PIP PNFJ8000
Jacketed Piping
Fabrication and Installation Details
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

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1. Introduction

1.1 Purpose
This Practice provides requirements for the design, fabrication, and installation of jacketed piping systems.

1.2 Scope
This Practice describes the requirements for the design, material selection, fabrication, installation, inspection, and testing of jacketed piping systems.

2. References
Applicable parts of the following Practices and industry codes and standards shall be considered an integral part of this Practice. The latest edition in effect at the date of contract award shall be used, except as otherwise noted. Short titles will be used herein where appropriate.

2.1 Process Industry Practices (PIP)
- PIP PNC00004 - Piping Flexibility Analysis Criteria for ASME B31.3 Metallic Piping
- PIP PNE00012 - Piping Examination and Leak Test Guide
- PIP PNSC0001 - ASME B31.3 Metallic Piping Fabrication and Examination Specification
- PIP PNSM0110 – Procurement of Valves

2.2 Industry Codes and Standards
- American Society of Mechanical Engineers (ASME)
  - ASME B16.5 - Pipe Flanges and Flanged Fittings
  - ASME B31.3 - Process Piping

3. Requirements

3.1 General
3.1.1 The fabrication details in this Practice shall be used in the design and fabrication of jacketed piping.
3.1.2 Any substitution to or variance from this Practice shall be approved by purchaser before implementation.
3.1.3 Codes, standards, and specifications referenced in this Practice, the piping line class specifications, valve purchase descriptions, or any referenced document form a part of the requirements of this Practice in the manner and to the extent specified.
3.2 Materials of Construction

3.2.1 Materials shall be in accordance with the PIP Piping Material Specifications or the PIP Valve Descriptions.

3.2.2 All materials shall be new and unused.

3.2.3 Substitution of materials specified in the design or specified in the PIP Valve Descriptions shall not be permitted without written authorization from the purchaser.

3.3 Design

3.3.1 Codes and Standards

3.3.1.1 Jacketed piping design shall be in accordance with the latest revision of the standards noted in the PIP Piping Material Specification or in the PIP Valve Description.

3.3.1.2 Except as otherwise specified in this Practice, jacketed piping shall be in accordance with PIP PNE00012.

3.3.1.3 Except as otherwise specified in this Practice, jacketed piping shall be in accordance with PIP PN0001.

3.3.1.4 Except as otherwise specified in this Practice, jacketed piping, including integrally cast jacketed valves, base valves, and all types of fabricated jackets, shall be in accordance with PIP PNSM0110.

3.3.2 Pressure-Temperature Ratings

Comment: Certain types of flanges common in jacketed piping may not be entirely in accordance with ASME B16.5 pressure-temperature ratings.

If requested, information on the pressure-temperature ratings shall be submitted to the purchaser for approval.

3.3.3 Piping Design

3.3.3.1 The supplier’s designer shall ensure that the jacketed piping details shown in this Practice are used in the intended manner.

Comment: Some designs shown in this Practice are not acceptable for all temperature ranges or for large differences in core and jacket pipe. Cautionary notes are provided on details if the large thermal strains on the assembly may cause failure.

3.3.3.2 The appropriate flexibility analysis shall be performed in accordance with PIP PNC00004.

3.3.3.3 Additional thermal and mechanical analysis methods may be required to fully qualify the design.

3.3.3.4 The supplier’s designer shall ensure that each detail is used with the appropriate heat transfer fluid in accordance with the referenced PIP Piping Material Specification.
Comment: Each design within a detail group (e.g., jacket termination) may not provide the same amount of heat transfer to the core pipe.

3.3.4 Use of Spacers

3.3.4.1 Uniformity of the jacket annulus shall be maintained. Spacers shall be used in accordance with the following requirements:

a. Maximum distance between spacer groups or spacers and jacket end termination shall be 2.1 meters (7 feet) for core NPS 2 and smaller.

b. Maximum distance between spacer groups or spacers and jacket end termination shall be 3.1 meters (10 feet) for core NPS 3 and greater.

c. Spacers or jacket end termination shall be placed within 1.2 meters (4 feet) of the tangent point of elbows or center point of concentric fittings.

d. At least one spacer group or jacket end termination shall be provided for each straight run of pipe.

