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شرکت ملی گاز ایران  
مدیریت پژوهش و فناوری  
امور تدوین استانداردها

# IGS

مشخصات فنی خرید

اتصالات فولادی جوش لب به لب ، اندازه های ۵/۸ تا ۵۶ اینچ

Carbon Steel Butt Welding Fittings  
in Size NPS 1/2 through NPS 56



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شرکت ملی گاز ایران



دفتر مدیرعامل



## ابلاغ مصوبه هیأت مدیره



### مدیر محترم پژوهش و فناوری

باسلام،

به استحضار می‌رساند در جلسه ۱۹۴۸ مورخ ۱۴۰۰/۰۹/۰۱ هیأت مدیره، نامه شماره گ. ۹۱۸۴۶/۰۰۰/۹ مورخ ۱۴۰۰/۰۷/۲۶ مدیر پژوهش و فناوری در مورد تصویب نهایی مقررات فنی شرکت ملی گاز ایران به شرح زیر مطرح و مورد تصویب قرار گرفت.

۱- مشخصات فنی کاتالیست های واحد مرکاپتان زدا IGS-M-CH-052(0)

۲- مشخصات فنی کاتالیست های واحد بازیافت گوگرد IGS-M-CH-054(1)

۳- مشخصات فنی خرید تجهیزات گرم کننده گاز غیرمستقیم آبی نوع مشعل دمنده دار

IGS-M-PM-106(2)

۴- مشخصات فنی خرید کنتورهای نوع توربینی IGS-M-IN-102(3)

۵- مشخصات فنی خرید اتصال سه راهی انشعاب گرم IGS-M-PL-033(2)

۶- مشخصات فنی خرید اتصالات جوش لب به لب در اندازه های ۱/۲ الی ۵۶ اینچ

IGS-M-PL-022(2)

۷- مشخصات فنی و نقشه های اجرایی انشعابات در شبکه های توزیع گازرسانی پلی اتیلن

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## Foreword

This standard specification is intended to be mainly used by N.I.G.C. and contractors, and has been prepared base on interpretation of recognized standards and technical documents, as well as knowledge, backgrounds and experiences in gas industries at national and international levels.

Iranian Gas Specification (IGS) are prepared, reviewed and amended by technical standard committees within NIGC standardization division of research and technology management and submitted to "the standards council of NIGC" for approval.

IGSs are subjected to revision, amendment or withdrawal, if required, and thus the latest edition of IGS shall be checked / inquired by NIGC'S users.

This standard must not be modified or altered by NIGC employees or its contractors. Any deviation or conflicts between this specification and other applicable standards, codes, procedure or well-known manufacturer's specifications must be resolved in writing by the user or its representative through Manager, Engineering Department or standardization division of NIGC.

The technical standard committee welcomes comments and feedbacks from concerned or interested corporate and individuals about this standard, and may revise this document accordingly based on the received feedbacks.

## General Definitions

Throughout this standard the following definitions, where applicable, should be followed:

- 1- "STANDARDIZATION DIV." is organized to deal with all aspects of industry standards in NIGC. Therefore, all enquiries for clarification or amendments are requested to be directed to mentioned division.
- 2- "COMPANY": refers to National Iranian Gas Company (NIGC).
- 3- "SUPPLIER": refers to a firm who will supply the service, equipment or material to IGS specification whether as the prime producer or manufacturer or a trading firm.
- 4- "SHALL ": is used where a provision is mandatory.
- 5- "SHOULD": is used where a provision is advised only.
- 6- "MAY": is used where a provision is completely discretionary.

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## 1. SCOPE

This specification covers the minimum requirements for wrought butt-weld fittings with seamless or fusion-welded construction covered by ASME B16.9 and MSS SP 75 in sizes NPS 1/2 through NPS 56. These fittings are for use in high-pressure sweet natural gas transmission and distribution system designed as per ASME B31.8. This specification doesn't cover fabricated fittings, cast-welding fittings or fittings machined from castings, bare stock or forged block.

## 2. REFERENCES

Throughout this specification, the following standards and codes are referred to. The edition of these standards and codes those are in effect at the time of issuing of this standard specification are noted in the references. Applicability of any changes in the standards and codes that may occur after issuing the current specification shall be mutually agreed upon by the purchaser and supplier and/or manufacturer.

**ASME Section IX (2013)** "Welding, Brazing and fusing Qualification"

**ASME Section VIII (2013)** "Rules for Construction of Pressure Vessel"

**ASME B16.9 (2018)** "Factory -Made Wrought Butt Welding Fittings"

**ASME B36.10 (2004)** "Welded and Seamless Wrought Steel Pipe"

**ASME B31.8 (2012)** "Gas Transmission and Distribution Piping System"

**ASTM A 105 (2012)** "Standard Specification for Carbon Steel Forgings for Piping Application"

**ASTM A 234(2015)** "Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service"

**ASTM A 370 (2012)** "Standard Test Method and Definitions for Mechanical Testing of Steel Products"

**"ASTM A 960(2006)** "Standard Specification for Common requirements for Wrought Steel Piping Fittings"

**MSS-SP-75 (2019)** "Specification for High Test Wrought Butt-welding Fittings"

**ISO 10893-8(2011)** "Automated ultrasonic testing of seamless and welded steel tubes for the detection of laminar imperfection".

