# Introduction to Fittings + Manufacturing Process

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Specialty metals supply solutions

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### **Introduction to Fittings**

A pipe fitting is defined as a part used in a piping system, for changing direction, branching or for change of pipe diameter, and which is mechanically joined to the system. There are many different types of fittings and they are the same in all sizes and schedules as the pipe.



- Welding a fitting to the pipe means it is permanently leak proof
- Continuous metal structure formed between pipe and fitting adds strength to the system
- Smooth inner surface and gradual directional changes reduce pressure losses and turbulence and minimize the action of corrosion and erosion
- A welded system utilizes a lack of space
- Welded fittings compliment pipe flanges in piping system

## Introduction to Fittings

down of the second seco	90° Elbow	Eccentric Reducer	Concentric Reducer
ControlLarge Tee	Small Tee	Flange	Stub End

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### **Fittings - Pressed Fitting Manufacturing**

### **Pressed Fittings**

- Our large dia. fittings made by Press Forming
  - Hydraulic press forms the two half's of the fitting
  - The fitting is trimmed, welded
  - Machine beveled
  - Bead blasted stenciled and shipped
- Tee's, Conc's, Ecc's and Elbows
- Plasma table is used to cut the size of the input blank





### **Fittings - Butt Weld Fittings**

- Butt Weld pipe fittings comprises of elbows, concentric & eccentric reducers, tees, stub ends, etc
- All dimensions are in inches
- Dimensional tolerances conform to ASME B16.9
  - Light-weight corrosion resistant fittings are made to MSS SP43
- Fitting wall thicknesses conform with standard schedule 10S, 40S and 80S ASME B36.19M wall pipe
- Stub End Faces are supplied with a serrated spiral finish per ASME B16.5 other surface finishes can be supplied on special order
- Butt welding fittings are permanently marked by electro-chemical etching in accordance with ASME B16.9
- Estimated fitting weights are based on a density of 0.163 lbs/cubic inch
- Butt Weld fittings are beveled
  - Shape of bevel depends on actual wall thickness
- ASME B16.25 covers preparation of butt-welding ends of piping components to be joined into a piping system
- Weld edge preparation requirements are also incorporated into ASME standards (e.g., B16.9, B16.5, B16.34)



#### **Fittings – Elbows**

### Elbows – Mandrel Method (Hot Forming)

- One of the most common manufacturing methods for manufacturing Elbows from pipes.
- After heating the raw material, it is pushed over a die called "mandrel" which allows the pipe to expand and bends simultaneously.
- Applicable to a wide size range.

### **Elbows – Extrusion Method (Cold Forming)**

- Using raw material with the same diameter as finished product, pipe is pushed through a die and formed into its desired shape.
- Usually applied to corrosion resistant metals through 10" NPS.

#### Elbows – Clam Shell – 2piece construction 6"NPS and larger

- Most common methods for manufacturing Elbows is from plate
  - Two pieces of raw material plates are cut out symmetrically, each piece are press formed and welded together.
  - Method is applicable to various materials and can even be applied to large items with diameters over 36".
  - Has two seams and special welding technology is used to meet various standards required by the customer.



90° Elbow

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### Fittings – Tees, Reducers, and Stub Ends

### **Tees – Hydraulic Bulge Method (Cold Forming)**

- After cutting and placing raw material into a die, the pipe is pressed as hydraulic pressure pushes out the branch.
- The Tee is pressed against the die, leaving the finished product to have a truly smooth outer surface.
- Titanium is prone to cracking during this process

### **Reducers – Outer Die Method**

- One of the most common method for manufacturing Reducers, using an outer die.
- Raw material pipe is cut and pressed in an outer die, compressing one end of pipe into a smaller size

### Lap Joint/Stub Ends – Flare Method

- One of the most common manufacturing methods of Lap Joint/Stub Ends.
- One end of the raw material pipe is spun out to form the brim.
- There are other methods, where the brim is welded onto the end of a cut pipe or where the whole product is machined from block.



