



**TECHNICAL SPECIFICATIONS FOR FITTINGS**

**DOCUMENT NO.: GGL/TS/STEEL/SUPPLY/FITTINGS/TECH. SPEC.**

Approved

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## 1. SCOPE

This specification covers the minimum requirements for the design, manufacture and supply of factory-made seamless and welded carbon steel fittings of size NPS 24" and smaller for the use in natural gas pipeline and piping system and city gas distribution network including terminal piping, compressor stations, metering and pressure regulating stations.

This specification covers the minimum requirements for materials, chemical & mechanical properties, heat treatment, notch toughness properties, design & manufacturing, inspection, testing, marking and supply of high strength carbon steel fittings such as elbow, tee, bend, reducers, caps, O-lets fittings etc. This specification is limited to fittings with NPS 0.5 inches to 24 inches in compliance with latest editions of ASME B 16.5, ASME B 16.9, ASME B 16.11, MSS SP 75 and MSS SP 97.

All requirements contained in the above standards shall be fully valid unless cancelled, replaced or amended by more requirements as stated in this specification.

## 2. DEFINITIONS:

Purchaser/Owner: The Company which makes purchase order means "Gujarat Gas Limited (GGL)".

Manufacturer: Manufacturer who receives the purchase order.

TPI: "Third Party Inspection Agency" appointed by Owner/Manufacturer and approved by Purchaser/Owner

Shall: This verbal form indicates requirements strictly to be followed in order to confirm to the standards and form in which no deviation is permitted.

Should: This verbal form indicates that among several possibilities one is particularly suitable without mentioning or excluding others or that a certain course of action is preferred but not necessarily required.

May: This verbal form indicates a course of action permissible within the limits of this standard.

Can: This verbal form used for statements of possibility & capability, whether material, physical or casual

## 3. REFERENCE STANDARDS AND DOCUMENTS

The following Codes and Standard includes provision which, through reference in this text constitute provision of this Standard. Latest revision of this standard shall be used unless otherwise specified.

### CODES AND STANDARDS:

ASME B 31.8	-	Gas Transmission and Distribution Piping Systems
ASME B 16.11	-	Forged Fittings Socket Welded and Threaded
ASME B 16.9	-	Factory made Wrought Steel Butt Welding

ASME B 16.25	-	Butt-Welding Ends
ASME Sec VIII / IX	-	Boiler and Pressure Vessel Code
ASTM A 370	-	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 105	-	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A 350	-	Standard Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
ASTM A 234	-	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 420	-	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service
ASTM A 694	-	Standard Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service
MSS SP 25	-	Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP 75	-	Specification for High Test Wrought Welded Fittings.
MSS SP 97	-	Forged carbon steel branch outlet fittings – socket welding, threaded and butt-welding ends.
PNGRB T4S	-	T4S for City or Local Natural Gas Distribution Networks
ASTM A 153	-	Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASME B 1.20.1	-	Pipe Threads General Purpose (inch)

In case of codes indicated without the year of publication, the latest edition of the code shall be taken into consideration. In case of conflict between the requirements of this specification and reference standard mentioned above, the more stringent requirement shall apply.

#### 4. SUBMITTALS BY MANUFACTURER

**Prior to start of fabrication, the Manufacturer shall submit the following document for approval to OWNER / TPI s within 15 days after receipt of PO:**

- Detailed Fabrication drawings & calculations;
- Fabrication and control procedures;
- Material List;
- Qualified welding procedures (if applicable);
- Welder's performance qualifications (if applicable);
- Heat treatment procedures;
- Non-destructive testing procedures;
- Any other relevant drawings / documents required by OWNER.

**Prior to shipment, the Manufacturer shall submit for approval to OWNER / TPI the following documents:**

- Test Certificates relevant to the Chemical composition and mechanical properties including hardness test of the materials used for manufacturing of fittings as per relevant standards and this specification.
- Test reports on Non-Destructive Examination.
- Test Reports of heat treatment carried out as per the specification.
- Test certificates for each fitting stating that it is capable of withstanding, without leakage, a test pressure which results in a hoop stress equivalent to at least 100 % of the specified minimum yield strength (SMYS) for the pipe with which the fittings are to be attached without impairment of serviceability.
- Test Report on Proof Test of each size & type of item.

Note: The certificates shall be valid only when approved / certified by **OWNER / TPI**. Only those fittings, which have been certified by **OWNER / TPI**, shall be dispatched from **Manufacturer's** works. All documents shall be in English language only.