**ISO 3834-2(2005)** "Quality requirements for fusion welding of metallic materials-part

2: comprehensive quality requirements".

### 3. DEFINITIONS

#### **NPS**

Nominal size of fitting (NPS): refers to the largest nominal size of the matching pipe

#### **SAWL pipe**

Tubular product having one longitudinal seam, produced by submerged-arc welding

#### **GMAW**

Gas Metal-Arc Welding process.

#### **SAWH pipe**

Tubular product having one helical seam, produced by submerged-arc welding

#### **SMLS pipe**

Tubular product without any weld seam, produced by a hot-forming process, which can be followed by cold sizing or cold finishing to produce the desired shape.

#### **SMYS**

Specified minimum yield strength

#### **PWHT**

Post weld heat treatment

#### **CMTR**

Certified material test report

#### **HFW pipe**

Pipes produced with electric welding process with a frequency current equal to or greater than 100 kHz.

#### **HAZ**

Heat Affected Zone

#### **NDT**

## Nondestructive tests

### UT

Ultrasonic Testing

### MT

Magnetic Particle Testing

### PT

Liquid Penetrant Testing

### RT

Radiographic Testing

### Seamless fittings

Fittings manufactured without welding from starting material which is not welded

### Welded fittings

- a) Fittings made from tubular fusion welded products.
- b) Fittings made from sheets, plates or pipes where welding is a part of the manufacturing process.

### Fabricated fittings

Fittings fabricated by circumferential or intersection weld of pipe pieces.

### Purchaser

Person or Organization/Company that orders products in accordance with this specification.

### Carbon equivalent

Based upon the international institute of welding, carbon equivalent ( $CE_{IIW}$ ) calculated as following equation when the carbon content is greater than 0.12:

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

**Extrados**

Outer curved section of the elbow

**Intrados**

Inner curved section of the elbow

**Fusion welding with Filler metal**

A welding process which a metal added in making of a joint through welding. The following process is approved for use:

- Shielded Metal Arc Welding (SMAW)
- Gas Tungsten Arc Welding (GTAW)
- Submerged Arc Welding (SAW)

**Tubular products**

High quality circular hollow section steel products in cylindrical shape such as: hollow forging stocks, seamless pipes (SMLS), or fusion welded pipes (SAWL).

**Technical specification**

This specification covers the minimum requirements of design, material, and fabrication, inspection, testing and marking of seamless and welded wrought steel butt weld end fittings such as elbow, cap, tee and reducer

**4. DESIGNATION**

Except as supplemented or amended by this specification fittings shall be designed, manufactured and supplied in accordance with:

- ASME B16.9 for ASTM A234 grade WPB in sizes NPS $\leq$  12 and;
- MSS SP-75 for WPHY butt –welding fittings in sizes NPS $\geq$ 16

**5. MATERIAL**

-WPB fittings shall be made of seamless tubular products conform to the requirements of ASTM A234.



-WPHY fittings shall be forgings, plates, sheets, fusion welded or seamless tubular products conform to the requirement of MSS SP -75.

Note: Grade of fittings shall be the same as or comply with the matching pipe and to be specified by purchaser.

## 6. MANUFACTURING

The different allowed manufacturing processes and the relevant starting materials listed in Table 1.

**Table 1-Fitting making process-Starting product forms<sup>a</sup>**

Process <sup>c</sup>	Hot forming			Cold forming	
	Bending	Pressed in die, Extruding	Rolled, Forging	Bending	Pressed in die, Extruding b
Elbows	1,2,4	1,2,3,4	4	1,2,4	1,2,3,4
Tees	-	1,2,3,4	4	-	1,2,3,4
Reducers	-	1,2,3,4	4	-	1,2,3,4
Caps	-	3,4	4	-	3,4

**a Starting material:**

- 1 seamless tubular product
- 2 welded tubular product
- 3 plate or sheet
- 4 forging

**Notes:**

- a) When manufacturing fittings from tubular products;
- Only seamless or welded tubular products with one longitudinal weld seam made with filler metal are permitted. The choice of the type of tubular products (seamless or welded) shall be specified in purchase order.
  - High-frequency (HFW) or helical –seam submerged arc welding (SAWH) tubular products are not permitted.
  - For welded tubular products, the full length of the weld seam shall be nondestructively tested in tube condition.
  - The outlet of all straight/ reduced tees shall be extruded
- b) - followed these process, welding may be used .When fittings constructed by welding ;
- Only welding with filler metal are permitted (see clause 7).
  - All welds shall have complete penetration
  - Welding process/procedure and welding qualification shall be as clause 7.
- c) -Fabricated fittings, cast-welding fittings or fittings machined from castings or bare stock are not permitted.
- The manufacturing procedure specification (MPS) and welding NDE results shall be approve by purchaser

### 6.3 Tee

- Straight tees with  $NPS \leq 24$  or reduced tees with larger end 24 and less shall be seamless. Other larger tees can be made of one straight seam weld tubular products or shall be weld construction type.
- When tee is fabricated from tubular product, the branch outlet of tees shall be extruded to the run and shall have smoothly curved transition between run and branch.
- Outlet branch in tee manufactured from welded tube shall be extruded and diametrically opposite the longitudinal weld.
- When tee is fabricated from plate (weld construction type), the weld seams shall be parallel to the axes of the run and the branch.
- Welded-on branch connections (set-on or stub-in) are prohibited.
- Tees shall have a minimum wall thickness which is equal or greater than the specified wall thickness of the matching pipe (of equal SMYS).
- When barred tee is required, the guide bars shall have a configuration and requirements as indicated in Appendix A.

