EXPANSION JOINT SPECIFICATION

Facility: XXX

Engineering Contract: XXX
Contracting Contact: XXX

Inquiry Number: XXX

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1.0 GENERAL

1.1 SCOPE - Design, Fabricate and ship equipment as described herein and on the separate data sheet. It is the vendor's responsibility to design and fabricate an expansion joint to meet the reliability and service life requirements of this specification. Compliance with the minimum requirements and /or materials specified in this specification or in other referenced specifications, practices, standards and codes, shall not release the expansion joint manufacturer from his responsibility to provide an expansion joint with maximum reliability with regard to the stated design code.

1.1.1 This specification, with the individual data sheets, establishes the minimum requirements for mechanical design, materials, fabrication, inspection, and testing of metal expansion joints for the [CUSTOMER].

1.1.2 Any deviation or exception from this specification shall be submitted in writing with the vendor's bid. The deviation or exception must be reviewed and approved by [CUSTOMER] in writing prior to be incorporated as part of this contract.

1.2 CODES

1.2.1 Fabricate all pressure components, in strict accordance with this specification and the code indicated on the data sheet.

1.2.2 The design of the joints shall comply with all requirements of the Expansion Joint Manufacturers Association (EJMA), latest edition.

1.2.3 The vendor shall have a quality assurance program complying with ASME Section VIII, division 1 for components. "U" stamp is not required unless specifically stated on the data sheet. As an alternative, ISO-9001 certification with all welding complying with ASME Section IX is acceptable. A copy of vendor's quality assurance compliance certificate shall be submitted with the inquiry.

1.2.4 All pressure retaining / containing material shall be ordered in accordance with ASME / ASTM specifications. Mill certificates and complete material tractability are required.

1.2.5 The vendor shall comply with any local rules, regulations and/or codes specified and attached to this specification.

2. DESIGN

2.1 GENERAL

2.1.1 The joints will be installed in lines carry process gas with particulate matter, or air at elevated temperatures. Design data sheets indicate service, design pressure, design temperature, and other requirements for each joint.

2.1.2 Design the bellows elements for a minimum spring rate compatible with these temperatures, pressures, and requirements.

2.1.3 Basic joint design is shown on the attached data sheets. These details are general pictorial representations of the required components. The fabricator shall be responsible for the actual design and detailing of all components on the expansion joint.

2.1.4 The joints shall be designed for continuous operation at the temperatures and pressures shown on the data sheets.

2.2 DESIGN LIFE

2.2.1 The expansion joints shall be designed to with stand a minimum of fifteen years at the pressures and temperatures stated in this specification.

2.2.2 The design temperature for all pressure containing components shall be the full flow temperature unless a reduced design temperature is justified using accepted heat transfer calculations. Calculations shall be submitted with the vendor's proposal for review and approval.

2.3 MOVEMENTS

2.3.1 All movements stated are the total movement including the expansion joints length.

2.3.2 The joint shall be designed to accommodate all stated movements acting simultaneously on either side of the pipe axis.

2.4 BELLOWS

2.4.1 The bellows elements shall be designed in accordance with the reference codes. Final heat treatment of the bellows elements shall be in accordance with the manufacturer's stand procedures. When the media temperature exceeds 900°F, the bellows operating temperature shall be controlled to prevent the element from operating in the creep range (850°F) or below the dew point of entrained gases in the media (400°F). This will be accomplished through the use of both an internal and external insulation pillows, unless otherwised specified. The vendor shall submit heat transfer calculations to substantiate the bellows operating temperature and the design of the insulation pillows. This requirement supercedes the data sheet.

2.4.2 Each bellows shall have a minimum of 3 convolutions.

2.4.3 Bellows are to be punch formed or hydraulically formed. Roll formed bellows are not acceptable. Supplier shall specify the method of forming in the bid.

2.4.4 The bellows shall be formed from a tube having only longitudinal seams. The number of longitudinal seams shall be minimized and no two seams shall be closer than 6". No repair of the longitudinal seams is allowed.

2.4.5 The forming of the bellows shall be done in such a manner as to prevent galling or tool marks on the convolutions. Any evidence of such damage will be cause for rejection of the part.

2.4.6 Longitudinal welds shall have a finished thickness prior to forming equal to the thickness of the parent metal with a tolerance of –0%, + 10% and shall be full penetration welds.

2.4.7 The crown of individual convolutions formed by expanding internal pie-shaped dies shall be smooth, circular and free of punch marks. Subsequent rolling to remove the irregularities of forming is not acceptable. Re-rolling is allowed only to size the bellows to the proper pitch. Any indications may be grounds for rejection of the bellows.