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### **Inquiry Checklist - Fittings**

**FITTINGS** (Welded & Seamless) Products: Elbows, Tees, Stub Ends, Reducers, Caps, etc. (Welded & Seamless) Specifications: ASTM B363, ASME SB363

Is Liquid Penetrant Inspection required?

Is X-Ray (Radiograph) of the welds required?

Is a Stress Relieve Anneal required?

Surface Inspection [Supplemental Requirement S1]

[Supplementary Requirement S2]

[Supplementary Requirement S3]

Option: Hydrostatic Tests (Not a requirement)

Pressure vessels such as pipelines, plumbing, gas cylinders, boilers and fuel tanks can be tested for strength and leaks.

### **Fittings - Flanges**

### Flanges

- All dimensions are in inches
- Dimensional tolerances conform to ASME B16.5
- Flange bore diameters agree with standard ASME B36.9M Sch-40S wall pipe.
  - Other bore diameters can be supplied on special order.
- Raised Face Flanges are supplied with a serrated spiral finish per ASME B16.5.
  - Other gasket surface finishes can be supplied on special order.
- Flanges are permanently marked by electro-chemical etching in accordance with ASME B16.5
- Estimated flange weights are based on a density of .163 lbs/cubic inch.

### **Plate and Sheet**

• ASTM B265 and ASME SB265 are identical and are not an issue for certification from the producer at the time of purchase



### **Inquiry Checklist Fittings - Flanges**

#### **FLANGES**

Are they asking for a forged Flange? Why?

ASTM B381 and/or ASME SB381 (Forgings) should be on any forged bar and forged billet in addition to ASTM B348 and/or ASME SB348.

If forging is not required, a flange may be made from plate, if convenient.

ANSI Flange or MSS: Will either be an ANSI Flange (ASME) or more commonly MSS.

ANSI = American National Standards Institute and is a part of the ASME = American Society of Mechanical Engineers MSS = Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.

<u>Slip-On Flanges</u> Is it a Slip-On Flange or a Lap Joint Slip-On Flange?



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### **General Fittings Specifications**

- ASTM B363 and ASME SB363 are NOT the same.
- ASME has restrictions on the welds made with filler metal
  - To certify welded fittings that use filler metal the manufacturer must hold the appropriate ASME Code Symbol Stamp.
  - Precision Metal Spinning is not an ASME Code shop so if they use filler metal their stub ends will not be capable of ASME certification.
- ASTM B862 and ASME SB862 welded pipe are **NOT** the same.
  - ASME has restrictions on welds made with filler metal
  - Situation is the same here as ASME SB363 fittings
  - To certify welded pipe that uses filler metal the manufacturer must hold the appropriate ASME Code Symbol Stamp
- ASTM B862 and ASME SB862 welded pipe are NOT the same.
  - ASME has restrictions on welds made with filler metal.
    - Situation is the same here as ASME SB363 fittings.
  - To certify welded pipe that uses filler metal the manufacturer must hold the appropriate ASME Code Symbol Stamp.
- Titanium alloy 6AI-4V (Gr-5) is in specification ASME SB265 (plate and sheet) but not in ASME SB 363 (welding fittings)