#### 5. MATERIALS

- 5.1 Steel used shall be fully killed and fine grain Structure.
- 5.2 Fittings Material shall comply with requirements defined in ASTM A 105, ASTM A 234, ASTM A 350, ASTM A 420, MSS SP 75 & MSS SP 97 (latest edition).
- 5.3 Carbon content requirement shall comply to relevant code & material standard as well as PNGRB technical standard for CGD.
- 5.4 If the Carbon Content is greater than 0.12 %, then Carbon Equivalent (IIW) shall not exceed 0.43 for

each heat of steel used, as calculated the following formula:

$$CE \text{ (IIW)} = C + \frac{Mn}{6} + \frac{(Cr + Mo + V)}{5} + \frac{(Ni + Cu)}{15}$$

If carbon content is less than or equal to 0.12% in product analysis; the CE (Pcm) shall not exceed 0.25%.

$$CE \text{ (Pcm)} = C + \frac{Ni}{60} + \frac{Si}{30} + \frac{(Mn + Cu + Cr)}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B$$

Unless specified otherwise, Charpy V-notch test shall be conducted for each heat of steel, in accordance with the impact test provisions of ASTM A 370 at temperatures specified in standards relevant to which MOC is complying. If not mentioned in MOC standard, impact test shall be carried out at 0° C and absorbed energy value shall be 35 J (avg.). The minimum impact energy value of any one specimen of the three specimens analyzed as above shall not be less than 80% of the above-mentioned average value.

- 5.5 Hardness testing shall be carried out by Manufacturer in accordance with applicable material standard.

If hardness is not specified in applicable material standard with which MOC complies then hardness shall not exceed 248 HV10 based on minimum 3 measurements.

- 5.6 The actual yield strength shall be as close as possible to the specified minimum yield strength (SMYS) of connected pipe grade but in no case, it shall exceed by 20,000 psi.
- 5.7 The steel used shall have tensile properties conforming to the requirements prescribed in the applicable material standard.

## 6. DESIGN AND MANUFACTURE

- 6.1 Fittings shall be made by forging, hammering, pressing, piercing, rolling, extruding, upsetting, welding, or by a combination of these operations. The forming procedure shall be so applied that it will not produce injurious defects.
- 6.2 Fittings not covered in ASME B 16.9 and ASME B 16.11 like weld-o-lets, sock-o-lets etc. shall be manufactured in accordance with MSS SP 97 and in accordance with Manufacturer's recommendation which shall be submitted and approved from OWNER / TPIA before starting of production.
- 6.3 The temperature and pressure range shall be as per the applicable Piping Material Specification and material data sheet.
- 6.4 Fittings such as tee, elbow and reducer shall be seamless type and shall conform to ASME B 16.9 for sizes NPS 2" and above ASME B 16.11 for sizes below NPS 2".
- 6.5 Fittings such as weldolets, sockolets, etc. shall be manufactured in accordance with MSS SP 97.
- 6.6 Stub-in or pipe-to-pipe connection shall not be used in the manufacture of tees. Tees shall be manufactured by forging or extrusion methods. The longitudinal weld seam shall be kept at 90° from the extrusion. Fittings shall not have any circumferential joints.

- 6.7 All butt weld ends shall be beveled as per ASME B 16.25.
- 6.8 Repair by welding on parent metal of the fittings is not allowed.
- 6.9 Bends are to be made from straight length of pipe without girth welds. Mitre or Wrinkle bends are not permitted.
- 6.10 All outlets NPS 2" pipe and larger shall be of integral contour type and ends of outlets, shall match the joining pipe or fitting specified.
- 6.11 Type and end of fittings shall be as specified in data sheet and purchase order.

## **7. DIMENSIONS, WORKMANSHIP AND DEFECTS**

### **7.1 Dimensions**

Dimensional check shall be carried out on finished products as per ASME B16.9 and B16.11 as applicable for fittings and as per this specification. Fittings not covered in the specifications stated above shall be checked as per Manufacturer's standard which shall be approved by TPI before starting of production.

Dimensional tolerance on fittings shall be as under:

Wall thickness : The tolerances on wall thickness shall be as specified in the relevant codes and standards.

Minimum wall thickness must be greater than or equal to the largest value of either the calculated minimum wall thickness in each zone of the fitting or of the nominal thickness of the pipe on which the fitting is welded.

### **7.2 Workmanship and Defects**

All fittings shall be free of injurious defects and shall have workmanlike finish. Injurious defects are defined as those having a depth in excess of 5 % of specified wall thickness. Each fitting in which injurious defects are found during plant or field fabrication shall be rejected, and Manufacturer shall be notified. Manufacturer shall replace the fittings at no extra cost to OWNER.