3.3.4.2 Spacers shall be considered in the flexibility analysis.

3.3.5 Layout Considerations

3.3.5.1 Jacketed piping systems shall be designed to be efficient in transferring heat from the heating medium to the core. This is dependent upon how well fluid flows through the jacket.

3.3.5.2 For liquid-heated jacketed piping, the supply shall be introduced at the lowest (inlet) tapping of the pipe, circuit, or system, and shall exit at the highest point.

3.3.5.3 For jacketed piping heated with a condensing vapor, the inlet shall be at the highest jacket tapping. Condensate shall be drained from the lowest pipe or fitting and may be returned to a common return header.

3.3.5.4 The heating medium shall flow countercurrent to the product flow.

3.3.5.5 Jacketed piping should be designed and installed with a 1% slope to facilitate drainage.

3.3.5.6 The number of jackets included in a circuit should not exceed eight pipe sections, valves, or fittings.

3.4 Testing, Inspection, Examination, and Repair

3.4.1 All jacketed piping and jacketed valves shall be pressure-tested in accordance with *ASME B31.3* and the following additional requirements and restrictions:

a. The internal line shall be leak-tested before closure of the jacket piping.

b. All core pipe welds shall be visible during the leak test.
c. If the test pressure in the jacket is too high for the internal line as an external pressure, the internal line shall be pressurized to minimize the differential pressure, or the wall thickness of the internal line shall be increased to meet test-pressure requirements.

3.4.2 Jacketed valves shall be inspected in accordance with the inspection requirements of PIP PNSM0110.

3.4.3 Inspections and/or tests of fabricated jacketed valves may be reviewed and/or witnessed by the purchaser at the supplier’s facility.

3.4.4 Jacketed piping examination shall be performed in accordance with PIP PNSC0001.

3.4.5 Jacketed valve repairs shall be performed in accordance with the repair requirements of PIP PNSM0110.

3.5 Valve Identification

3.5.1 For integrally cast jacketed valves, the valves shall be marked and tagged in accordance with the identification requirements of PIP PNSM0110.

3.5.2 Manufacturers of fabricated jackets for valves shall mark and tag valves in accordance with the identification requirements of PIP PNSM0110.

3.5.3 If a fabricated jacket is welded to a pre-manufactured base valve, the jacket fabricator shall maintain the base valve manufacturer’s markings on the valve tag.
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1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRES A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
3. ALTERNATE DESIGN SHOWN. USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
4. DIMENSION "A" AND "B" SHALL BE CALCULATED BASED ON FLUID SERVICE AND PROCESS CONDITIONS.
CZEK PLATE

NOTES:

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4. DIMENSION "A" AND "B" SHALL BE CALCULATED BASED ON FLUID SERVICE AND PROCESS CONDITIONS.
SWAGE

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
STUB END WITH LAP JOINT FLANGE

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
SLIP-ON FLANGE, FACE GROOVE WELD

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PI piping MATERIAL SPECIFICATION LINE CLASS.
WELDING NECK FLANGE

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
SLIP-ON FLANGE, FACE FILLET WELD

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
PLATE/BIND FLANGE

NOTES:

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2. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
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NOTES:

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2. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
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NOTES:
1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
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3. FLANGE MATERIAL - ASTM A105 CS
JACKET SIZE INSERT SLIP-ON FLANGE

NOTES:
1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. INSERT MATERIAL TO MATCH CORE PIPE
3. FLANGE MATERIAL - ASTM A105 CS
JACKET SIZE SLIP-ON FLANGE

NOTES:

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2. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
3. INSERT MATERIAL TO MATCH CORE PIPE
4. FLANGE MATERIAL - ASTM A105 CS
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NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
REDUCING (JACKET SIZE) SLIP-ON FLANGE, FACE GROOVE WELD

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. ALTERNATE DESIGN SHOWN. USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
REDUCING (JACKET SIZE) SLIP-ON FLANGE, FACE FILLET WELD

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
STANDARD LR/SR COMBINATIONS
SIZES 1"x2" THROUGH 6"x8"

NOTES:
1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
STANDARD SR/LR COMBINATION
SIZES 8"x12" AND LARGER

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
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1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.