2.5 HINGES / GIMBALS

2.5.1 Hinge plates on hinge and gimbal joints shall be designed with the hinge pins in double shear.

2.5.2 The hinge pins shall be a different material then the hinge plates. The vendor shall attempt to maximize the hardness of the two materials as measured by the brinnel hardness value.

2.5.3 Hinge arms on hinge and gimbal units shall be equipped with angulation indicators. The movement indicators shall be a minimum of 18" long and have a graduated scale showing movement in ½° increments.

2.5.4 The arms of gimbal units shall provide a gap between the gimbal ring and the hinge arms to allow for the differential thermal expansion of the gimbal ring versus the attachment hardware to carry the specified dead load forces in addition to the specified pressure and vacuum thrust loads.

2.6 TIE RODS

2.6.1 Tie rods shall be designed for the system pressure thrust in addition to the specified external loads.

2.6.2 Attention shall be given to the support and control of the center spool. The stability of the center spool shall be calculated and submitted with the vendor's bid.

2.6.3 The tie rod nuts shall be tack welded in place, double nutted or equipped with cotter pins.

2.6.4 Units designed for a negative pressure, vacuum, shall use pipe tie rods. Threaded rod shall not be used.

2.6.5 The tie rods shall be designed to extend past the line insulation and shall not contact the insulation under any condition.

2.7 LINERS

2.7.1 When required by the data sheet, the vendor shall provide liner(s) in accordance with the additional requirements of paragraph 6.

2.7.2 If the vendor sees a need for liners where none have been specified, he should so state in his proposal.

2.7.3 Joints equipped with liners shall have the flow direction clearly painted on either side of the unit.

2.7.4 When located on a vertical run and not refractory lined, the liner shall have a sufficient number of drain holes to allow any condensate to drain.

2.8 COVER

2.8.1 When required by the data sheet, the vendor shall provide cover(s) in accordance with the additional requirements of paragraph 6.

2.8.2 The vendor shall equip the unit with a mechanical shield which protects the outside diameter of the bellows. The cover material is stated on the individual data sheets. It shall be removable to allow inspection of the bellows elements. The cover shall be fabricated in a minimum of two sections and a maximum of four sections. When the joint is located in a vertical line, the cover shall be mounted on the top end.

2.9 HARDWARE ATTACHMENTS – When hardware is attaching to pipe which is operating above 800°F, special care must be taken to eliminate differential thermal growth of the hardware and the pipe. The vendor shall prepare hardware attachment design calculations, which address this problem. The use of floating hardware is required.

When required by the data sheet, all hinge, gimbal and tie rods shall be designed with sufficient room to allow a second, oversized, clamshell bellows to be installed.

2.10 LIFTING LUGS

2.10.1 Provide suitable lifting lugs for use in handling the assemblies safely during shipment and for rigging in the field.

2.10.2 The lugs that are welded to the shell sections shall be of the same material as the shell.

2.10.3 The detail and location of the lifting lug shall be subject to approval prior to fabrication.

3.0 <u>FABRICATION</u>

3.0.1 Oxygen or electric arc processes shall not used to cut nickel and nickel-copper alloy materials.

3.0.2 There shall be no weld, other than a longitudinal seam, closer than 8 times the pipe or plate thickness to the bellows attachment weld.

3.1 SHOP DRAWINGS - The vendor shall produce shop detail drawings and calculations for each expansion joint and submit them for review and approval. Fabrication shall not commence until the reviewed drawings and calculations have been returned to the vendor stamped "APPROVED FOR FABRICATION" or "APPROVED WITH COMMENT". In the event they are stamped "APPROVED WITH COMMENT" the vendor shall revise the drawings and/or calculations in accordance with the comments and proceed with fabrication. The vendor shall record all modifications and at the end of the project shall resubmit them as "AS-BUILT DRAWINGS" and "AS-BUILT CALCULATIONS".

3.2 PIPE

3.2.1 The fabrication of the pressure containing sections shall be in strict accordance with the referenced code, this specification and the attached data sheet. Fabricated pipe shall meet all of the requirements for the specified fabrication code. As a minimum all fabricated pipe shall be double butt welded with the interior welds ground smooth. All pipe shall be round in accordance with the tolerances of section 3.5.

3.2.2 Weld ends shall be furnished with a bevel cut at 37 ½° with a 1/16" land unless otherwise specified on the data sheet. The cut shall not vary more than 1/8" out of plane and all burrs shall be removed.