The unfinished product arriving at Manufacturer's shop shall be verified & tested for full compliance with the required specification.

## **8. INSPECTION AND TESTING**

- 8.1 The Manufacturer shall perform all inspection and tests as per the requirements of this specification and the relevant codes, prior to shipment, at his works. Such inspection and tests shall be, but not limited to the following:
  - 8.2 Visual Inspection
    - 8.2.1 Dimensional checks as per applicable standards for fittings.

- 8.2.2 Chemical composition, mechanical properties, notch toughness and hardness examination.
- 8.2.3 All finished Butt (wrought) weld ends shall be 100 % ultrasonically inspected for imperfections for a distance of 50 mm from the end. Laminations shall not be acceptable.
- 8.2.4 The entire surface of the fittings shall be checked by ultrasonic method for cracks and any material defects, which shall be witnessed by the TPI.
- 8.2.5 The full circumference of ends of butt-welded fittings after beveling shall be ultrasonically tested for imperfections. Any laminations shall not acceptable.
- 8.2.6 Magnetic particle or liquid penetrate examination shall be performed on cold formed butt-welding tees with extrusion outlets, that are subjected to an extreme fiber elongation of greater than 5 % shall be carried out as per the supplementary requirement SR 3 of MSS-SP-75.
- 8.2.7 Hot Dip Galvanized fittings shall comply to the testing requirements defined as per the ASTM A 153.
- 8.2.8 All other tests not specifically listed but are required as per applicable standard/ specification.
- 8.3 Purchaser's Inspector may also perform stage wise inspection and witness tests as indicated in Para 9.1 at manufacturer's works prior to shipment. Manufacturer shall give reasonable notice of time and shall provide without charges reasonable access and facilities required for inspection to the Purchaser's Inspector. Inspection and tests performed/witnessed by Purchaser's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and test.

Note: NDE inspector & procedures shall be qualified in accordance with ASME Sec. V, Article 5. The evidence of such records shall be furnished by **Manufacturer** to **OWNER / TPI** on request. Minimum qualification of NDE Inspector shall be ASNT Level-II certification.

## 9. PAINTING, MARKING AND SHIPMENT

- 9.1 All fittings shall be marked as per MSS SP 25.
- 9.2 Fittings shall be Hot Dip Galvanized as and when specified in the purchase order.
- 9.3 All loose material and foreign material i.e. rust, grease etc shall removed from inside and outside of the fittings.
- 9.4 Ends of all fittings shall be suitably protected to avoid any damage during transit. Metallic bevel protectors or high impact plastic protectors shall be used for fittings and each item shall be marked with indelible paint with the following data:
  - Manufacturer name / trademark
  - Material specification
  - Size and schedule/wall thickness
  - Heat Number
- 9.5 Package shall be marked legibly with suitable marking ink to indicate the following:
  - Order Number



- Package number
- Manufacturer's Name/trademark
- Type of fitting
- Size and wall Thickness/schedule

## 10. WARRANTY

### Warranty Type

**Manufacturer** shall give warranty stating that the fittings comply with the requirements stated in this specification and the other relevant standard & codes. **Manufacturer** is bound to replace or repair all fittings, which are found defective due to inadequate engineering or to the quality of materials and machining or any other reasons at no extra cost to OWNER.

If fittings defects cannot be eliminated, **Manufacturer** shall replace the same without any delay.

Manufacturer will reimburse OWNER for any fitting furnished on the order that fails under field hydrostatic test if such failure is caused by a defect in the fitting, which is outside the acceptance limits of this specification. The reimbursement cost shall include fitting, labor and equipment rental for finding, excavation, cutting out, and installation of replaced fitting in position. The field hydrostatic pressure will not exceed that value which will cause a calculated hoop stress equivalent to 100% of SMYS for the pipe with which the fitting is to be attached without impairing its serviceability.

### Warranty validity

The above warranty shall be valid for any defect occurring during the first year of operation, but not later than 24 months from the date of shipment from Manufacturer's works. All expenses shall be to Manufacturer's account.

