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REV.	DATE	DESCRIPTION	PREPARED	CHECKED	REVIEWED	APPROVED
OWNER		 SPPC 신평택발전 SHIN PYEONGTAEK COMBINED CYCLE POWER PLANT				
OE		 KOREA WESTERN POWER CO., Ltd.				
CONTRACTOR		 포스코건설  (주) 서희건설				
SUPPLIER		 한국가스기술공사 KOREA GAS TECHNOLOGY CORPORATION				
TITLE		절연조인트 자재사양서				
PJT. No.		OWNER'S No		CONTRACTOR No.		
10000		100009-24100-P-212-013		WD-520-EP230-0013		

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1. SCOPE

This specification applies to insulation joints to be used in PURCHASER natural gas piping system.

2. CODES AND STANDARDS

The following codes and standards referred to in this specification shall be the latest editions effective prior to contract date. Any inconsistency with this specification shall be brought to PURCHASER' attention and be approved by KOGAS prior to starting manufacturing the insulation joints.

2.1 Korean Gas-Related Laws

- High-Pressure Gas Safety Control Act
- Urban Gas Business Act
- Safety Control and Business Regulation of Liquefied Petroleum Gas Act

2.2 Korean Industrial Standards (KS)

- KS B 0816 Method for Liquid Penetrant Testing and Classification of the Indication
- KS B 0845 Methods of Radiographic Examination for Welds in Steel
- KS B 0896 Method for Ultrasonic Examination for Welds of Ferritic Steel
- KS M 3012 Testing Methods for Polyethylene
- KS M 5250 Epoxy Resin Powder Coating

2.3 American Petroleum Institute Specification (API)

- API-5L Specification for Line Pipe
- API-1104 Welding of Pipelines and Related Facilities

2.4 American National Standard Institute (ASME)

- ASME B16.5 Pipe Flanges and Flanged Fittings
- ASME B16.25 Butt Welding Ends
- ASME B31.8 Gas Transmission and Distribution Piping System
- Sec. V Nondestructive Examination
- Sec. VIII Pressure Vessels
- Sec. IX Welding and Brazing Qualifications

2.5 American Society for Testing and Materials (ASTM)

- E165 Standard Practice for Liquid Penetrant Inspection Method
- E114 Standard Practice for Ultrasonic Inspection
- A53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- A370 Specification for Mechanical Testing of Steel Product

2.6 Others

- ISO 804 Preparation of Steel of Substates before Application of Paints and Related Products Surface Preparation Methods
- SIS SS 05 59 00 Blast Cleaning
- SSPC CP10 Near White Blast Cleaning
- NACE RP0274 High Voltage Electrical Inspection of Pipe Line Coatings Prior to Installation
- MSS-SP-75 Specification for High Test Wrought Butt Welding Fittings

3. TECHNICAL SPECIFICATION

3.1 General

3.1.1 Fluid

The fluid to flow through the insulation joints to be purchased on this specification is natural gas vaporized from LNG and its composition is as follows:

Composition	Mol (%)	Molecular Weight (kg/kg mol)	Remarks
CH ₄	88.892	16.043	natural gas
C ₂ H ₆	8.924	30.070	
C ₃ H ₈	1.237	44.097	
i-C ₄ H ₁₀	0.381	58.123	
n-C ₄ H ₁₀	0.537	58.123	
i-C ₅ H ₁₂	0.016	72.150	
n-C ₅ H ₁₂	0	72.150	
N ₂	0.013	28.013	
Total	100		
T. H. T	max	13 ppm	odorant
T. B. M	max	6 ppm	

3.1.2 Nominal operating pressure: The nominal operating pressures used by KOGAS and the pressure ratings corresponding to them are as follows:

- Class 300 shall be used for P4(working pressure; 3.92MPa(40kg/cm²) and under) and P4(working pressure; 3.92MPa(40kg/cm²) and under).
- Class 600 shall be used for P5(working pressure; 4.90MPa(50kg/cm²) and under) and P7(working pressure; 6.86MPa(70kg/cm²) and under).

* Classes 300 and 600 of the insulation joints are the Classes 300 and 600 in API 6D Section 2-1.