### 6.4 Reducer

Concentric /eccentric reducers with  $NPS \leq 12$  shall be seamless. Larger reducers can be made of one straight seam weld tubular products or weld construction type (one/two welds seams). The fittings shall have smoothly curved transition and parallel end. Reducers shall have a minimum wall thickness which is equal or greater than the specified wall thickness of the matching pipe (of equal SMYS).

### 6.5 Cap

All caps shall be seamless, conforms to the Ellipsoidal shape and requirement given in ASME section VIII, Appendix 1. The minimum wall thickness within the body of the cap and the straight skirt shall be equal or greater than the specified wall thickness of the matching pipe (of equal SMYS)

## 6.5 Elbow

Short / long radius elbows with  $NPS \leq 24$  shall be seamless. Larger elbows can be made of one straight seam weld tubular products or weld construction type (one/two welds seams). The minimum wall thickness of the elbows shall not be less than the specified wall thickness of the matching pipe (of equal SMYS) and comply with Appendix B

When producing elbows from welded pipe, the weld seam shall be positioned at lateral side.

## 7. WELDING

When producing fittings from plate or strip, welding is considered being a part of the manufacturing of fittings, welding process/procedures and welders / welding operators shall be qualified based on ASME IX. All qualified welding procedure specification (WPS) and procedure qualification records (PQR) shall be written in English and available for review by the purchaser. Welding process shall comply with ISO3834-2.

Welding construction fittings processes are:

- Shielded Metal Arc Welding (SMAW)
- Gas Tungsten Arc Welding (GTAW)
- Submerged Arc Welding (SAW)
- Gas Metal-Arc Welding (GMAW)-short Circuiting transfer shall not be used.

Notes:

- 1- Circumferential welds are not allowed
- 2-Flux Core Arc Welding (FCAW)-shall not be used for root pass.
- 3-Automatic welding without filler material is not permitted

## 8. HEAT TREATMENT

Fittings requiring heat treatment shall be normalized / normalized and tempered or Quenched and tempered after welding and forming as defined in ASTM A234 or MSS SP -75.

## 9. END PREPARATION

End preparation for fittings in sizes NPS 14 and smaller shall be as per ASME B16.9, Table 8-1 & fig 8-1 . Butt-welding fittings with NPS 16 and larger shall comply with MSS-SP-75, fig1&2 (section 13).

- The entire end bevel shall be machined flat .Root faces shall not be brought into tolerance by filing or grinding.
- Fittings that do not have a thickness or SMYS, or both equal to the matching pipe, are acceptable provided the end preparation comply with Appendix C

## 10. REPAIRING

### 10.1 Treatment of dress able surface defects

All dress able surface defects shall be dressed out by grinding. Grinding shall be carried out in such a way that the ground area blend in smoothly with the contour of the fitting. Complete removal of defect shall be verified by local visual inspection and, where necessary, by suitable Non-destructive inspection methods (PT/MT). After grinding the remain wall thickness in dressed area shall not encroach on the minimum permissible wall thickness.

### 10.2 Repair of defects by welding

Repair of fitting body (base metal) by welding is not permitted. Repair by welding shall be limited to the weld seams of weld construction fittings. The weld repairs shall submit by manufacturer and approved by purchaser. Cracks shall be repaired only if approved by the purchaser. The defect shall be completely removed and the resulting cavity shall be thoroughly cleaned. The remaining weld defects separated by less than 100 mm shall be repaired as a continuous single weld repair. The total length of repaired zones shall be  $\leq 5$  % of the total weld length. After weld repair; the total area of the repaired zone shall be subjected to RT. Unsuccessful weld repairs after the second attempt shall be completely cut out and replaced.

Note: No weld repair shall be carried out after heat treatment

## **11. TESTING AND INSPECTION**

### **11.1 General requirements**

Quality Control Plan (QCP) shall be approved by purchaser. The Inspection Testing Plan (ITP) shall be issued by manufacturer/supplier and approved by purchaser.

When specified by the purchase order, tests on materials or components shall be witnessed by purchaser, or his appointed inspector, the purchaser or his appointed inspector shall be given access to those parts of the manufacturer's works engaged on the production of fittings to inspect the materials being processed at any stage of manufacture. The purchaser may reject any materials or components which in his opinion do not conform to the requisition.

### **11.2 Chemical Composition**

The chemical composition shall conform to the requirements prescribed in clause 5 (Materials). The carbon equivalent of base metal shall not exceed of 0.42.

### **11.3 Hydrostatic Testing**

Mill hydrostatic testing of fitting is not required, but the manufacturer shall certify that the fitting will withstand an internal field pressure established by the purchaser without failure or leakage by issued of related type test certificate.

### **11.4 Tensile Testing**

#### **11.4.1 Base Metal**

Tensile properties of base metal shall conform to:

- a) ASTM A234, Table 2 for WPB fittings
- b) MSS SP75, Table 2 for WPHY fittings.

