

EASTERN STEEL

TECHNICAL REFERENCE

Pipe Fittings List Types, Names & Uses

A comprehensive visual and technical reference guide covering 12 essential pipe fittings — classification by function, connection type, material grades, pressure ratings, sizing standards, and a quick selection matrix for engineers and procurement teams.

12 Fitting Types

4 Connection Types

ASME B16.9 / B16.11 / B16.5

Pressure Ratings

Material Grades

Quick Reference Matrix

Pipe Fittings List: 12 Common Types

These twelve fittings cover the large majority of industrial piping requirements. Each is identified by name, primary function, and typical connection options. Classification by function follows on page 3; sizes, standards, and material grades on page 6.

NO.	FITTING	MAIN USE & FUNCTION	TYPICAL CONNECTION TYPES
01	Elbow	Changes flow direction; standard angles 45°, 90°, 180°; available in long radius (1.5D) or short radius (1.0D).	Butt Weld, Socket Weld, Threaded, Flanged
02	Tee	Creates a branch connection at 90°, splitting or combining flow. Equal tee: branch = run; Reducing tee: branch < run.	Butt Weld, Socket Weld, Threaded
03	Reducer	Connects pipes of different diameters. Concentric keeps centerline aligned; Eccentric has a flat side for horizontal pump suction lines.	Butt Weld, Socket Weld, Threaded
04	Cross	Four-way connection joining four pipes at a single intersection. Used in fire sprinkler lines and multi-branch distribution.	Butt Weld, Socket Weld, Threaded
05	Coupling	Joins two pipe sections on a straight run. Full coupling: both ends; Half coupling: one end for branch outlets; Reducing coupling: different sizes.	Socket Weld, Threaded
06	Union	Connectable joint allowing disassembly without rotating the pipe. Three-piece design: male end, female end, and center nut.	Socket Weld, Threaded
07	Cap	Closes the end of a pipe, sealing the run temporarily or permanently. Designed for pressure-tight end closure.	Butt Weld, Socket Weld, Threaded
08	Plug	Closes a threaded opening such as a spare outlet or drain point. Hex, square, or round head for removal.	Threaded
09	Nipple	Short threaded connector between two fittings or valves. Available as close nipple (fully threaded) or barrel nipple.	Threaded
10	Flange	Bolted connection with gasket for pipes, valves, pumps, and equipment. Types: Weld Neck, Slip-On, Blind, Lap Joint, Socket Weld, Threaded.	Butt Weld, Socket Weld, Threaded, Bolted
11	Bushing	Reduces a threaded connection from larger to smaller size. Hex head for installation; flush type sits flush with fitting face.	Threaded
12	Adapter	Joins different connection types or thread standards (e.g., NPT to BSP, threaded to socket weld, or male/female conversion).	Threaded, Socket Weld

Pipe Fittings Classification by Function

Function is the practical way to classify fittings: each group answers one piping question — turn, branch, resize, join, close, or connect to equipment.

1 Direction Change

- › Elbow — 45° / 90° / 180°
- › Bend — Long Radius
- › Return Bend — U-turn for heat exchangers

2 Branch Connection

- › Equal Tee — branch = run
- › Reducing Tee — branch < run
- › Cross — 4-way junction
- › Lateral Tee — angled branch
- › Branch Outlet (Olet) — Weldolet, Thredolet, Sockolet

3 Size Change

- › Concentric Reducer — centerline aligned
- › Eccentric Reducer — flat side, horizontal lines
- › Bushing — threaded size reduction

4 Inline Connection

- › Full Coupling — both ends
- › Half Coupling — one end, for branch outlets
- › Union — quick disconnect
- › Nipple — short threaded extension
- › Adapter — cross-standard conversion

5 End Closure

- › Cap — external pipe end cover
- › Plug — internal threaded port closure
- › Blind Flange — removable bolted closure

6 Equipment Interface

- › Weld Neck Flange — high-stress joints
- › Slip-On Flange — economical attachment
- › Blind Flange — isolation / test closure
- › Lap Joint Flange — rotating backing flange
- › Socket Weld / Threaded Flange

Engineering Note — Flow Optimization: Selection between Long Radius (1.5D) and Short Radius (1.0D) elbows directly impacts pressure drop. Long Radius elbows reduce frictional head loss by approximately **30%** compared to Short Radius variants and are mandatory in slurry and high-velocity gas lines. Short Radius elbows are reserved for compact skid units and space-constrained modules where pressure loss is acceptable.

Pipe Fittings by Connection Type

The connection type determines how a fitting is installed, whether the joint can later be taken apart, and the pressure and temperature limits of the system. Four methods dominate industrial steel piping.