3.1.3 Service temperature

Ambient and fluid temperature: -30°C to +80°C (-22°F to 176°F)

3.1.4 Installation location

(Indoor and outdoor) piping in the supply facilities

3.2. Specification for insulation joints

The types and constructions of all insulation joints shall satisfy the following requirements:

3.2.1 Materials

a) Body: Forged steel

○ Chemical composition

The ladle analysis of the material used for insulation joints shall conform to the chemical requirements of ASTM A105 Table 1.

○ Carbon equivalent

The carbon equivalent shall be calculated by the following formula and the result shall not exceed 0.42%:

$C.E \text{ (carbon equivalent)} = C + Mn/6$ (C: carbon, Mn: manganese)

○ Mechanical property

The mechanical property shall conform to the mechanical requirements of ASTM A105 Table 4.

b) Pups

The material and specification of pups shall be the same as that of the pipe to be connected or equivalent.

○ Class 600 : API 5L Gr. X65, ERW/SAW (14" and larger)

API 5L Gr. X42, API 5L Gr. B ERW (12" and smaller)

○ Class 300 : API 5L Gr. B ERW/SAW

c) Insulating materials: The insulating materials shall have chemical stability, durability, and insulation capacity required in this specification.

d) Nonmetallic material: The electric insulating ring shall be of a gas-resistant type.

3.2.2 Dimensions and ends of pub

a) Ends of pub

○ Bevel end (ASME B16.25): For nominal diameter 2" and larger

○ Plain end: For nominal diameter smaller than 2"

b) Thickness of pub: The thickness of a pup shall conform to the following table:

(unit: mm)

Class	P7, P5			P4, P3, P2, P0.9
Rating	Class 600			Class 300
Material NPS size	API 5L X-70	API 5L X-65	API 5L X-42	API 5L Gr. B
30 "	15.9	17.5	-	14.3
26 "	14.3	15.9	-	12.7
24 "	12.7	14.3	-	12.7
20 "	11.9	11.9	-	12.7
18 "		11.1	-	11.1
16 "		9.5	-	9.5

14 "		9.5	-	9.5
12 "		-	14.3	8.4
10 "		-	12.7	7.8
8 "		-	9.5	7.0
6 "		-	7.1	7.1
4 "		-	6.0	6.0
2 "		-	5.5	5.5
$\frac{1}{2}$ to $1\frac{1}{2}$ "		-	XS	XS

3.3 Manufacture

3.3.1 General requirements

- One end of the pup shall be a forged hub while the other end shall be a bevel end or a plain end in Paragraph 3.2.2.
- One end of the pub shall be a forged stub while the other end shall be a bevel end or a plain end in Paragraph 3.2.2.
- Electric insulating joint tubes shall be manufactured in such a way as to solidly hold the internal components.
- Forged rings (hubs, stubs, and retainers) shall be manufactured in accordance with ASME Sec. VII.Div.1.Appendix 2.
- The surface of the ring-type space between the pup and the retainer shall be treated to conform to SSPC-SP-10 (or SIS Sa $2\frac{1}{2}$), and the products shall be assembled within 2 hours after shop blasting.
- The round space between the retainer and the insulation joint hub shall be filled up with an insulating material.
- External surfaces shall be coated. The surfaces shall be treated to conform to SSPC-SP-10 (or SIS Sa $2\frac{1}{2}$) and the surface treating material shall not affect the insulation characteristics of the insulation joint.
- The whole length of an insulation joint complete with all tests shall be the length in the approved drawing.
- At each ends of an insulation joint, a handle shall be provided for easy installation in the field.
- The length of a pup from the external coating shall be $50 \pm 1\text{mm}$ and the pup shall be anticorrosive.
- Insulation material shall be fully filled in an insulation joint (between both pipes) and the pup at each sides of the body shall be assembled with its protection pipe.
- In the construction of the insulation joint of which working pressure is

- 0.98MPa(10kg/cm²) and higher, one end of the protection pipe shall be welded.
- m) Any harmful oil shall be removed from the pipe and the external surface of the insulation joint shall be coated with an insulating material.
 - n) Nonmetallic parts such as the insulation ring shall be free of any defect.
 - o) The insulation part shall be of a round shape and be perpendicular to the insulation pipe.