Note: Actual yield shall not exceed specified minimum by more than 15ksi [105Mpa]

#### **11.4.2 Transverse Weld Seam**

For NPS $\geq$ 16, the SMYS of welds metal of weld fabricated fittings shall meet the minimum requirement of the corresponding base metal.

### **11.5 Transverse Guided –Weld Bend Test**

When specified in purchase order, transverse guided-weld bend test shall be performed on weld fabricated WPHY fittings in accordance with MS SP-75 for NPS $\geq$ 16.

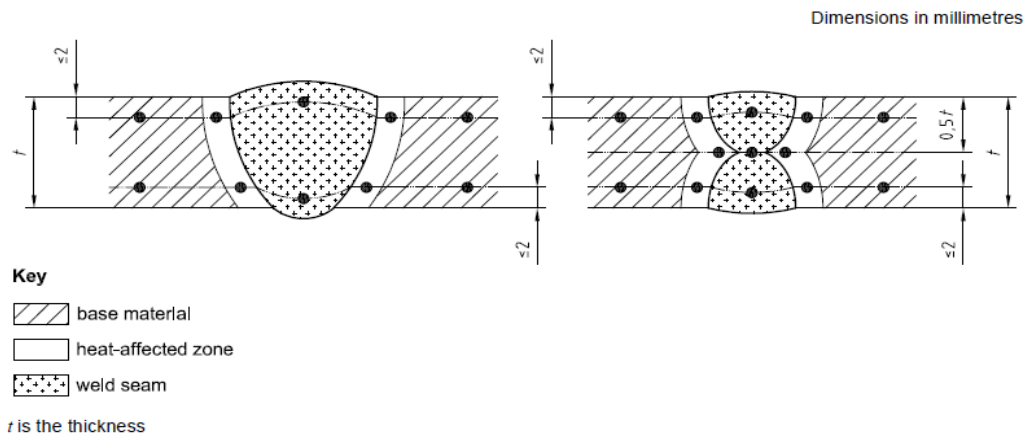
### **11.6 Charpy V-notch Impact Testing**

Notch –toughness test shall be conducted on fittings with NPS $\geq$ 12, grade WPHY-42 and higher as per MSS SP 75. One set (three specimens) of base metal, HAZ and weld metal

shall be tested at +20 °F and show minimum average 20 ft-lb with no one specimen less than 15 ft-lb .

### 11.7 Hardness Testing

Hardness testing shall be performed on surface and through-thickness (if applicable as per Figure1). Maximum surface/ through-thickness hardness of WHPY fitting shall be 237 HBW and for WPB fittings is according to ASTM A234 specification (197 HBW).



**Figure1- Through -thickness Hardness indents locations for welded fittings**

### 11.8 Nondestructive Testing

All NDT shall be conducted after final heat treatment in accordance with documented procedures which approved by NDT level III.

All NDT personnel shall be qualified and certified in accordance with ASNT-TC-1A.

#### 11.8.1 Fittings Ends

**11.8.1.1** Welding ends of fittings in sizes NPS  $\geq 1$  shall be tested by:

a) Dye penetration (PT) in accordance with ASTM E165 and acceptance criteria ASME Sec. VIII D1, Appendix 8. Or:

b) Magnetic particle (MT) in accordance with ASME Sec. VIII D 1, Appendix 6

**11.8.1.2** For fittings with  $t \geq 5\text{mm}$ , a 25 mm wide band at each end shall be inspected for laminar imperfections by UT in accordance with ISO 10893-8. Laminations or inclusions extending into the face or bevel of the fitting and having a length of  $\geq 6.4\text{ mm}$  in the circumferential direction shall be classified as defect.

### **11.8.2 Weld Seams**

**11.8.2.1** All butt welds shall be 100% radiographically examined throughout the entire length of each weld in accordance with Article 2 of ASME Section V.

Longitudinal weld seam shall meet the acceptance standards ASME Section VIII Division 1.

Note: For  $t \geq 20$  mm, radiographic examination may be replaced by ultrasonic examination.

### **11.8.3 Fitting Body**

Magnetic particle or liquid penetrant examination shall be performed on cold formed butt welds by one of the specified in supplementary requirements S69 or S70 of specification ASTM A960. This examination shall be performed in accordance with MSS SP 75, para 15.3 on finish.

### **11.9 Visual examination**

After final heat treatment and all Non-destructive examination, the full body and welds of every fitting shall be examined internally (if applicable) and externally respectively in accordance with ASTM A960 and ASME Sec. VIII. Surface shall be dry and free of all dirt, oil, grease, Lint, scale, welding flux and spatter. For internal examination of fitting with  $NPS \geq 24$ , the inspector shall pass through the bore of the fitting. General appearance workmanship and fit up shall be acceptable. Weld surface shall show a smooth counter with no crack, exceeding of weld reinforcement and incompletely filled weld penetration. Imperfections of the following types exceeding the specified criteria shall be considered injurious:

- All sharp gouges deeper than 1.0 mm
- Dents without sharp-bottom gouges, exceeding 3 mm in depth
- Peaks exceeding 3 mm in height
- Any hard spot
- Weld reinforcement exceeding 3 mm, for fittings with a wall thickness  $\leq 12$  mm
- Weld reinforcement exceeding 4 mm for fittings with a wall thickness  $> 12$  mm
- Incompletely-filled weld preparations
- Radial offset of plate edges, or plate misalignment, exceeding 2mm, for fittings with a wall thickness of 12 mm or less