3.2.3 The schedule or wall thickness of weld ends specified on the data sheet are those of the mating pipe. When expansion joint weld ends exceed this value, the ends shall be machined at a 3:1 taper to match the mating pipe.

3.3 WELDING

3.3.1 All welding, welder qualifications and weld procedures shall comply with ASME Section IX. Certificates and documentation to be available to the owners inspector.

3.3.2 Weld procedures and weld maps shall be submitted for review and approval when required by the attached data sheets.

3.3.3 Bellows shall be protected from weld splatter at all times. Any evidence of weld splatter or spray on the bellows will be grounds for rejection of the bellows.

3.4 MATERIALS

3.4.1 All components requiring welding shall be, as a minimum, carbon steel containing a maximum carbon content of 0.35%. Free-machining steel shall not be used.

3.4.2 All material shall be as specified in the data sheets.

3.4.3 Attachments welded directly to the pipe shall be of the same material as the pipe unless specifically noted otherwise.

3.4.4 Any substitution of materials must be reviewed and approved by the customer.

3.5 TOLERANCES

3.5.1 The expansion joints shall be fabricated to the general tolerances specified by the ASME B31.3 code and EJMA, latest editions.

3.5.2 The flange bolt holes shall straddle the normal centerlines unless otherwise noted. The maximum allowable rotation of the flange bolt pattern from the indicated position shall be 1/16 inch.

3.6 FLANGES

3.6.1 The following section is not applicable to angle flanges or low pressure (less than 2 psig) service plate flanges.

3.6.2 The sealing surfaces of the machined flanges shall be flat to provide for proper seating of the gasket.

3.6.3 Allow stock for a final finish machining of the gasket face after the flange has been welded to the adjoining section.

3.6.4 The finished surface shall be flat within 0.020 inches total indicator reading. Machine to 120-130 RMS finish.

3.7 SUPPORT RINGS

3.7.1 When required by the data sheets, support / fit up rings shall be supplied in accordance with this section.

3.7.2 Furnish external end support rings on ends not flanged, or otherwise supported, to maintain the shop roundness tolerance at +/- 3/8" of the measured circumference from the theoretical value. Out of roundness shall be limited to +/- ¼" measured diametrically.

3.7.3 The rings shall be bored 1/8" larger in diameter than the shell as determined by taping and the shell then rounded to fit the rings without deforming them.

3.7.4 End support rings shall be 3" by ½" for diameters up to and including 48", 4" by ¾" for diameters greater than 48" and less than or equal to 66"; and 6" by 1" for diameters greater than 66".

3.7.5 The 3 inch wide rings shall have (4) 7/8" diameter holes, equally spaced on a bolt circle 1 ½" in from the outside diameter. The 4" wide rings shall have (6) 7/8" diameter holes, equally spaced on a bolt circle 2" in from the outside diameter. The 6" wide rings shall have (8) 7/8" diameter holes, equally spaced on a bolt circle 3" in from the outside diameter.

3.7.6 The end support rings are to be placed 3" inches from the ends of the shell sections.

3.7.7 The rings are carbon steel and welded to the shell ends by staggered intermittent welds in accordance with the weld summary. They shall be removed after field construction welds have been made by carefully grinding down to the shell without undercutting and checking the area with liquid penetrant examination.

4.0 INSPECTION AND REPORTS

4.1 INSPECTION

4.1.1 The owner's authorized inspector shall be allowed to check materials, fabrication and tests at any time. The examiner or the inspector may require tests and repairs or replacement of any material or work not in accordance with this specification, the applicable codes or the applicable ASTM material specification.

4.1.2 Any rejections by the inspector shall be final However, acceptance by the inspector shall in no way release the supplier from guarantees as to materials, workmanship, and performance of equipment

4.1.3 The vendor shall notify the Owner's Engineer at least five days before start and completion of fabrication hold points, specified testing and/or preparation for shipment.

4.2 VISUAL EXAMINATION

4.2.1 Visually inspect all welds for completeness, excess crown reinforcement, and evidence of undercutting.

4.2.2 Where possible, inspect all welds internally for burn-through, excess crown, lack of penetration of fusion, and weld spatter, flux or icicles. Repair all defects found.

4.2.3 Check all sections for alignment and dimensions.

4.3 RADIOGRAPHY

4.3.1 Unless otherwise noted on the data sheets, the following applies to all pressure containment and / or retaining welds other than the welds on the convoluted bellows element.

4.3.2 Shop welds shall receive the level of radiographic inspection indicated on the attached data sheet or as required by the pipe fabrication specification.