3.3.2 Welding

a) Welding processes

- Shield Metal Arc Welding (SMAW)
- Gas Tungsten - Arc Welding (GTAW or TIG)
- Gas Metal Arc Welding (GMAW)
- Submerged Arc Welding (SAW)
- Combinations of above Process
- Electric Resistance Welding (ERW)

b) Welding procedure specification

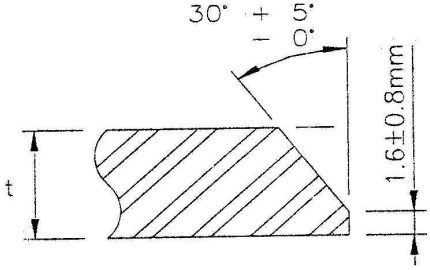
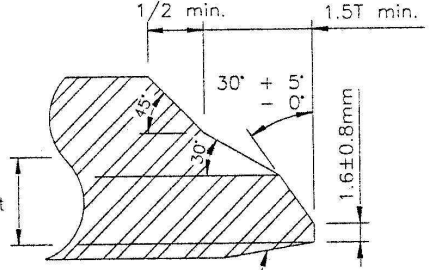
The welding procedure specification shall be prepared in accordance with ASME Sec.IX and be approved by the purchaser prior to manufacturing the insulation joints.

c) Detailed welding method: All welds of the insulation joint shall be butt welds.

d) Others

- In case the end part of an insulation joint is laminated, the laminated part shall be completely removed.
- The height of an internal weld bead shall not exceed 2 mm.
- Welds shall be free of undercuts and cracks.
- Welds shall be free of damages, cracks and undercuts, and the height of a weld bead shall not be lower than the pipe surface.

3.3.3 Connection of ends: The edge preparation of insulation joints shall be as shown in the following drawing:

In case the thickness of a pipe to be welded are the same as that of the insulation joint	In case the thickness of a pipe to be welded is thicker than that of the insulation joint
 <p>30° ± 5° 1.6 ± 0.8mm t ID tolerance: ±0.8mm</p>	 <p>1/2 min. 1.5T min. 30° ± 5° 1.6 ± 0.8mm t max slope 1 : 3 ID tolerance: ±0.8mm</p>

3.3.4 Heat treatment

The heat treatment of insulation joints shall be performed in accordance with ASME Sec. VIII Div.1 and relevant ASME/ASTM specification. The furnace temperature shall be automatically recorded during the heat treatment and the record sheets shall be submitted to the purchaser.

In addition, the manufacturer shall submit the heat treatment specification prior to the manufacture and the specification shall include the heat treatment procedure, standard temperature gradient chart, temperature regulation range, and other related data.

3.3.5 Painting

Stage		Surface process method	Paint	Painting method	Coating Thickness (μm)
Surface Treatment	Metal Surface of Equipment	A1+A10	-	-	-
	On-Site Welding Parts	A3+A13	-	-	-
Primer(Epoxy Zinc)		-	B2	C2 or C4	65
Secondary Coat(Epoxy)		-	B13	C4+C5	125
Third Coat(Urethane)		-	B5	C1+C2+C4	50
Total					240

※ Refer to GSD-2206 Standard for facilities painting in Governor Stations.

Stage	Type	Content	Standard applied
Surface Process method	A1	Solvent clean(per section 5.3.5 in the case of S.S. surface)	SSPC-SP1
	A3	Power tool clean	SSPC-SP3
	A10	Near white blast clean	SSPC-SP10
	A11	Vacuum blast with portable equipment to equivalent standard used on adjoining surfaces	-
	A13	Remove remaining detrimental weld flux deposits	SSPC-SP1
Paint (thickness, color)	B2	Two pack organic zinc rich polyamide cured epoxy primer	65μm, Metallic gray
	B5	Two pack aliphatic urethane	50μm, As data sheet
	B13	Two pack polyamide cured high build epoxy/M10	125μm, Silver grey
Painting method	C1	Paint shall be brush applied	
	C2	Paint shall be air spray applied	
	C4	Airless or high pressure spray applied	
	C5	Spot clean and touch-up damaged areas(*)	

- * Note) For C5 where spot clean and touch-up of damaged areas of galvanized surfaces and shop applied inorganic zinc silicate coating(B1) is involved, use organic zinc rich polyamide cured epoxy primer(B2) for operating temperatures up to 150°C, and limit the use of inorganic zinc silicate(B1) to surfaces having an operating temperature in excess of 150°C.