- Radial offset of plate edges, or plate misalignment, exceeding 12.5% wall thickness or 3 mm, whichever is smaller, for fittings with a wall thickness greater than 12 mm
- Laps, flats, tears, pulls and similar defects

Surface imperfections which considered injurious shall be repaired as MSS SP75, Para. 14.5.3, but any repair of fitting body by welding is not permitted

### **11.10 Dimensions and Tolerances**

All dimensions and tolerances (wall thickness, inside diameter at ends, out of roundness, beveling, specific dimensions, etc...) shall be in accordance with;

a) ASME B16.9, for fittings with NPS  $\leq 12$

b) MSS-SP-75, for fittings with NPS  $\geq 16$

-Nominal wall thickness (in inches)/Schedule No (as per ASME B36.10) shall be checked as per purchase order.

## **12. MARKING**

The required marking information included of:

- manufacturer's name or trademark.
- fitting designation (ASME B16.9 or MSS SP-75).
- Size.
- material identification/ class symbol. (WPB/WPHY) .
- schedule No / wall thickness of weld end.
- Heat number.
- Serial Number.

The permitted methods are:

a) paint- stenciled by heat resistance color (approximate 230 0 C) on the outside surface in white block capitals for all fittings.

b) In addition of method a, all fittings with NPS  $\geq 2$  shall be marked with:

- Low-stress dies stamping or dot- peen with round- nosed indenter; or
- Electro-etching or vibro-tool marking

**Note 1: Conventional sharp stamp/peen shall not be used. The maximum depth shall be less than 10% of specified wall thickness or 2mm whichever is less.**

**Note 2: Marking shall not be applied to internal surfaces, highly stressed parts and weld preparations**



### 13. COATING

After inspection, fitting exposed surface may be painted, rust temporary coated or supplied without any coating as per purchase order by agreement between purchaser and supplier.

### 14. ORDERING INFORMATION

The following information shall be included in the purchase order.

- Type of fitting
- Nominal size, wall thickness / schedule and end details of pipe to be matched
- Grade or specified minimum yield strength of fitting material
- Quantity
- Material specification/grade of matching pipe
- Pipeline design pressure & temperature.
- Pipeline field hydrostatic test pressure.
- Charpy impact testing requirements. (if required& applicable))
- Transverse guided-weld bend test (if required)
- guide bar for Tees (if required)
- Coating / painting (if required)
- Third- party inspection
- Supplementary/additional requirements

### 15. DOCUMENTATION

**15.1** When requested by the purchaser, the manufacturer /vendor shall provide a certificate of compliance to this specification.

**15.2** In addition, if requested to provide test reports, the manufacturer shall also provide the following certificate reports:

- Chemical analysis (base metal)
- Tensile property (base metal -yields, ultimate strength and elongation).
- Transverse weld tensile strength.
- CVN, (base metal, HAZ & weld metal).

- NDE (ends, welds, body)
- Dimensional check
- Heat treatment procedure and chart
- Any supplemental testing required by the purchase order.

**15.3** All certificates shall be written in the English Language and available at the time the fittings are ready for inspection

## **16. PACKING AND SHIPMENT**

### **16.1 General**

Prior to packing the fittings shall be dusted, cleaned internally and externally. Packing shall be sufficient to withstand, without irritation, rough handling during loading/unloading, inland transport and shall be used high quality wooden cases and /or crate. Ends of fittings greater than 8" should be protected with rubber in a manner where no sharp pieces are exposed and then should be inhibited with metal straps.

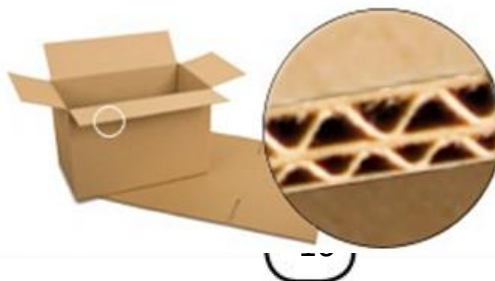
All of the wooden case, wooden crate box and pallets shall have raised skid platform to permit sling or forklift truck handling.

The contents of each package must be specified and must be attached to the box. Packing list and detail packing list of the packages shall be in English. The packing list shall be at least include the following:

- a) The Manufacturer's Name& Country of origin goods
- b) List of actual Content (Description of goods, Quantity)
- c) Name of purchaser
- d) Package No
- e)Order No.
- f)Item/Storage No.
- g)Weight

### **16.2 Cardboard Box**

This type of box must be used for small butt welding fittings with NPS  $\leq 1$ " and then must be put inside the wooden crate box as described 16.4.



### 16.3 Wooden Box

This type of box must be used for butt welding fittings with  $1" < \text{NPS} \leq 4"$ .



### 16.4 Wooden Crate Box

This type of wooden box must be used for butt welding fittings (Tee, Elbow, Cap, and Reducer) with  $4" < \text{NPS} \leq 8"$ .



### 16.5 Wooden Pallet

This type of wooden pallet must be used for butt welding fittings (Elbow, Tee, Cap, Reducer) with  $8" < \text{NPS} \leq 36"$ .