CONNECTION	CODE	COMMON FITTINGS	KEY CHARACTERISTICS & APPLICATIONS	STANDARD
Butt Weld	BW	Elbows, Tees, Reducers, Caps, Stub Ends	Beveled ends welded directly to pipe. Offers seamless interior flow, highest pressure integrity, permanent joint, and superior fatigue resistance. The standard for process piping and high-pressure service lines ≥ NPS 2. Bevel angle typically 37.5° for full-penetration welding.	ASME B16.9
Socket Weld	SW	Elbows, Tees, Couplings, Unions	Pipe inserts into a recessed socket before fillet welding. No edge beveling required. Excellent leak tightness for high-pressure, small-diameter lines (NPS 2 and below). A 1/16" (1.6mm) gap at the socket bottom absorbs thermal growth and minimizes weld root cracking.	ASME B16.11
Threaded	THD	Plugs, Bushings, Nipples, Couplings, Street Elbows	Uses tapered threads (NPT / BSPT / BSPP) to achieve mechanical seal. Ideal for low-pressure utility lines, fire protection, and non-weldable areas where disassembly is required. Pressure ratings: Class 2000#, 3000#, 6000#.	ASME B16.11
Flanged	FLG	Flanged Tees, Companion Flanges, Blind Flanges	Bolted gasket assembly facilitating easy disassembly for cleaning, inspection, and valve replacement. The standard for piping requiring maintenance access and larger pipe sizes. Common ratings: Class 150 to Class 2500.	ASME B16.5

Practical Rule: Where frequent dismantling is expected — at maintenance points, valve connections, and equipment tie-ins — unions or flanged joints are more service-friendly than permanent welded joints. Butt weld remains the first choice for critical, high-pressure, and high-temperature service where leak-tightness under cyclic loading is paramount.

Pipe Fitting Sub-Types & Variants

Detailed geometric variations, dimensional ratios, and specialized design configurations within each fitting family.

Elbow Variants: LR vs. SR

Long Radius (LR): Center-to-face radius = $1.5 \times$ nominal pipe size ($R = 1.5D$). Delivers lower friction loss and reduced fluid turbulence. The default for process piping.

Short Radius (SR): Center-to-face radius = $1.0 \times$ nominal pipe size ($R = 1.0D$). Engineered for compact skid units and space-constrained modules where pressure loss is acceptable.

Tee Variants: Equal vs. Reducing

Equal Tee: All three outlets share identical internal diameters, ensuring balanced flow rates across headers.

Reducing Tee: Branch outlet diameter is smaller than the run (e.g., $4" \times 4" \times 2"$), eliminating the need for a separate reducer fitting at the branch point.

Reducer Styles: Concentric vs. Eccentric

Concentric: Cone-shaped with aligned centerlines. Ideal for vertical piping to avoid asymmetrical load on hangers.

Eccentric: One flat edge parallel to pipe axis. Essential on horizontal pump suction lines to prevent cavitation-inducing air pockets and ensure proper drainage.

Coupling Styles: Full, Half & Reducing

Full Coupling: Threads or welds over both pipe ends to extend a run or repair a cut section.

Half Coupling: One end only — welded directly onto main headers to create small branch outlets.

Reducing Coupling: Directly links two pipes of different diameters without nipple assemblies.

Unions & Olets

Union: Three-piece assembly — male end, female end, threaded center nut — enabling line disconnection without cutting pipe.

Olets (Branch Outlets): Weldolet, Thredolet, and Sockolet provide integrally reinforced branch connections directly onto headers without requiring full-sized tees.

Flange Types

Weld Neck: Tapered hub for high-stress, high-temperature equipment joints.

Slip-On: Economical low-pressure attachment; fillet-welded both sides.

Blind: Solid disc for line isolation and hydrotest ends.

Lap Joint: Loose backing flange with stub end for alignment flexibility.

Pipe Fitting Sizes & Standards

Nominal size, governing standard, and material grade — the three data points every fitting order needs. OD is constant for a given NPS; wall thickness varies by schedule (Sch 10 / 40 / 80, STD / XS / XXS). NPS and DN are nominal designations, only approximate equivalents.