- a) Paint color : Munsell No. 7.5GY 5.5/1
- b) Color both ends of welded parts with anticorrosive paint
- c) Pin hole, crack, and peeling off should be absent when painting

3.3.6 Repair

- a) Forging defects shall be repaired in accordance with MSS-SP-75.
- b) The defects in base metal shall be ground off with a grinder and then repaired. Repaired parts shall undergo magnetic particle examination.
- c) Repair welds shall undergo radiographic examination in accordance with ASME Sec.V. Div. 1. However, closing welds shall undergo ultrasonic test.

3.4 Marking

Insulation joints shall be marked with the followings:

- Purchaser name
- Manufacturer and his brand
- Nominal diameter and thickness
- Pressure rating and material
- Serial number
- Maximum operating pressure / gas flow direction
- Installation method /quality warranty period

3.5 Packing and Transportation

Each insulation joint shall be covered with plastic sheets and its ends shall be protected with a bevel protector (1.6mm and thicker) to protect the beveled ends and prevent foreign materials from entering the insulation joint.

4. TEST AND INSPECTION

4.1 Test of Raw Materials

4.1.1 Chemical analysis

The chemical analysis shall be performed by ladle analysis, and the chemical composition of various materials shall satisfy the requirements in this specification.

4.1.2 Mechanical test

Tensile test shall be performed for every lot after heat treatment.

- Forgings: Tensile tests shall be performed in accordance with ASTM A105 Para. 9 or equivalent code, and the test results shall satisfy the requirements in this specification.
- Pups: The test result shall satisfy the specification for API 5L.

4.2 Test of Finished Products

4.2.1 Hydrostatic test

After assembly, insulation joints shall undergo hydrostatic test for the holding time of 1 hour and over and there shall be no leakage, deformation, or pressure drop.

Pressure Rating	Class 600	Class 300
Hydrostatic pressure	15.30MPa(156kg/cm ² .g)	7.74MPa(79kg/cm ² .g)

4.2.2 Leakage test

The insulation joints shall undergo leakage test at 1.1 times the maximum working pressure for 10 minutes, and there shall be no leakage, deformation, or pressure drop.

Pressure Rating	Class 600	Class 300
Leakage Test Pressure	7.55 MPa(77kg/cm ² .g)	4.31MPa(44kg/cm ² .g)

4.2.3 Insulation resistance test and voltage withstand test

After the assembly, each insulation joint shall undergo insulation resistance test at 1,000 V DC prior to hydrostatic test, and the insulation resistance shall be 25MΩ and over. Each insulation joint shall undergo voltage withstand test at 5,000 V AC 60Hz(or 6,000 V AC 50Hz) for 1 minute, and there shall be no short or rupture.

4.2.4 Tensile strength test

When an insulation joint is applied with the tensile strength shown in the following table and hydrostatic pressure is applied for 5 minutes and over on the basis of

6.86MPa(70kg/cm²)forclass600and3.92MPa(40kg/cm²)forclasses300and 150, there shall not be any abnormality such as leakage or partial expansion.

< Table 1. Bending and Tensile Strengths by Pipe Sizes >

Pressure Rating	Class 600		Class 300, class 150	
Strength NPS size	Bending Strength (kgf.m)	Tensile Strength (kgf)	Bending Strength (kgf.m)	Tensile Strength (kgf)
30 "	170,000	330,000	75,000	205,000
26 "	115,000	295,000	50,000	155,000
24 "	89,000	245,000	42,000	145,000
20 "	51,000	170,000	30,000	120,000
18 "	38,000	140,000	21,000	95,000
16 "	26,000	105,000	14,000	73,000
14 "	20,000	95,000	10,500	65,000
12 "	12,500	68,000	7,800	56,000
10 "	8,000	51,000	5,100	43,000
8 "	3,800	39,000	2,900	37,500
6 "	1,700	25,000	1,600	25,000
4 "	645	15,000	600	15,000
2 "	145	4,600	145	4,600
1 1/2 "	85	3,400	85	3,400
5/4 "	60	2,800	60	2,800
1 "	32	2,000	32	2,000
3/4 "	17	1,300	17	1,300
1/2 "	12	1,000	12	1,000

4.2.5 Bending test

When an insulation joint is applied with the bending strength shown in the following table and hydrostatic pressure is applied for 5 minutes and over on the basis of 6.86MPa (70kg/cm²) for class 600 and 3.92MPa(40kg/cm²) for classes 300 and 150, there shall not be any abnormality such as leakage or partial expansion.