## Industrial Specifications

ASTM B 265 GR 1	Sheet/Strip/Plate Commercially Pure 25 KSI min YS
AMS-T-9046	Sheet/Strip/Plate 6AL4V
ASTM B 265 GR 2	Sheet/Strip/Plate Commercially Pure 40 KSI min YS
ASTM B 265 GR 3	Sheet/Strip/Plate Commercially Pure 55 KSI min YS
ASTM B 265 GR 4	Sheet/Strip/Plate Commercially Pure 70 KSI min YS
ASTM B 265 GR 5	Sheet/Strip/Plate 6AL4V
ASTM B 265 GR 23	Sheet/Strip/Plate 6AL4V Eli
ASTM B 861	Seamless Pipe
ASTM B 862	Welded Pipe
ASTM B 338 Grade 2	Seamless and Welding Tubing Commercially Pure 40 KSI min YS
ASTM B 348 GR 1	Bars and Billets Commercially Pure 25 KSI min YS
ASTM B 348 GR 2	Bars and Billets Commercially Pure 40 KSI min YS
ASTM B 348 GR 3	Bars and Billets Commercially Pure 50 KSI min YS
ASTM B 348 GR 4	Bars and Billets Commercially Pure 70 KSI min YS
ASTM B 348 GR 5	Bars and Billets 6AL4V
ASTM B 363	Fittings
ASTM B 367	Castings
ASTM B381	Forgings
ASME SB 265	Sheet/Strip/Plate Commercially Pure and Alloyed
ASME SB 861	Seamless Pipe
ASME SB 862	Welded Pipe
ASME SB 348	Bars and Billets Commercially Pure and Alloyed
	Constitution Mattels Constitutions

### Heat Treating of Titanium

Titanium and Titanium Alloys are heat treated in order to:

- Reduce residual stresses developed during fabrication (stress relieving)
- Produce an optimum combination of ductility, machinability and dimensional and structural stability (annealing)

#### Lead Times

- Not many manufacturers of Titanium Fittings
- Most fittings not in stock 6 weeks
- Forged Flanges 5 weeks
- Pipe depending on quantity and size avg. 6-8 weeks
- Stub Ends not in stock 6 weeks
- Large Dia. Fittings above 12"NPS 6 8 weeks

\*All Fittings can be expedited for a faster turnaround\* Lead times subject to change

### Industrial – Pipe and Fittings Product Look Up in Stratix

### Metals:

Titanium	ΤI
Stainless Steel	SS
Nickel	NI

### **Pipe & Fitting Product Codes:**

Welded Pipe	WP
Welded Tube	WT
Seamless Pipe	SP
Seamless Tube	ST
Stub Ends	SE
Flanges	FL
90 Elbows	EL
45 Elbows	EL
Tees	TE
Concentric Reducer	CR
Eccentric Reducer	ER

Titanium Grades Grade 1 CP 4 ..... 1 Grade 2 CP 3 ..... 2 Grade 3 CP 2 ..... 3 Grade 4 CP 1 ..... 4 0.3-Mo-0.8Ni Grade 12 .... 12 6AI-4V ELI Grade 23 ...... 64E 6AI-2SN-4ZR-6MO ...... 6246 Grade 7 ..... 7 Nickel Alloys 625 ..... 625 718 ..... 718 Waspaloy ..... WASP **Stainless Steel Alloys** 13-8 PH ..... 13-8 15-5 PH ..... 15-5

#### Grade Codes:

Product Look Up Example: Choose Warehouse = JAC (Jacksonville) (\* can be used in any field to find all listings)

Metal + Product = Form i.e. Titanium + Seamless Pipe = TISP

Form selected, choose grade i.e. Grade 2 = 2 (Titanium Seamless Pipe Grade 2)

Grade selected, choose size i.e. 2" SCH/40 = 2S40

Size selected, choose finish i.e. R (Remnant), US (US), USR (US Remnant) [If finish is not specified = \*]

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Full code: TISP\2\2"SCH/10\\*\\JAC

17-4 PH ..... 17-4 PH

## Industrial – General vs Specific Product Look Up in Stratix

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	.5"SCH/10 2		18' 0"	JAC	JAC R	6	120	6	120	0	0	14.11	0	0 0	0 0	0		0.386 FT	
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	.5°SCH/40 2		18' 0"	JAC	JAC R H	23	450 1./500	23	450 1./500	0	0	12.57	0	0 0	0 0	0		0.489 FT	
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### Quick Quiz



### 1. What is this product called?

- A. Stub End
- B. Eccentric Reducer
- C. Concentric Reducer
- D. Flange
- 2. Are Butt Weld fittings beveled?
  - A. Yes
  - B. No
  - C. Sometimes
- 3. What is this product called?
  - A. Flange
  - B. Tee
  - C. Butt weld fitting
  - D. 45° Elbow



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