2. ALTERNATE DESIGN SHOWN. USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
MITERED ELBOW, DETAIL B

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
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1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. ALTERNATE DESIGN SHOWN. USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
STANDARD CONSTRUCTION

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
MITERED CONSTRUCTION

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
STRAIGHT TEE

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
NOTES:
1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRES A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
CONCENTRIC REDUCER

CORE

JACKET

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
ECCENTRIC REDUCER

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
ALTERNATE DESIGN FOR ECCENTRIC REDUCERS

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRES A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
3. ALTERNATE DESIGN SHOWN. USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
STRAIGHT TEE AND REDUCER

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
REDUCING TEE AND REDUCER

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
CORE PIPING WITH INTEGRALLY REINFORCED BRANCH CONNECTION AND JACKET WITH CONCENTRIC REDUCER

(A) WITH REINFORCING PAD  (B) WITHOUT REINFORCING PAD

NOTES:
1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN requireS A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
3. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
4. INCREASE BRANCH JACKET SIZE 1 OR 2 NPS SIZES LARGER THAN CORE BRANCH. SEE BRANCH CONNECTION CHART IN PIPING MATERIAL SPECIFICATION LINE CLASS.
CORE AND JACKET PIPING SADDLE-ON

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGNRequires a REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
CORE PIPING SADDLE-ON WITH STANDARD TEE JACKET

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRE A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
PIPING STAB-IN ON HEEL OF CORE AND JACKET ELBOW

NOTES:
1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGNRequires A REVIEW By A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
SOCKET WELD ELBOLETT

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRES A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
3. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.

** TRADMARK **
FULL COUPLING (THREADED OR SOCKET WELD)

(A) THREADED FULL COUPLING

(B) SOCKET WELD COUPLING

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRES A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
3. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
RUPTURE DISC/PRESSURE TRANSDUCER SADDLED ONTO CORE

NOTES:
1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRES A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
CORE TAP

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRE A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
3. ALTERNATE DESIGN SHOWN. USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
THERMOWELL ON CORE ELBOW

NOTES:
1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRES A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
3. ALTERNATE DESIGN SHOWN USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
PAD FLANGE

MOUNTING DETAIL

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRE A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
3. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
FLOW-THROUGH DRAIN/SAMPLING VALVE

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
STAB-IN DRAIN/SAMPLING VALVE

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRES A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
IN-LINE SOCKET WELD OR BUTT WELD VALVE

(A) SOCKET WELD   (B) BUTT WELD

NOTES:
1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. ALTERNATE DESIGN SHOWN. USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
TYPICAL SOCKET WELD OR BUTT WELD VALVE WITH STEAM JACKET

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
3. BOLT-ON BONNET JACKET 4" AND LARGER VALVE ONLY.
4. BASE VALVE TO BE SOCKET WELD 1/2" THRU 2" NPS. BUTT WELD FOR VALVES GREATER THAN 2" NPS. SCHEDULE TO MATCH PIPE.
5. OVERSIZED FLANGES TO SUPPORT JACKET ARE TO BE MADE FROM UNBORED SLIP-ON (HIGH HUB BLIND) FLANGES.
6. E-E DIMENSION, PER ANSI B16.10 SHORT PATTERN, BASED ON VALVE OF THE LARGER FLANGE SIZE.
7. JACKETS SHALL BE DESIGNED AND FABRICATED WITH FULL PENETRATION WELDS PER CRITERIA OF ASME, SECTION VIII, DIVISION 1.
8. BODY JACKET TO HAVE THREE THREADED 3/4" NPT COUPLING CONNECTIONS; ONE ON EACH SIDE AND ONE ON THE BOTTOM. BONNET JACKET ON 4" AND LARGER VALVE ONLY, TO HAVE TWO THREADED 3/4" NPT COUPLING CONNECTIONS, ONE ON EACH SIDE.
9. JACKET TO HAVE HYDROSTATIC LEAK TEST DETERMINED BY THE OWNER.
10. LIABILITY FOR VALVE IS THE JACKETER'S RESPONSIBILITY.
STANDARD CLASS 3000 SOCKET WELD COUPLINGS