4.2.6 Cold resistance test

When an insulation joint has been left in the air of (-) 25°C for 24 hours and then undergoes leakage test for 1 minute, there shall be no abnormality, and also the joint shall be free of any abnormality after insulation resistance test and voltage withstand test.

4.2.7 Heat resistance test

When an insulation joint has been left in the air of (+) $85\pm 1^{\circ}\text{C}$ for 24 hours and then undergoes leakage test for 1 minute at ambient temperature, there shall be no abnormality, and also the joint shall be free of any abnormality after insulation resistance test and voltage withstand test.

4.2.8 Gas resistance test

When a nonmetallic material has been left in the LPG of (-) 20°C and (-) 40°C and in the air of (-) 25°C for 24 hours, there shall be no abnormality.

4.2.9 Nondestructive examination

- a) All circumferential and longitudinal welds except for closing welds shall undergo 100 % radiographic examination in accordance with ASME Sec.V.
- b) Closing welds shall undergo ultrasonic examination in accordance with ASME Sec.V.
- c) The 70 mm wide end part of each pup shall undergo ultrasonic examination in accordance with ASME Sec.V after being beveled.
- d) The beveled surface of each pup shall undergo magnetic particle examination or liquid penetrant examination in accordance with ASME Sec.V after being beveled.
- e) The acceptance criteria of each nondestructive examination shall conform to ASME Sec.VIII Div.1 Appendix. However, the acceptance criteria of radiographic examination f) The person in charge of the final approval of nondestructive examinations shall be qualified for ASNT level III or over.

4.2.10 Visual inspection

All parts or finished products shall undergo visual inspection after their machining. The acceptance criteria and repair shall conform to MSS-SP-75. In addition, the lamination defects at the beveled ends of products shall be completely removed.

4.2.11 Dimension check

Dimensions of finished insulation joints shall be checked in accordance with API 5L. The allowable limit ranges are as follows:

- Outside diameter:
 - 10" and smaller: $+1.59\text{mm}$ to -0.4mm ,
 - 12" and larger: $+2.38\text{mm}$ to -0.79mm
- Thickness: API 5L Table 9
- Length: $\pm 5\text{mm}$
- Out of roundness: $\pm 1\%$ (The largest difference between the largest diameter and the smallest diameter at the end part shall be 12.7mm and under.)
- Perpendicularity of machined part: 1.6mm and under (at the end part)

4.2.12 Painting inspection

- a) Painted parts shall conform to the requirements of 3.3.5 Painting.
- b) Pinhole test: After internal and external painting is completed, the painted internal and external surfaces shall undergo pinhole test with a

holiday detector at the test voltage of 3,000 V and there shall be no abnormality.

4.3 Detailed inspection

- New manufacturers' products (including those of changed specifications for material and construction due to their changed performance) delivered for the first time shall undergo all of the tests in Paragraphs 4.1 and 4.2.
- The manufacturer shall submit the detailed inspection record witnessed and approved by KOGAS, a third-party inspection agency, or Korea Gas Safety Corporation.
- The manufacturer shall submit the imprinting inspection result Included below contents
 - Designated Korea Gas Safety Corporation local name and contact point
 - Imprinting Inspection date and inspector name
 - Product serial number and quantity

4.4 Products inspection

When products of the same specification are supplied by the manufacturer who has already passed the detailed inspection of those products, the tests in Paragraphs 4.2.4 to 4.2.8 may be replaced with the test records of the detailed inspection, but the other tests shall be performed.

4.5 Others

4.5.1 The contractor shall submit the test and inspection schedule 30 days before the test and inspection.

4.5.2 The contractor shall submit the test records listed in the following table:

No	Test Item	Contractor	Purchaser or Third Party Inspection Agency	Remarks
1	Test of Raw Material	○	△	
2	Heat Treatment	○	△	
3	Nondestructive Examination (RT, UT, MT, PT)	○	△	
4	Hydrostatic Test	○	○	
5	Leakage Test	○	○	
6	Insulation Resistance Test and Voltage Withstand Test	○	○	
7	Painting Inspection (including pinhole test)	○	○	

8	Visual Inspection	○	○	
9	Dimensional Check	○	○	
10	Detailed Inspection	◇	◇	

※ ○ : 100 % witness test and inspection

※ △ : Review of test reports

※ ◇ : 100 % witness test and inspection for the product specification delivered for the first time.

