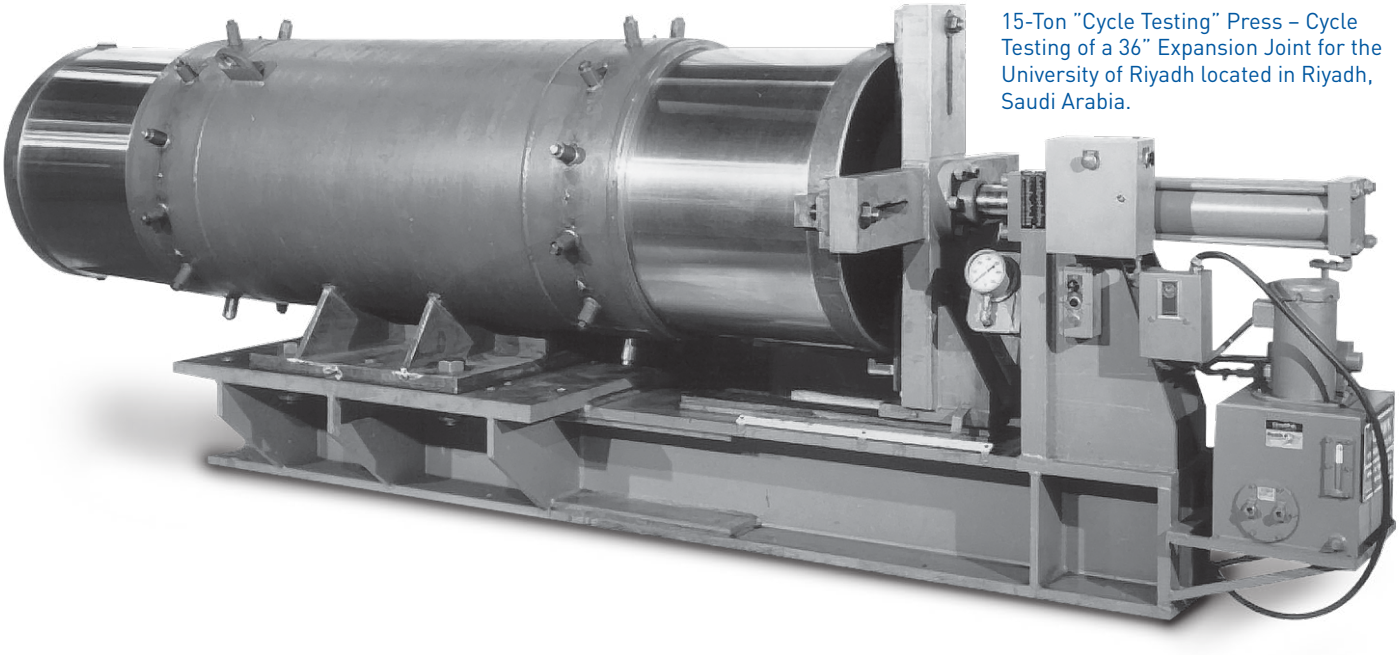
V - Velocity of Fluid, ft./sec.

g - Acceleration Due to Gravity, 32.2 $ft./sec.^2$

θ - Angle of Pipe Bend.