(A) FULL COUPLING

(B) HALF COUPLING

NOTES:
1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
STANDARD CLASS 3000 THREADED COUPLINGS

(A) FULL COUPLING

(B) HALF COUPLING

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
JACKET EXTENSION WITH HALF COUPLING OR Sockolet

(NIPPLE (POE x TOE))

(A) HALF COUPLING

(NIPPLE (POE x TOE))

(B) Sockolet

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
JACKET EXTENSION WITH FLANGE

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. SEE BRANCH CONNECTION CHART IN PIPING MATERIAL SPECIFICATION LINE CLASS FOR JACKET BRANCH REINFORCEMENT REQUIREMENTS.
TANGENTIAL NOZZLES

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRE A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
3. ALTERNATE DESIGN SHOWN, USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRES A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
PLATE WINDOW

NOTES:
1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. THIS DESIGN REQUIRE A REVIEW BY A PIPING FLEXIBILITY ANALYST PRIOR TO USE.
**SPACER, TYPE A**

1/8" R. MIN.
ELIMINATE ALL SHARP EDGES

1/16" TYP. CLEARANCE

**SPACER SCHEDULE - INCHES**

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<th>CORE PIPE SIZE</th>
<th>JACKET PIPE SIZE</th>
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<th>SPACER SIZE FOR SCH 10S JACKET (W X H X L)</th>
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**NOTES:**

1. SPACER MATERIAL TO MATCH CORE PIPE.
SPACER, TYPE B

NOTES:

1. ALTERNATE DESIGN SHOWN. USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
2. SPACER MATERIAL TO MATCH CORE PIPE.
SPACER, TYPE C

NOTES:

1. ALTERNATE DESIGN SHOWN. USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.

2. SPACER MATERIAL TO MATCH CORE PIPE.
NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
SIPHON TUBE ASSEMBLY

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
FLEXIBLE METAL HOSE JUMPOVER

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. ALTERNATE DESIGN SHOWN. USE ONLY WHEN SPECIFIED IN THE ENGINEERING DESIGN OR PIPING MATERIAL SPECIFICATION LINE CLASS.
3. FLEXIBLE JUMPER HOSE SHALL BE OF THE PROPER LENGTH AND BEND RADIUS TO SUIT THE PARTICULAR INSTALLATION PER THE MANUFACTURER'S GUIDELINES.
NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.

2. FOR VALVE SIZES 1" AND SMALLER WITH 2" INSULATION, NIPPLE TO BE 1/2" x 4". FOR VALVE SIZES 1 1/2" AND LARGER WITH 2" INSULATION, NIPPLE TO BE 3/4" x 4". NIPPLE MATERIAL AND SCHEDULE TO BE PER THE LINE CLASS SPECIFICATION.

3. FOR JACKET SIZES SMALLER THAN 2" USE 1/2"-3000LB COUPLING, SIZES 2 1/2" AND LARGER USE 3/4"-3000LB COUPLING. FOR JACKET SIZES 1" THRU 2" WITH 2" INSULATION, USE 1/2" x 5" NIPPLE. FOR JACKET SIZES 2 1/2" THRU 4" WITH 2" INSULATION USE 3/4" x 5" NIPPLE.

4. IN PIPING SYSTEMS WITH 4" INSULATION, ADD 2" TO LENGTH OF NIPPLES.

5. THREADS HIDDEN UNDER INSULATION SHALL BE THOROUGHLY CLEANED BEFORE ASSEMBLY AND SHALL BE SEAL WELDED.
NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.
2. BUTT WELD FITTINGS SHOWN. USE SIMILAR CONSTRUCTION FOR SOCKET WELD.
3. NOT FOR RING JOINT FLANGED JUMPER CONNECTIONS. SEE PNFJ9160.
4. ORIENTATION OF JUMPER INLET AND OUTLET TO BE AS SPECIFIED IN DESIGN.
PIPING JUMPOVER

3/4" - 1 1/2"
SOCKET WELD

2" - 4"
BUTT WELD

NOTES:

1. MATERIALS OF CONSTRUCTION SHALL BE PER PIPING MATERIAL SPECIFICATION LINE CLASS.