4.3.3 When spot radiograph is required, one shot per seam is required for each circumferential and longitudinal seam. Circumferential seam shot shall be located at a junction of the circumferential seam with the longitudinal seam. Two additional shots, equally spaced, are required for each circumferential seam of all mitered elbows.

4.3.4 Results shall be interruption in accordance with the ASME Pressure Vessel and Boiler Code, Section VIII, UW52.

4.4 REPAIRS

4.4.1 If radiographs reveal defective welds, the welds shall be repaired and the weld re-examined. If a bellows element weld seam is deemed unacceptable, it shall not be repaired. The bellows will be scrapped and a new element fabricated.

4.4.2 Additional radiographs shall be taken in accordance with ASME Section VIII, Division I, Paragraph UW 51c, (2).

4.5 LIQUID PENETRANT

4.5.1 When specified on the data sheet or required by the pipe fabrication specification, all austenitic stainless steel welds shall receive 100 percent liquid penetrant examination of the root and final weld pass. The examination shall be made in accordance with ASME Section V and the applicable code. Owner's examiner inspector may witness this test.

4.5.2 In addition, when specified on the data sheet, the longitudinal seam weld of the bellows element shall receive 100 percent liquid penetrant examination after forming in accordance with ASME Section V and the applicable code. Owner's examiner inspector may witness this test.

4.6 PROOF TESTING

4.6.1 Hydrostatic or pneumatic testing may be required. The test shall be performed in accordance with the ASME Section VIII, division 1 code. The calculated bellows operating temperature may be used in determining the code required hydro test pressure. A pneumatic test may be substituted instead of a hydro test, however, the vendor should be aware of the inherent dangers of an air test and accept this responsibility. Pneumatic testing is required on all refractory lined and internally insulated joints.

4.6.2 Low chloride water (50 ppm maximum) shall be used where stainless steel is present.

4.6.3 The unit shall be drained and dried by forced air after the hydro test.

4.6.4 All pressure thrust carrying hardware shall be exposed to the full pressure thrust during the pressure test. There shall be no supplemental restrains used to prevent squirm during the pressure test.

4.7 REPORTS

4.7.1 The fabricator shall furnish copies of the following reports when applicable.

4.7.2 Mill test and chemical analysis report from the line or fitting manufacturer as required by the applicable ASTM material specifications. It may be reviewed by the owner's authorized inspector before shipment of the joints.

4.7.3 Fabricator's report on test of welding operators, in accordance with Section IX of the ASME Code. It may be reviewed by the owner's authorized inspector before start of fabrication.

4.7.4 Copies of the time-temperature cycle report for each post weld heat treat or annealing heat cycle used during fabrication. These reports shall identify the number of all joints treated for each heat cycle. The complete temperature cycle of heating, soaking, and cooling shall be shown. They may be reviewed by the owner's authorized inspector before shipment of the joints.

4.7.5 Shop test records. They may be reviewed by the owner's authorized inspector before shipment of the joints.

5.0 PREPARATION FOR SHIPMENT

5.1 CLEANING

5.1.1 The joints shall be clean and dry inside and outside. All loose scale, weld spatter, shop dirt, and debris shall be removed before shipment.

5.1.2 The completed assemblies shall be lightly sand or walnut shell blasted to remove grinding marks, assembly markings, grease or other foreign material.

5.2 IDENTIFICATION

5.2.1 Electro-etch / weld deposit the item number on the inlet rim.

5.2.2 Furnish a stainless steel tag bearing the item number, purchase order number, direction of flow, offset, design information, rated movement capacity and production drawing. The tag information shall be shown on the shop drawings and submitted for approval.

5.2.3 Paint a flow arrow and direction of offset on two opposite sides of the joint near the center.

5.2.4 Any marking of austenitic stainless steel and non-ferrous alloys shall be done using a paint or ink which contains no harmful metal or metal salts. These harmful chemicals include zinc, lead, copper, or any other ingredient which upon heating causes corrosive attack of the base metal.

5.2.5 On joints with external insulation, locate the identification tag on a part of the joint which will not be covered by insulation or provide a standoff.

5.3 PAINTING

5.3.1 Shop painting of non stainless steel parts shall be in accordance with the attached data sheets.

5.3.2 The painting subgroup will be indicated on the individual expansion joint data sheet.

5.4 PROTECTION FOR SHIPMENT

5.4.1 The joint must be thoroughly cleaned and free of all moisture prior to shipment.

5.4.2 The joint shall be totally enclosed and heat seal the joint in a polyethylene plastic envelope, 6 mils minimum thickness, when required by the data sheets.