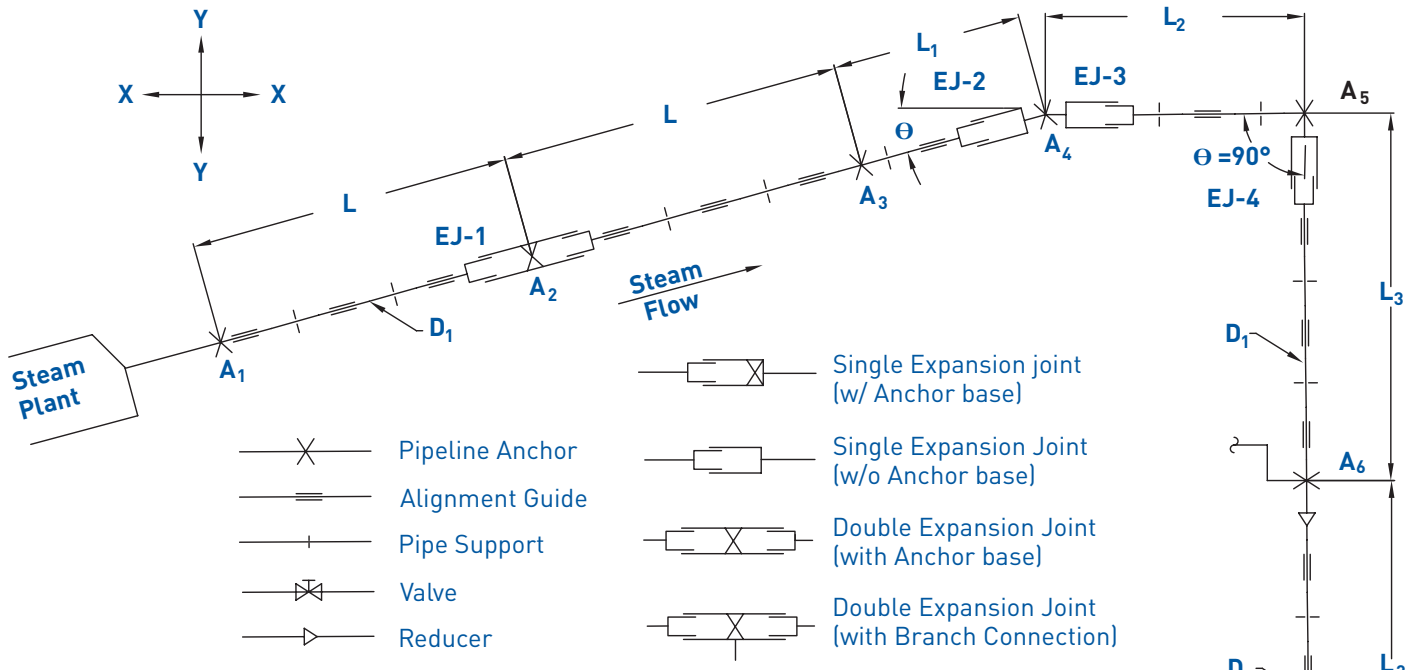
ATS offers pre-engineered pre-fabricated anchors that provide the assurance of knowing the anchor will be properly designed and fabricated to meet the application requirements. Designs are easily modified to accommodate various centerline height and load requirements. ATS can supply the anchor attached to a heavy wall pipe spool section, either with ends machined to match the mating pipe, or as a loose assembly for field attachment. Branch connections up to the size of the pipe run can be incorporated for simplified field installation.

Refer to the ATS Pre-Engineered Supports, Guides & Anchor Catalog for a complete description of ATS Anchors.



15-Ton "Cycle Testing" Press – Cycle Testing of a 36" Expansion Joint for the University of Riyadh located in Riyadh, Saudi Arabia.

Expansion Anchor Load Calculations



MAIN ANCHORS

$FA_1=F_p+F_c+F_s\frac{L}{100}$ — FA_1

$FA_4=(F_1+F_2)\sin\frac{\theta}{2}$
$F_1=F_2=F_p+F_c$
$FA_4=2(F_P+F_C)\sin\frac{\theta}{2}$

$\emptyset=90-\frac{\theta}{2}$; FA_4, F_1, F_2

$FA_5=\sqrt{F_3^2+F_4^2}$
$F_3=F_p+F_c+F_s\,(L_2/100)$
$F_4=F_p+F_c$
when $F_3=F_4=F$
$FA_5=(1.414)(F)$

FA_5, F_3, F_4, $\text{Tan}\emptyset = F_4/F_3$

$FA_{6(Y-Y)}=F_5-F_6$
$F_5=pa_1+KD_1+F_{s1}\,(L_3/100)$
$F_{6(Y-Y)}=pa_2+KD_2+F_{s2}\,(L_3/100)$
$FA_{6(X-X)}$= See note 2

F_5, M, $F_{(x-x)}$, F_6

$FA_{7(Y-Y)}=F_c=KD_2$
$FA_{7(X-X)}$= See note 2

F_c, M, $F_{(x-x)}$

$FA_{8(Y-Y)}=F_c+F_s\,(L_3/100)$ (Valve V_2 open)
$FA_{8(Y-Y)}=F_p+F_c+F_s\,(L_3/100)$ (Valve V_2 closed)
$FA_{8(X-X)}$= See note 2

FA_8, $F_{(x-x)}$

$FA_9=F_p+F_c$ (Valve V_2 open)
$FA_9=0$ (Valve V_2 closed)

FA_9

INTERMEDIATE ANCHORS

$FA_2=F_c+KD_1$ — FA_2
$FA_3=F_c+F_s\frac{L}{100}$ — FA_3

NOTES

1. INTERMEDIATE ANCHORS
It is recommended that all intermediate anchors be designed based upon the highest calculated forces for any given intermediate anchor.