Packing procedure of fittings greater than 36" shall be specified by manufacturer and approved by purchaser. Bevel of all the fittings greater than 36" shall be protect with rubber, hard plastic, plywood or etc.

**PIPE THICKNESS (T) OF BARS**

**DIMENSION TABLE**

BAR NO.	PIPE SIZE					PIPE THICKNESS (T)
	4"	6"	8"	10"	12"	
1	100	150	200	250	300	350
2	100	150	200	250	300	350
3	100	150	200	250	300	350
4	100	150	200	250	300	350
5	100	150	200	250	300	350
6	100	150	200	250	300	350
7	100	150	200	250	300	350
8	100	150	200	250	300	350
9	100	150	200	250	300	350
10	100	150	200	250	300	350
11	100	150	200	250	300	350
12	100	150	200	250	300	350
13	100	150	200	250	300	350
14	100	150	200	250	300	350
15	100	150	200	250	300	350
16	100	150	200	250	300	350
17	100	150	200	250	300	350
18	100	150	200	250	300	350
19	100	150	200	250	300	350
20	100	150	200	250	300	350
21	100	150	200	250	300	350
22	100	150	200	250	300	350
23	100	150	200	250	300	350
24	100	150	200	250	300	350
25	100	150	200	250	300	350
26	100	150	200	250	300	350
27	100	150	200	250	300	350
28	100	150	200	250	300	350
29	100	150	200	250	300	350
30	100	150	200	250	300	350
31	100	150	200	250	300	350
32	100	150	200	250	300	350
33	100	150	200	250	300	350
34	100	150	200	250	300	350
35	100	150	200	250	300	350
36	100	150	200	250	300	350
37	100	150	200	250	300	350
38	100	150	200	250	300	350
39	100	150	200	250	300	350
40	100	150	200	250	300	350
41	100	150	200	250	300	350
42	100	150	200	250	300	350
43	100	150	200	250	300	350
44	100	150	200	250	300	350
45	100	150	200	250	300	350
46	100	150	200	250	300	350
47	100	150	200	250	300	350
48	100	150	200	250	300	350
49	100	150	200	250	300	350
50	100	150	200	250	300	350
51	100	150	200	250	300	350
52	100	150	200	250	300	350
53	100	150	200	250	300	350
54	100	150	200	250	300	350
55	100	150	200	250	300	350
56	100	150	200	250	300	350
57	100	150	200	250	300	350
58</						

## APPENDIX B- Elbow Design

The minimum wall thickness of the intrados ( $t_i$ ) shall be determined from the following formula:

$$t_i = t \times E$$

Where

$t$  is the minimum wall thickness.

$E$  is a factor given in bellow table

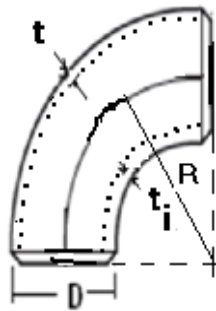
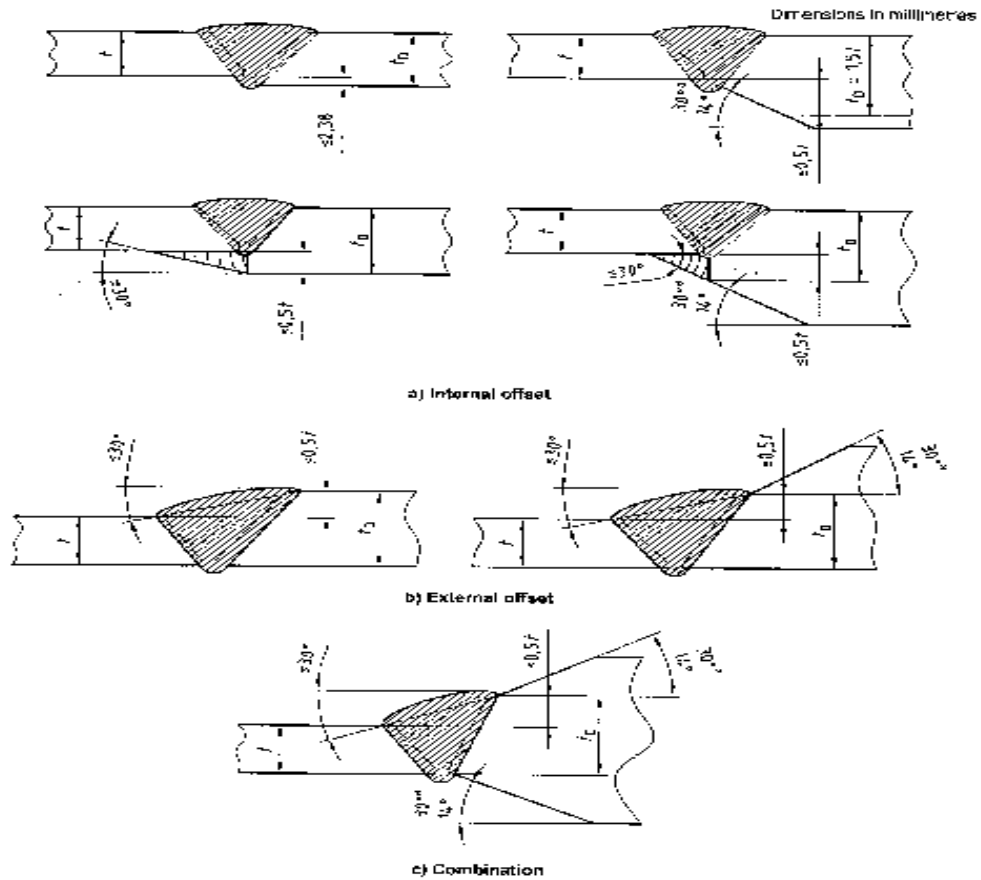