5.4.3 A copy of installation instructions and production drawing shall be placed in a plastic envelope enclosed in the joint.

5.4.4 The joint shall then be mounted on skids or supports in such a manner so that the bellows are protected from vibration fatigue due to external loads from the mode of transportation selected.

5.4.5 Details of protection for shipment shall be shown on the shop fabrication drawings.

5.4.6 Export packaging shall be required, when specified by the attached data sheets. The units shall be encased in a wood or metal container capable of withstanding ocean transport.

5.5 PRESET

5.5.1 Ship the joints preset to the installed length and offset by means of shipping bars.

5.5.2 The shipping bars shall be sized to allow handling and rigging of the joint during shipment and erection.

5.5.3 On hinge and gimbal joints the bars should be threaded and sized to rotate the joints through the full design capability.

5.5.4 Paint all temporary shipping bars and rods yellow and tag with “REMOVE AFTER INSTALLATION”.

5.5.5 The preset may be verified by direct measurement by the owner’s authorized inspector prior to shipment.

6.0 **DATA SHEET SPECIAL REQUIREMENTS** – The following requirements apply when they have been specified on the appropriate data sheet.

6.1 DESIGN CODE – The design code as a minimum will be the EJMA standards. Additional codes are as indicated on the data sheet. When a conflict exists between codes, the most stringent code governs.

6.2 ASME B31.3 Process Piping Code, Latest edition. The bellows element shall meet all requirements of the mandatory appendix X.

6.3 ASME Section VIII, Div 1, Boiler and Pressure Vessel Code, Latest edition. The bellows element shall meet all requirements of the mandatory appendix BB. A “U” stamp will be required if indicated on the data sheet.

6.4 CYCLE LIFE CALCULATION CODE – The minimum required number of calculated cycles shall be 2,000 cycles in accordance with the EJMA Standards. Optional bases are indicated on the data sheet and shall govern when specified.

6.5 MULTIPLE MOVEMENT CONDITIONS, when specified on the data sheet, a cumulative fatigue cycle life analysis shall be performed and submitted for review and approval. The analysis shall comply with ASME Section VIII, division 2.

6.6 MAXIMUM REACTIONS / SPRING RATES – Are the maximum forces and moments that the bellows can develop as the result of thermal and/or mechanical deflection.

6.7 EXTERNAL FORCES AND MOMENTS – Are the forces and moments that the system will transfer through the expansion joint hardware. Pressure thrust must be added to these values. When the pressure thrust reduces the specified values, the worst case shall be used in designing the expansion joint hardware.

6.8 TWO PLY TESTABLE BELLOWS

6.8.1 When a two ply testable bellows element is specified on the attached data sheet, the bellows shall be designed to satisfy all of the design requirements with a single ply bellows, then a second redundant ply shall be added. The two plies shall be resistance seam welded together at each end prior to welding to the shell. The cuff shall be trimmed through the weld nugget. The bellows shall be baked out after resistance welding to remove any water trapped between the plies. Each two ply testable bellows shall be equipped with two ports. One test port and a flow port located 180° opposite and on the opposite end to the test port. Peanut welding of the two plies is not allowed.

6.8.2 The vendor shall submit calculations substantiating the bellows design in both the single ply and two ply conditions. Both cases shall satisfy all requirements of this specification. Calculations shall be submitted with the vendor's bid.

6.8.3 Each element shall be equipped with (2) two ports mounted 180° apart and on opposite ends of the element.

6.9 BELLOWS ANNEALING – Annealing, unless specified on the data sheet, is left to the manufacturer's standard. If specified on the data sheets, the annealing shall be performed after forming of the bellows is complete. The anneal must be in an inert atmosphere and the bellows shall be temporarily supported to prevent heat distortion.

6.10 X-RAY INSPECTION – When specified on the data sheet shall be performed prior to forming of the convolutions. If two plies are specified, each ply shall be inspected separately. The X-Ray shall be water clear as defined by ASME Section VIII, UW51.

6.11 PT INSPECTION of attachments requires that the bellows attachment welds and longitudinal weld seam(s) be 100% dye penetrant inspected. No indications of any kind are acceptable.

6.12 TWO PLY TEST - Prior to shipment, the vendor shall pressurize the space between the plies to 15 psig. The pressure shall equalize across the ports within 2 minutes of the start of the test. The bellows shall then be isolated from the pressure source and the pressure maintained for a minimum of 30 minutes. A pressure drop in excess of 2 psig will be grounds for rejecting the bellows element.