NPS	DN	OD (MM)	NPS	DN	OD (MM)
1/2	15	21.3	3	80	88.9
3/4	20	26.7	4	100	114.3
1	25	33.4	6	150	168.3
1 1/4	32	42.2	8	200	219.1
1 1/2	40	48.3	10	250	273.0
2	50	60.3	12	300	323.9

STANDARD	SCOPE	CONNECTION
ASME B16.9	Factory-made wrought butt-welding fittings	Butt Weld
ASME B16.11	Forged fittings, socket-welding and threaded	Socket Weld / Threaded
ASME B16.5	Pipe flanges and flanged fittings, NPS 1/2–24	Flanged
MSS SP-43	Light-class stainless butt-welding fittings (Sch 5 / 10)	Butt Weld

Material Grade Specifications

MATERIAL FAMILY	BUTT-WELD GRADE	FORGED GRADE	TYPICAL APPLICATION & TEMPERATURE
Carbon Steel	ASTM A234 WPB / WPC	ASTM A105 / A105N	General oil & gas lines, steam utilities, non-corrosive industrial processes up to 425°C .
Low-Temp Carbon	ASTM A420 WPL6	ASTM A350 LF2	Cryogenic services, cold-climate cross-country pipelines down to -45°C .
Stainless Steel	ASTM A403 WP304/304L, WP316/316L	ASTM A182 F304L / F316L	Corrosive chemicals, food & beverage, marine environments, high-purity media.
Alloy Steel	ASTM A234 WP11 / WP22 / WP91	ASTM A182 F11 / F22 / F91	High-pressure power plant boilers, refinery cracking units, high-temperature steam lines.

Compatibility Warning: ASME, DIN, EN, and JIS dimensional systems are **not interchangeable**. Even when nominal sizes match, differences in bolt patterns, sealing faces, and tolerances can prevent proper assembly. This becomes especially visible in multi-supplier projects. Always confirm the governing standard before ordering.

Pipe Fittings Quick Selection Matrix

Engineering cross-reference guide matching fitting geometry, connection options, and pressure ratings. Use this matrix to verify that the selected fitting, connection type, and pressure class are compatible before ordering.

FITTING TYPE	PRIMARY FUNCTION	CONNECTION TYPES	PRESSURE RATING RANGE	KEY SELECTION CRITERIA
Elbow (90°/45°)	Change Direction	BW, SW, Threaded, Flanged	Sch 10 – Sch 160 / 3000#, 6000#	LR for low pressure drop; SR for tight spaces
Tee (Equal/Reducing)	Branch Flow	BW, SW, Threaded	Sch 40 – Sch XXS / 3000#, 6000#	Reducing tee eliminates extra reducer at branch
Reducer (Conc/Ecc)	Change Line Size	BW, SW, Threaded	Sch 10S – Sch 160	Eccentric for horizontal pump suction; concentric for vertical
Coupling / Union	Inline Join / Disconnect	SW, Threaded	Class 2000, 3000, 6000, 9000	Union where future disassembly is needed
Cap / Plug	End Closure	BW, SW, Threaded	Matches pipe schedule / 3000#, 6000#	Cap for pipe end; plug for threaded port
Flange (WN/SO/Blind)	Equipment Junction	Bolted (BW/SW/THD end)	Class 150 – Class 2500	WN for high stress; SO for economy; Blind for closure
Bushing	Reduce Threaded Size	Threaded	3000#, 6000#	Hex head for installation access
Nipple	Short Extension	Threaded	Matches pipe schedule	Close nipple fully threaded; barrel nipple with plain center
Weldolet / Thredolet	Branch Outlet (Integral)	BW, Threaded	Sch STD – Sch XXS / 3000#, 6000#	Reinforced branch without full-size tee

Procurement Checklist: A complete fitting specification always includes **standard, size, pressure rating (or schedule), material grade, and connection type**. Anything less increases the risk of substitution errors on site. For multi-supplier projects, verify dimensional interchangeability before fabrication begins.

About Eastern Steel

Eastern Steel is a manufacturer and stockist of high-grade seamless and welded steel pipes, industrial butt-weld fittings, forged high-pressure fittings, and ASME flanges. Serving petroleum refineries, offshore platforms, power plants, and EPC construction projects globally.

Product Range

- Seamless Steel Pipe — API 5L, ASTM A106/A53/A333
- Welded Steel Pipe — ERW, LSAW, SSAW
- Butt-Welding Fittings — ASME B16.9
- Forged Fittings — ASME B16.11 (SW & Threaded)
- Flanges — ASME B16.5
- OCTG — Casing, Tubing, Drill Pipe

Companion Article

This guide accompanies the full technical article on pipe fittings classification, including FAQs, gas pipe fittings, and selection guidance for buyers and engineers.

Read the full article: www.eastern-steels.com/newsdetail/commonly-used-pipe-fittings-and-their-classification.html

Contact & Technical Support

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Quality Assurance: ISO 9001:2015 / PED 2014/68/EU Certified

Documentation: EN 10204 3.1 / 3.2 Mill Test Certificates

Materials: Carbon Steel · Stainless Steel · Alloy Steel · Low-Temperature Grades