※ The third party inspection agency shall be selected from those approved by KOGAS.

※ The contractor shall submit the test and inspection reports prepared by the third party inspection agency for PURCHASER approval prior to the shipment.

4.5.3 All manufacturing drawings shall be converted to ACAD computer files and be submitted in the form of diskettes or CD ROMs. All certificate sheets and test and inspection records for submittal shall be stored in dxf files and submitted in the form of diskettes or CD ROMs.

4.5.4 The contractor shall submit the documents listed in attachment 3 at KOGAS request.

4.6.5 Training Service

- If necessary, KOGAS could request the contractor to provide Training Services concerning designing of Insulation Joint. At that time, the contractor shall provide comprehensive formal training courses for KOGAS, as follows.

Number of persons	Training Period	Training Place
2 Men	5 days	Designing Center of main contractor or original manufacture

- The Supplier shall be responsible for furnishing detailed course outline, manuals of training, equipment necessary to conduct the training exercises and to evaluate trainees' progress.

- Course contents

The outline of each course shall give the subject matter, a short resume of the pre-requisite subjects(if applicable), the position of the course in the training program, the aim and criteria for evaluation and other topics which will added the usefulness of the program.

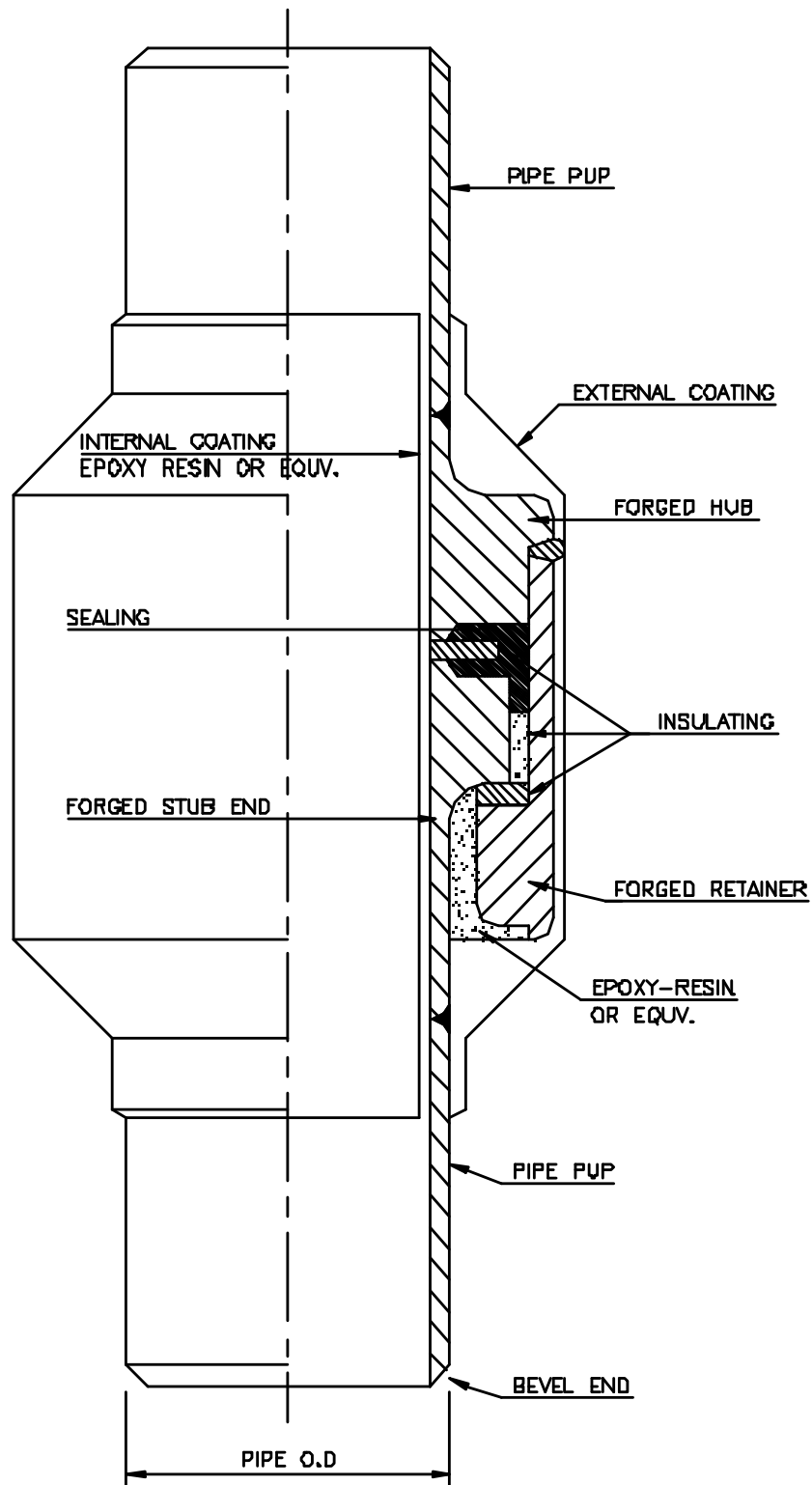
The detailed training schedule and training course outline shall be submitted 2 months prior to the start of training for review. The training exercises shall be designed to be objective in nature and shall include trouble shooting exercises on similar equipment.