6.13 LINER – A standard liner shall consist of a stainless steel sheet metal tube attaching on the upstream end and extending past the downstream bellows attachment point. The liner shall be designed to cover the downstream attachment by a minimum of 1" in any movement conditions. The liner shall be designed in accordance with the standards of EJMA.

6.13.1 FLUSH BORE LINER – The vendor shall fabricate the unit so that the inside diameter of the liner is the same bore as the adjacent pipe. The line pipe shall be expanded to provide a smooth pipe transition. The diameter of the bellows shall be calculated to provide sufficient room for the bellows deflection and any internal insulation. Welded cone instead of expanded pipe is not acceptable,

6.13.2 LINER SEAL - The vendor shall provide a wire-braided hose of at least twice the minimum clearance between the pipe and the liner. This hose shall be stuffed with loose fill Kaowool insulation and then retained in place by 3/16"dia x 6" long clips at 6" on center. The clips will be interlocking and at least 3" upstream of the edge of the liner. The liner seal material shall be S/S tp 309.

6.13.3 VANSTONE LINER – Shall not be welded to the unit. It shall be a lap joint or vanstone design. The dimensions for the flange-facing surface shall extend to the outside diameter of a raised face flange. The thickness shall be no less than the liner thickness.

6.14 COVER – When specified, the minimum requirement shall be a two piece metal cover that bolts on and shall have sufficient clearenance to not touch the bellows under any condition.

6.14.1 SEALABLE COVER - The covers shall be designed to withstand the operating pressure and will permit sealing the joint by welding in the event of a bellows leak. The sealable cover shall consist of two end rings, two

telescoping covers and a seal ring tack welded on the inner cover. The minimum thickness of any component shall be ¼". In the event of a bellows failure, the seal ring must be capable of being broken loose, slid up until it butts the outer cover and then seal welded in place. The end rings shall be double sided fillet welded to the shell with a ¼" minimum weld.

6.15 LIMIT RODS – The expansion joint shall be protected against axial, lateral and angular movement beyond the design limits of the bellows plus 50% by means of limit rods across each bellows or by another suitable method. Limit stops and temporary positioning devices, when required, shall not interfere with the installation or removal of the expansion joint cover. The limit stop design basis shall be reviewed and subject to approval by the Owner's Engineer.

6.16 SLOTTED HINGES – The universal expansion joint shall be equipped with hinges over the bellows elements, which have been slotted to allow axial movement only. The slotted hinges shall support the centerspool and it is contents and prevent the dead load from deflecting the bellows elements. Slotted hinges may be required due to instability of the centerspool and if required shall be supplied regardless of the data sheet requirement.

6.17 INTERNAL INSULATION – An insulation pillow shall be manufactured and installed between the bellows and the liner. It shall be fabricated from 8 lbs/cf density low chloride Kaowool (or equal) board and loose fill. The Kaowool shall be compressed 50% of it's density and encased in a stainless steel wire mesh bag that is stitched closed using stainless steel wire. The bag shall be held in place using 3/16" dia. x 6" long clips at a minimum of 12" oc.

6.18 EXTERNAL INSULATION - An insulation pillow shall be manufactured and installed between the bellows and the cover. It shall be fabricated from low chloride insulation and encased by stainless steel wire mesh bag that is stitched closed using stainless steel wire.

6.19 PRESSURE INDICATOR - The two ply testable bellows shall be equipped with an early warning device which is capable of alerting the operators of failure of the inner ply. The vendor shall provide a non-mechanical pressure sensing device which when exposed to the system pressure will provide a warning flag or tab painted red. The warning tap shall be visible from 50 feet away. The warning device shall be equipped with an isolation valve and be securely mounted on a separate bracket. The warning device shall provide an indication of any pressure in excess of 5 psig between the plies.

6.20 PURGE PORTS – The upstream end of the bellows cavity shall be equipped with (4) 1"Dia x 3000 lb half couples for purging of the bellows cavity. The injection angle shall not be less than 15°.

6.21 THERMO-COUPLES – The bellows shall be equipped with a temperature monitoring system. The system shall consist of a minimum of three type K dual element thermocouples mounted to the bellows by spring loaded bands. The thermocouple leads shall be routed in an explosion proof conduit to a junction box. The conduit shall have sufficient flexibility to prevent binding when the bellows moves through its design movements. The conduit shall be equipped with a spark dam to isolate the junction box from the conduit. The junction box shall be located so that the normal operating temperature is less than 100°F.