Table B - $E$ values for intrados wall thickness calculation	
R/D a	$E$
1 b	1.25
1.5c	1.1
3	1.04
Intermediate values may be interpolated	
a Elbow centerline radius divided by outside diameter	
b Known as a short –radius elbow	
c Known as a long –radius elbow	

Figure B-  
Principal  
Dimensions  
of Typical  
elbow

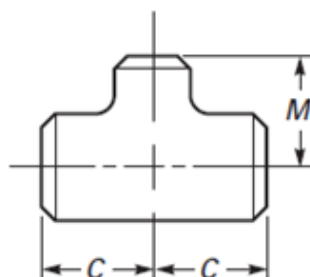
## APPENDIX C-Bevel designs for unequal wall thickness



If the SMYSs of the sections to be joined are not equal, the minimum thickness,  $t_0$ , shall be not less than 1 times the ratio of the SMYS of the pipe and fitting, but shall not exceed 1.5t.

- There is no restriction on the minimum angle if the materials joined have equal SMYS.

### APPENDIX D – Dimensions of Reducing Outlet Tees and Reducing Outlet Crosses



Nominal Pipe Size (NPS)	Outside Diameter at Bevel		Center-to-End	
	Run	Outlet	Run, <i>C</i>	Outlet, <i>M</i> [Note (1)]
<b>12×12×4</b>	<b>12.75</b>	<b>4.50</b>	<b>10.00</b>	<b>8.50</b>
GENERAL NOTE: All dimensions are in inches.				
NOTE: (1) Outlet dimension <i>M</i> is recommended but not required.				



**CAP DATA SHEET**

MANUFACTURER :	INQUIRY NO :
DRWG. NO. :	ORDER /JOB NO :
ITEM NO :	DESIGNE PRESS.:
QUANTITY :	DESIGNE TEMP :
NOMINAL SIZE:	CARBON EQUIVALENT / PCM :
WALL THICNESS/SCH:	CARBON CONTENT :
	SULFUR CONTENT :
MATCHING PIPE	OD ..... THK.....MATERIAL/GRADE.....
TYPE OF CAP :	<input type="checkbox"/> STANDARD    CROWN    OTHER
STARTING MATERIAL	<input type="checkbox"/> SOLID BAR    PLATE    OTHER
PROCESS OF MANUFACTURE	<input type="checkbox"/> HOT FORMING    COLD FORMING <input type="checkbox"/> FORGING    PRESS IN DIE OTHER.....
MATERIAL	<input type="checkbox"/> ASTM-A234 GRADE WPB <input type="checkbox"/> MSS-SP-75 WPHY 42    WPHY 52    WPHY 60    WPHY 65 <input type="checkbox"/> WPHY 70
Heat Treatment	<input type="checkbox"/> YES    NO
DIMENSIONS	<input type="checkbox"/> ASME B 16.9 <input type="checkbox"/> MSS-SP-75    OTHER
ENDS PREPARATION	ASME B16.25    MSSSP-75    ASME 31.8 OTHER.....

INSPECTION AND TESTS	<input type="checkbox"/> CHEMICAL COMP.    TENSILE    CVN    HARDNESS
	AT BEVELES:    UT    MT    PT    VT
DEVIATIONS FROM THIS SPEC :	
NOTE: THIS DATA SHEET SHALL BE COMPLETED AND SIGNED BY MANUFACTURER FOR EACH ITEM.	

LONG RADIUS ELBOW	
DATA SHEET	
MANUFACTURER :	INQUIRY NO :
DRWG. NO. :	ORDER/JOB NO :
ITEM NO :	DESIGNE PRESS:
QUANTITY :	DESIGNE TEMP :
NOMINAL SIZE:	CARBON EQUIVALENT / PCM:
WALLTHICKNESS / SCH :	CARBON CONTENT :
	SULFUR CONTENT :
MATCHING PIPE	OD .....THK .....MATERIAL/GRADE.....
BEND ANGLE :	BEND RADIUCE:
STARTING MATERIAL	<input type="checkbox"/> SEAMLESS TUBULAR PRODUCT
	<input type="checkbox"/> WELDED TUBULAR PRODUCT      SOLID BAR PLATE
PROCESS OF MANUFACTURE	<input type="checkbox"/> HOT FORMING      COLD FORMING
	<input type="checkbox"/> FORGING      PRESS IN DIE
	<input type="checkbox"/> EXTRUDING      ROLLING
	<input type="checkbox"/> WELDING
	<input type="checkbox"/> ASTM 24234 , GRADE WPB    MSS-SP-75

MATERIAL	<input type="checkbox"/> WPHY 42    WPHY 52    WPHY 60    WPHY 65    WPHY 70
Heat Treatment	<input type="checkbox"/> YES                      NO
DIMENSIONS & TOLERANCES	<input type="checkbox"/> ASME B 16.9            MSS-SP-75            OTHER.....
END PREPARATION	ASME B16.25            MSS-SP-75            ASME B 31.8 OTHER.....