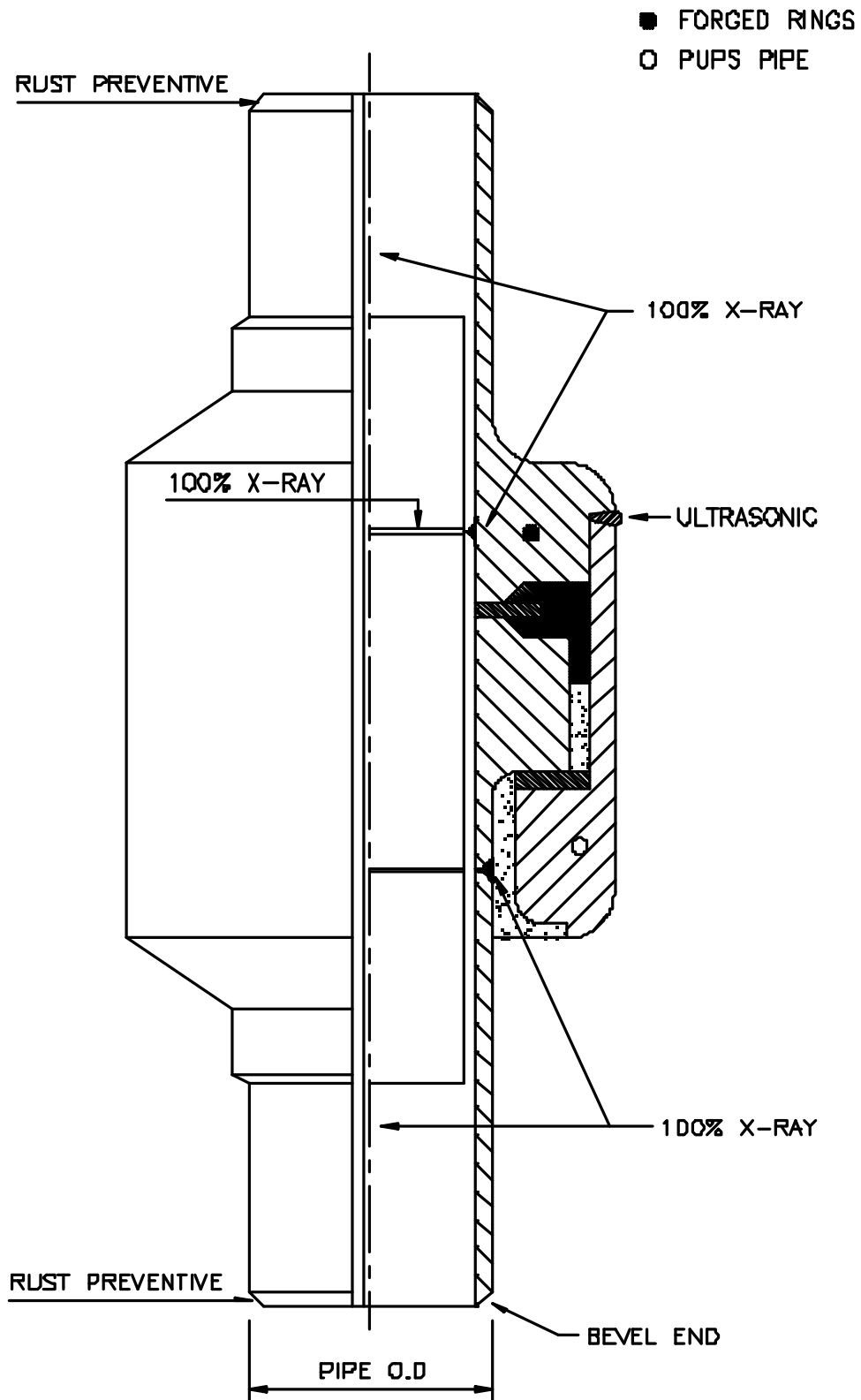
- Training Manuals

All training manuals shall be prepared by the Supplier and submitted for review 2 months prior to the commencement of the course.

After completion of the course, these manuals shall be the property of the purchaser. Any changes in equipment, manuals and other material shall be informed to the purchaser during the guarantee period.

- For the purpose of efficient and appropriate training, Experienced project engineers and/or managers who should have at least five years experience in related field and also who have participated in engineering, manufacturing of Insulation Joint in the same or similar project shall be assigned to the training program.
The Supplier shall submit, for approval, the trainer's personal history record for acceptance at least 1 month prior to the start of the training.
- The Supplier shall provide the trainees with the followings during the whole training period without additional costs.
 - Training aids, materials and instructions required for the training.
 - Transportation service between lodging place and training site for the trainees
 - The training languages shall be ENGLISH or KOREAN.





ATTACHMENT 3. LIST OF DOCUMENTS

No	Submittal	After Contract		Submittal Due Date for Approval
		For App.	For Final	
1	Supplier certificate (included manufacturer certificate)	5C	10C	Within 15 days after contract agreement
2	Bidding certificate (evidence of job experience)	5C	10C	"
3	Manufacturer brochure	5C	10C	"
4	Manufacture & inspection equipment list		10C	"
5	Fabrication, design, inspection schedule	5C	10C	"
6	Manufacturing specification	5C	10C	"
7	Assembly drawing showing material, dimension & weight, spare part list & spec	5C	10C	"