6.22 HEAT-BLANKETS – The bellows shall be equipped with a heating system that will at all times maintain a bellows temperature above 450°F and below 850°. Metallic portions of the heating blanket shall not gaul or rub on the bellows. All wiring and control systems shall be encased in explosion proof, self cooling conduit and boxes. The control system shall be capable of user adjustments in maximum and minimum temperatures.

6.23 PANTOGRAPHIC LINKAGE – The universal expansion joint shall be equipped with a linkage capable of assuring that all axial and lateral movement is distributed equally between the bellows elements. The Pantographic shall be capable of resisting a 20% difference in the bellows spring rates as well as supporting the centerspool and it's contents. Pantographic linkage shall be capable of absorbing ¼" of out of plain movement.

6.24 PANTOGRAPHIC LINKAGE WITH GIMBAL RING– In addition to the following, the pantograph linkage shall comply with the requirements of paragraph 6.23. The pantograph shall also be equipped with a gimbal ring to allow for out of plain movement in excess of ¼" and as specified on the data sheet.

6.25 AIR & SOAP BUBBLE TESTING – As a minimum, all expansion joints shall be air and soap bubble tested. All welds shall be thoroughly soaped with a low chloride water and detergent, snoop or equal, mixture. Shop air shall then be applied to the backside of the weld to check for leaks.

6.26 POSITIVE MATERIAL IDENTIFICATION – Each piece of pressure retaining / containing material shall be examined to determine it's metallurgic composition. The material shall be rejected if the results have a variance greater than 5%.

6.27 WELD HARDNESS

6.27.1 When specified on the data sheet, perform weld hardness tests on all pressure retaining and/or containing material. The maximum Brinell hardness is 225. Make the hardness test at or near the center of the weld seam or surface to be tested on the side exposed to the process. Where not practical, make the test on the opposite side.

6.27.2 Prepare the surface in accordance with ASTM E-10 Paragraph 4.1.2.

6.27.3 Use a Tellebrineller portable tester or other device of comparable accuracy that can be verified by calibration. Perform the test after final post weld heat treatment.

6.27.4 Make one hardness test for each 300 cm (10 feet), or fraction thereof for each circumferential seam and each longitudinal seam. Make one hardness test for each nozzle to shell weld. Make one test on each area where a temporary weld was made and removed.

6.28 FACTORY PRESET – The joint is to be preset in the factory by the specified amounts. Preset expansion joints require a minimum of four, heavy shipping bars to maintain the preset during shipment and erection. Units with lateral or angular preset shall be clearly marked indicating the direction of the preset. The method for marking shall be indicated on the shop fabrication drawings.

6.29 PAINTING – As a minimum, all carbon steel material shall be painted with one coat of inorganic zinc primary or other primary compatible with the media and temperature of the unit. Additional painting may be required as indicated on the data sheet and supplemental specifications.

6.30 EXPORT PACKAGING – The expansion joint shall be packaged for export shipment. The unit shall be encased in a sturdy wood box lined with a waterproof barrier and skid mounted.

6.31 REFRACTORY LINING – The unit is to be refractory lined in accordance with the referenced specification. As a minimum the vendor shall design and install all necessary anchors, dams, liners and components. If the data sheet indicates "Anchors Only", than the vendor shall not install the refractory. Otherwise, the vendor shall install the refractory and dry it out in accordance with the referenced specification.

6.32 VENDOR REQUIRED INFORMATION – Every bidder is required to complete this section of the data sheet. Failure to do so will be grounds for rejecting the bid.

SUBMITTAL REQUIREMENTS

The numbers below indicate the number of copies required for submittal

Number	Proposal	Design Review	Final Drawing	Engineer'g Data	Description
	(1)				Representative Outlines or general arrangements
	(1)				Typical sectional drawing
1	(1)	(1)		(1)	Data sheets completed as indicated
2					Dimensional outlines or general arrangements complete showing clearances, piping, and electrical connections.
3	(1)				Piping schematics showing all piping furnished and bill of materials
4		(1)	(1)		Shop drawings
5		(1)	(1)		Assembly drawings and details
6					Auxiliary equipment details
7	(1)	(1)	(1)		Bill of Material
8	(1)	(1)	(1)	(1)	Design calculations
9		(1)	(1)		Nameplate data
10		(1)	(1)		Cross sectional drawings
11	(1)				Priced recommended spare parts list
12		(1)	(1)		Storage and weather protection procedure
13				(1)	Material certifications (including physical and chemical analysis).
14					Manufacturer's report as required by ASME
15				(1)	Test performance curves and test data
16				(1)	Shop test reports as required by this specification
17				(1)	Installation, operating, and maintenance instructions. Must submit quantity indicated.
18				(1)	Weld maps
19					
20					

DRAWING AND DATA REQUIREMENTS - On all drawings, leave a 3" x 5" clear area above the title block for owner's use. The purchase order, item number, and requirement number must be shown on each copy of all drawings and data. This does not apply to typical drawings furnished with the proposal.