## 11. ENCLOSURE:

- Annexure -1: Data Sheet
- Annexure -2: Quality Assurance Plan (QAP)

**Annexure-1:****Data sheet For Butt weld end, Socket weld end, threaded end, Sock-o-let, Weld-o-let Fitting**

SR. NO.	DESCRIPTION	SPECIFICATION
<b>GENERAL</b>		
1	Size	0.5" to 24" NB
2	Schedule no./Class Rating	
a)	Butt-welded fittings	SCH STD/XS/40/60/80/160
b)	Socket welded fittings, sock-o-let and weld-o-let	3000#, 6000#
C)	Threaded (Forged Plug/ threaded fittings)	3000#, 6000#
<b>SERVICE CONDITIONS</b>		
3	Service Fluid	Natural Gas
4	Temperature	-10° C to 65° C
5	Design Pressure	19 Bar-g/ 49 Bar-g/ 98 Bar-g
6	Operating Pressure Maximum	19 Bar-g/49 Bar-g/ 98 Bar-g
<b>CONSTRUCTION DESIGN</b>		
7	Design Standard	ASME B 16.9/ASME B 16.11/MSS SP 75/MSS SP 97
8	Allowable Stress Value	ASME B 31.8
9	Bevelled angle (for butt weld fittings)	32.5° ± 2.5°
10	Threading (For forged plug/ threaded fittings)	NPTM / NPTF as per ANSI B1.20.1
<b>MATERIAL SPECIFICATION</b>		
	<b>Part</b>	<b>Specified Material</b>
11	Material of Construction Refer material details specified in Purchase Order	<ul style="list-style-type: none"> <li>▪ ASTM A 105</li> <li>▪ ASTM A 234 Gr. WPB</li> <li>▪ ASTM A 350 Gr. LF2</li> <li>▪ ASTM A 420 Gr. WPL 6</li> <li>▪ MSS SP 75 Gr. WPHY 52/65</li> <li>▪ MSS SP 97</li> </ul>
<b>TESTING &amp; INSPECTION</b>		
12	Proof test	ASME B 16.9
13	Charpy Impact Test	ASTM A 370 Shall be as per the requirements defined in applicable material standard In case Charpy test not specified in relevant material standard than Charpy test shall be carried out at 0° C and absorbed energy value shall be average 35 J and minimum 28 J respectively.
14	Hardness test	<ul style="list-style-type: none"> <li>▪ ASTM A 105 - 187 HBW maximum</li> <li>▪ ASTM A 234 Gr. WPB – 197 HBW maximum</li> <li>▪ ASTM A 350 Gr. LF2 – 197 HBW maximum</li> <li>▪ ASTM A 420 Gr. WPL6 – 197 HBW maximum</li> <li>▪ MSS SP 75 - 235 BHN maximum</li> </ul>

15	Tensile test	<ul style="list-style-type: none"> <li>ASTM A 105 - 485 MPa minimum</li> <li>ASTM A 234 Gr. WPB - 415 MPa minimum</li> <li>ASTM A 350 Gr. LF2 – 485 to 655 MPa,</li> <li>ASTM A 420 Gr. WPL6 – 415 to 655 MPa</li> <li>MSS SP 75 WPHY 52 - 455 MPa minimum</li> <li>MSS SP 75 WPHY 65 – 530 MPa minimum</li> </ul>
16	Yield strength (Minimum)	<ul style="list-style-type: none"> <li>ASTM A 105 - 250 MPa minimum</li> <li>ASTM A 234 Gr. WPB - 240 MPa minimum</li> <li>ASTM A 350 Gr. LF2 - 250 MPa minimum</li> <li>ASTM A 420 Gr, WPL6 - 240 MPa minimum</li> <li>MSS SP 75 WPHY 52 - 358 MPa minimum</li> <li>MSS SP 75 Gr. WPHY 65 – 448 MPa minimum</li> </ul>
17	Elongation	As per the applicable material standard
18	Reduction Ratio	As per the applicable material standard
19	UT	100% Surface
20	MPT	100% at Bevel Ends
21	DPT (if thickness less than 6MM)	100%
22	Hot Dip Galvanization (*) Thickness and Adherence of the coating <i>*Applicable only for fittings to be used in PE-PNG works and will be specified in Purchase Order</i>	ASTM A 153
23	Marking	MSS SP 25
<b>NOTE: -</b>		
1. Inspection and testing shall be carried out as per the data sheet, Technical specifications and applicable standards and codes. Requirement of material supply shall be read in conjunction with approved Piping Material Specification and material description specified in Purchase Order.		
2. Manufacturer to prepare Quality Assurance Plan (QAP) in line with Technical Specifications, Data sheet and sample QAP and submit for approval. Material testing shall be carried out at Manufacturer premises according to requirement defined in approved QAP and inspection to be carried out by Third Party Inspection Agency. Scope for appointment of TPIA shall be as per the Purchase Order / Contract.		
3. All the Test to be witnessed / reviewed by TPIA as per the requirement defined in approved QAP.		
4. Bidder shall clearly mention deviation, if any.		
5. Welded fittings shall be normalized and 100% radio graphed.		
6. Manufacturer to provide valid calibration report of all the measuring instruments and same shall be reviewed by TPIA.		

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