2. BRANCH CONNECTIONS
The forces and moments at branch connections (X-X direction on piping schematic) must be considered when designing the anchors at these junctures.

3. TRANSIENT LOAD FACTOR
It is recommended that a transient load factor of 15% be added to the calculated forces and moments at all pressure surges and/or other unknown conditions which may occur during the operating life of the system.

SAMPLE CALCULATIONS OF ANCHOR FORCES A_1 TO A_9 ALONG AXIS OF PIPELINE FURNISHED ON REQUEST.

ANSI B36.1 Carbon Steel Pipe Schedule

PIPE SIZE (NPS)	OUTER DIAMETER (in.)	5	10	20	30	40	STD	60	80	E.H.	100	120	140	160	DBL. E.H.
⅛	0.405	.035 .138	.049 .1863			.068 2.447	.068 2.447		.095 .3145	.095 .3145					
¼	0.540	.049 .2570	.065 .3297			.088 .4248	.088 .4248		.119 .5351	.119 .5351					
⅜	0.675	.049 .3276	.065 .4235			.091 .5676	.091 .5676		.126 .7388	.126 .7388					
½	0.840	.065 .5383	.083 .6710			.109 .8510	.109 .8510		.147 1.088	.147 1.088				.187 1.304	.294 1.714
¾	1.050	.065 .6838	.083 .8572			.113 1.131	.113 1.131		.154 1.474	.154 1.474				.218 1.937	.308 2.441
1	1.315	.065 .8678	.190 1.404			.133 1.679	.133 1.679		.179 2.172	.179 2.172				.250 2.844	.358 3.659
1¼	1.660	.065 1.107	.109 1.806			.140 2.273	.140 2.273		.191 2.997	.191 2.997				.250 3.765	.382 5.214
1½	1.900	.065 1.274	.109 2.638			.145 2.718	.145 2.718		.200 3.631	.200 3.631				.281 4.859	.400 6.408
2	2.375	.065 1.604	.109 2.638			.154 3.653	.154 3.653		.218 5.022	.218 5.022				.343 7.444	.436 9.029
2½	2.875	.083 2.475	.120 3.531			.203 5.793	.203 5.793		.276 7.661	.276 7.661				.375 10.01	.552 13.70
3	3.500	.083 3.029	.120 4.332			.216 7.576	.216 7.576		.300 10.25	.300 10.25				.437 14.32	.600 18.58
3½	4.000	.083 3.472	.120 4.973			.226 9.109	.226 9.109		.318 12.51	.318 12.51					.636 22.85
4	4.500	.083 3.915	.120 5.613			.237 10.79	.237 10.79	.281 12.66	.337 14.98	.337 14.98		.437 19.01		.531 22.51	.674 27.54
4½	5.000						.247 12.53			.355 17.61					.710 32.53
5	5.563	.109 6.349	.134 7.770			.258 14.62	.258 14.62		.375 20.78	.375 20.78		.500 27.04		.625 32.96	.750 38.55
6	6.625	.109 7.585	.134 9.289			.280 18.97	.280 18.97		.432 28.57	.432 28.57		.562 36.39		.718 45.30	.864 53.16
7	7.625						.301 23.57			.500 38.05					.875 63.08
8	8.625	.109 9.914	.148 13.40	.250 22.36	.277 24.70	.322 28.55	.322 28.55	.406 35.64	.500 43.39	.500 43.39	.593 50.87	.718 60.63	.812 67.76	.906 74.69	.875 72.42
9	9.625						.342 33.90			.500 48.72					
10	10.750	.134 15.19	.165 18.65	.250 28.04	.307 34.24	.365 40.48	.365 40.48	.500 54.74	.593 64.33	.500 54.74	.718 76.93	.843 89.20	1.000 104.1	1.125 115.7	
11	11.750						.375 45.55			.500 60.07					
12	12.750	.156 21.07	.180 24.20	.250 33.38	.330 43.77	.406 53.53	.375 49.56	.562 73.16	.687 88.51	.500 65.42	.843 107.2	1.000 125.5	1.125 139.7	1.312 160.3	
14	14.000	.156 23.06	.250 36.71	.312 45.68	.375 54.57	.437 63.37	.375 54.57	.593 84.91	.750 106.1	.500 72.09	.937 130.7	10.93 150.7	1.250 170.2	1.406 189.1	
16	16.000	.165 27.90	.250 42.05	.312 52.36	.375 62.58	.500 82.77	.375 62.58	.656 107.5	.843 136.5	.500 82.77	1.031 164.8	1.218 192.3	1.437 223.5	1.593 245.1	
18	18.000	.165 31.43	.250 47.39	.312 59.03	.437 82.06	.562 104.8	.375 70.59	.750 138.2	.937 170.8	.500 93.45	1.156 208.0	1.375 244.1	1.562 274.2	1.781 308.5	
20	20.000	.188 39.78	.250 52.73	.375 78.60	.500 104.1	.593 122.9	.375 78.60	.812 166.4	1.031 208.9	.500 104.1	1.280 256.1	1.500 296.4	1.750 341.1	1.968 379.0	
24	24.000	.218 55.37	.250 63.41	.375 94.62	.562 140.8	.687 171.2	.375 94.62	.968 238.1	1.218 296.4	.500 125.5	1.531 367.1	1.812 429.4	2.062 483.1	2.343 541.9	