8	Each accessories specification and quantity	5C	10C	"
9	Inspection procedure	5C	10C	"
10	WPS & PQR, Welding repair procedure	5C	10C	"
11	QC/QA manual	5C	10C	"
12	Painting specification	5C	10C	"
13	Test and inspection specification	5C	10C	"
14	Maintenance manual	5C	10C	"
15	Packing and transportation specification	5C	10C	"
16	Strength calculation sheets	5C	10C	"
17	Supply list for applicable codes and standards	5C	10C	"
18	Repair specification and manual	5C	10C	"
19	Specification, certificate of heat treatment	5C	10C	at supply
20	Other test and inspection reports	5C	10C+9C	"
21	The others requested drawings and documents by purchaser	5C	10C	at requirement

- Documents corrected according to PURCHASER comments shall be corrected and submitted within 15 days after receipt of such comments.
- The procedure for document correction is the same as that for document approval.
- If documents are in error or flawed, correction may be made in mutual consultation.
- The manufacturer shall be responsible for problems arising from delay in submitting documents.
- Supplier shall submit the document no. 19 and 20 to PURCHASER QA/QC Department

- f) For Document no.20, the original document is in principle submitted to PURCHASER QA/QC Department
- g) However, the original document can be substituted to the certified true copy only if it's absolutely necessary
- h) Ordering department upon request shall be submitted to final document cd and the additional final document copy.

ATTACHMENT 4. LIST OF INSULATION JOINTS

NO	STATION	STATION NO.	I.J NO.	SIZE	Q'TY	D.P (kg/cmf)	RATING	END TYPE	Material of Pup Pipe	REMARK
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
TOTAL										