PIPING SOLUTIONS BY
SENIOR OPERATIONS LLC, PATHWAY DIV

EXPANSION JOINT DATA SHEET

Line Description:	Rev	Sheet
0	O	0 OF 0

Customer	By	Quote / Job No:	Date
0	DLE	0	7/14/2008

GENERAL INFORMATION

TAG NO ..... LINE NO .....
NOM. DIA ..... QUANTITY .....
LENGTH ..... POSITION ..... ☐ Vert. ☐ Horiz ☐ Sloped

JOINT TYPE ..... ☐ Single ☐ Unrestrained ☐ Hinge ☐ Pressure balanced, tee/elbow
☐ Universal ☐ Tied ☐ Gimbal ☐ Pressure balanced, Inline

Design Code ..... ☐ EJMA ☐ B31.3 ☐ B31.1 ☐ ASME VIII, "U" Stamp Required
Calc. cycle life per ..... ☐ EJMA ☐ B31.3, Appendix X ☐ ASME VIII, Div 1, appendix BB

Media ..... Regenerated Catalyst Velocity ..... n/a
Density ..... n/a Composition ..... n/a

DESIGN INFORMATION

DESIGN DATA	Units	Design	Operating	Upset	Operating Fluctuations	Notes
Cycles	Ea.					Movement Descriptions:
Media Temper.	°F					c = Compression of the bellows
Pressure	psig					e = Extension of the bellows
Axial	in					i = In-plain lateral movement
Lateral	in					o = Out of plain lateral movement
Angular	deg					
Torsional	deg					

MAX ☐ SPRING FORCES Axial ..... Lateral .....
REACTION ☐ SPRING RATES Angular .... Torsional ...

EXTERNAL Axial ..... Lateral .....
Forces & Moments Angular .... Torsional ...

COMPONENT INFORMATION

	INLET	OUTLET
Material		
Thickness / Schedule		
Fabrication Specification		
Flange Type	RF FF WN SO LJ Plt	RF FF WN SO LJ Plt
Flange Specification / Rating		
Notes		

Bellows Material .....
Two Ply Testable .....
Minimum/Maximum Thick .....
Anneal after forming ..... ☐ Yes ☐ No
X-Ray Inspect ..... ☐ Yes ☐ No
PT Inspect, Attachments ..... ☐ Yes ☐ No
Two Ply test ..... ☐ Yes ☐ No
Notes .....

INTERNAL LINER
Material
Min/Max Thickness
Type ☐ Std ☐ Flush ☐ Seal ☐ Vanstone

EXTERNAL COVER
Material
Min/Max Thickness
Type ☐ Std ☐ Sealable

Additional Hardware
☐ Limit Rods ☐ Internal Packing ☐ Pressure Indicator ☐ Thermo-couples ☐ Pantograph Linkage
☐ Slotted Hinges ☐ External Insulation ☐ Purge Ports ☐ Heat Blanket ☐ Pantograph w/ Gimbal
☐ Support Rings ☐ Additional:

QUALITY ASSURANCE

Air & Soap Testing ☐ Yes ☐ No Procedure:
Hydro / Air test required ..... ☐ Yes ☐ No Pressure & Procedure Per B31.3 code
Positive Mat'l Identification ..... ☐ Yes ☐ No Equipment & Procedure:
Weld Hardness Testing ..... ☐ Yes ☐ No Equipment & Procedure:
Factory Preset ..... ☐ Yes ☐ No Axial / Lateral Preset: 4 1/8" Lateral
Painting Specification ..... None
Export Packaging ..... None
Refractory Lining ..... ☐ Anchors Only
.....

SKETCH

VENDOR REQUIRED INFORMATION

Bellows Material .....
" Thickness .....
Inside Diameter .....
Outside Diameter .....
Pitch .....
No. of Cons/Bellows .....
No. of Plies .....
Reinf'g Ring Material / Area .....
Band Material/Thickness .....
Analysis temperature .....
Cycle life for primary case .....

Axial Springrate .....
Lateral Springrate .....
Angular Springrate .....
Torsional Springrate .....
Unit weight, Installed .....
" " , Shipped .....
Exceptions to Specification ☐ None ☐ See Below

ADDL REQUIREMENTS