Return for Credit

No returns for credit shall be accepted unless sellers permission has been obtained in each case in advance. Only sizes and designs taken from the sellers standard catalog line, which are in active demand, can be accepted for credit. Obsolete or specially manufactured products cannot be accepted for return or credit. For further information pertaining to Advanced Thermal Systems, Inc. Return Policy, please contact Customer Service.

ATS Thermal Pak "TP2" Expansion Joint 5-Year Warranty And Replacement Guarantee

Warranty Terms

Advanced Thermal Systems, Inc.Thermal Pak "TP2" Expansion Joints are sold subject to the mutual agreement that they are warranted by ATS to be free from defects in material and workmanship but ATS's liability and the buyer's exclusive remedy shall be limited to replacement without charge, at ATS's factory of any material defects which become apparent within one year of the date of shipment, and which shall be determined to be defective by ATS upon their return to the factory, freight prepaid. ATS may opt to provide a refund of the purchase price and that ATS shall have no liability for damages of any kind, direct or indirect, arising from an installation and/or use of any material and by accepting the material the buyer will assume all liability for any damages, direct or consequential, which may result from issue or misuse.

Replacement Guarantee

In addition, ATS guarantees the satisfactory performance of ATS Thermal Pak "TP2" Expansion Joint for a period of five years from date of shipment. Provided only, that the Thermal Pak "TP2" Expansion Joints are installed and operated in accordance with ATS prescribed standards. ATS will either replace or repair, without charge, FOB ATS factory any Packed Expansion Joint which fails to give five years' service under these prescribed conditions.

5-Year Leak-Free Warranty

For Application to 300 psig - 800° F

In the event of leakage at the "TP2" stuffing box, spare "HPI®" packing plugs will be furnished at no charge for a period of 5-years from the date of shipment when the "TP2" is factory packed with "HPI®" injectable packing and equipped with BRONZALON® or HC800 low friction guide inserts.

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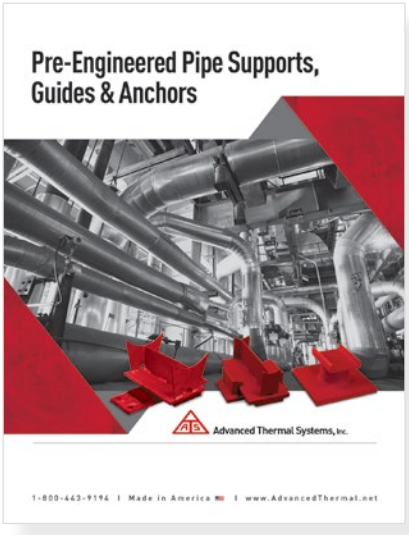
Thermal Pak Flexible Ball Joints



Pre-Engineered Pipe Supports, Guides & Anchors

"The bitterness of poor quality remains long after the sweetness of a low price is forgotten"

— Benjamin Franklin