INSPECTION AND TESTS	<input type="checkbox"/> CHEMICAL COMP.    TENSILE    CVN    HARDNESS
	VT                      RT of WELD SEAMS
	AT BEVELES:    UT    MT    PT    VT
DEVIATIONS FROM THIS SPEC :	
NOTE: THIS DATA SHEET SHALL BE COMPLETED AND SIGNED BY MANUFACTURER FOR EACH ITEM.	

UNEQUAL/EQUAL TEE'S DATA SHEET	
MANUFACTURER :	INQUIRY NO :
DRWG . NO . :	ORDER /JOB NO :
ITEM NO :	DESIGNE PRESS.:
QUANTITY :	DESIGNE TEMP .
NOMINAL SIZE:	CARBON EQUIVALENT / PCM :
	CARBON CONTENT :
	SULFUR CONTENT :
TYPE OF TEE :	<input type="checkbox"/> EQUAL    REDUCED    BARRED
SIZE IN(mm)	RUN :: OD ..... THICKNESS/SCH.....
	BRANCH: OD ..... THICKNESS/SCH .....
MATCHING PIPE	RUN:
	OD .....THK.....MATERIAL/GRADE.....
	BRANCH:
	OD .....THK.....MATERIAL/GRADE.....
STARTING MATERIAL	<input type="checkbox"/> SEAMLESS TUBULAR PRODUCT
	<input type="checkbox"/> WELDED TUBULAR PRODUCT
	SOLID BAR    PLATE

PROCESS OF MANUFACTURE	<input type="checkbox"/> HOT FORMING	COLD FORMING
	<input type="checkbox"/> FORGING	EXTRUDED BRANCHE
	ROLLING	
	PRESS IN DIE	WELDED BRANCH
	<input type="checkbox"/> OTHER.....	

MATERIAL	ASTM-A234 GRADE WPB					
	<input type="checkbox"/> MSS-SP-75					
	<input type="checkbox"/> WPHY 42    WPHY 52    WPHY 60    WPHY 65					
	<input type="checkbox"/> WPHY 70					
Heat Treatment	<input type="checkbox"/> YES                      NO					
DIMENSIONS	<input type="checkbox"/> ASME B16.9   MSS-SP-75    OTHER					
ENDS	<input type="checkbox"/> ASME B16.25    MSS -SP-75    ASME B 31.8    OTHER.....					
PREPARATION						
INSPECTION AND TESTS	<input type="checkbox"/> CHEMICAL COMP.   TENSILE   CVN            HARDNESS            VT					
	RT of WELD SEAMS					
	AT BEVELES:   UT    MT    PT					
	BODY(cold formed) :   UT    MT					
DEVIATIONS FROM – IGS-M-PL -022 SPEC :						
<b>NOTE: THIS DATA SHEET SHALL BE COMPLETED AND SIGNED BY MANUFACTURER FOR EACH ITEM.</b>						

REDUCER DATA SHEET	
MANUFACTURER :	INQUIRY NO :
DRWG . NO . :	ORDER /JOB NO :
ITEM NO :	DESIGNE PRESS.:
QUANTITY :	DESIGNE TEMP .
REDUCER SIZE:	CARBON EQUIVALENT / PCM :
	CARBON CONTENT :
	SULFUR CONTENT :
TYPE OF REDUCER :	<input type="checkbox"/> COCENTRIC <input type="checkbox"/> ECCENTRIC
MATCHING PIPE :	MAIN OD .....THK.....MATERIAL/GRADE.....
	REDUCE OD .....THK.....MATERIAL/GRADE.....
STARTING MATERIAL	<input type="checkbox"/> SOLID BAR <input type="checkbox"/> PLAT <input type="checkbox"/> SEAMLESS TUBULAR PRODUCT <input type="checkbox"/> WELDED TUBULAR PRODUCT <input type="checkbox"/> OTHER
PROCESS OF MANUFACTURE	<input type="checkbox"/> HOT FORMING <input type="checkbox"/> COLD FORMING <input type="checkbox"/> SOLID FORGE <input type="checkbox"/> ROLLING <input type="checkbox"/> PRESS IN DIE <input type="checkbox"/> OTHER.....

MATERIAL	ASTM-A234 GRADE WPB
	<input type="checkbox"/> MSS-SP-75 <input type="checkbox"/> WPHY 42   WPHY 52   WPHY 60   WPHY 65 <input type="checkbox"/> WPHY 70
Heat Treatment	<input type="checkbox"/> YES                      NO
DIMENSIONS	<input type="checkbox"/> ASME B16.9   MSS-SP-75   OTHER
ENDS	<input type="checkbox"/> ASME B16.25   MSS-SP-75   ASME B 31.8   OTHER.....
PREPARATION	
INSPECTION	<input type="checkbox"/> CHEMICAL COMP.   TENSILE   CVN                      HARDNESS
AND TESTS	AT BEVELES:   UT   MT   PT   VT
	BODY(cold formed) :   UT   MT
DEVIATIONS FROM – IGS-M-PL -022 SPEC :	
<b>NOTE: THIS DATA SHEET SHALL BE COMPLETED AND SIGNED BY MANUFACTURER FOR EACH ITEM.</b>	



