

ENGINEERING REFERENCE

Metallurgy & Standards Data Book

Chemistry, mechanical properties and ASTM / ASME specifications for flanges, forged and butt weld fittings in carbon, alloy, stainless, super austenitic, duplex, super duplex, nickel alloys, titanium and copper-nickel.

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How to use this book. Each section lists the grades Teshi Group manufactures, the ASTM / ASME specification for each product form, chemical composition limits and minimum room-temperature mechanical properties. Values are summarised from the governing specifications for convenience; the current edition of the specification and your project specification take precedence.

Super Austenitic SS 904L & 254 SMO Flanges & Fittings

SUPER AUSTENITIC STAINLESS

Super austenitic stainless steels combine high nickel, molybdenum and copper (904L) or 6 % molybdenum with nitrogen (254 SMO) to resist sulphuric and phosphoric acid, chloride pitting and stress corrosion cracking.

Teshi Group manufactures 904L and 254 SMO weld neck, slip-on, blind and socket weld flanges, forged fittings and butt weld fittings for acid plants, zinc and copper smelters and flue-gas desulphurisation, with EN 10204 3.1 certification and PMI on every piece.

Grades and specifications

Grade	Forged flanges & fittings	Butt weld fittings	Plate	Pipe
904L UNS N08904 · W.Nr. 1.4539	ASTM A182 F904L	ASTM A403 WP904L	ASTM A240 / B625	ASTM A312 / B677
254 SMO (6Mo) UNS S31254 · W.Nr. 1.4547	ASTM A182 F44	ASTM A403 WPS31254	ASTM A240 S31254	ASTM A312 S31254

Chemical composition (weight %, maximum unless a range is given)

Grade	C	Mn	Si	Cr	Ni	Mo	Cu	N
904L	0.020	2.00	1.00	19.0–23.0	23.0–28.0	4.0–5.0	1.00–2.00	0.10
254 SMO (6Mo)	0.020	1.00	0.80	19.5–20.5	17.5–18.5	6.0–6.5	0.50–1.00	0.18–0.25

Mechanical properties (minimum, room temperature)

Grade	Tensile	Yield (0.2 %)	Elongation	Note
904L	490 MPa (71 ksi)	215 MPa (31 ksi)	35 %	PREN ≈ 34
254 SMO (6Mo)	650 MPa (94 ksi)	300 MPa (44 ksi)	35 %	PREN ≥ 42

Typical applications

- Sulphuric acid dilution, cooling and storage
- Zinc and copper smelter roaster gas cleaning and leaching circuits
- Phosphoric acid evaporators
- Flue-gas desulphurisation scrubbers
- Seawater and brackish cooling water

Testing & certification

- Solution annealed and water quenched
- PMI on every piece for Ni, Mo and Cu
- Intergranular corrosion test to ASTM A262 when specified
- EN 10204 3.1 certificate; 3.2 with third-party inspection on request

Duplex Stainless Steel 2205 Flanges & Fittings (F51 / F60)

DUPLEX STAINLESS

Duplex 2205 has a balanced austenite–ferrite structure that gives roughly twice the yield strength of 316L, with much better resistance to chloride stress corrosion cracking and pitting.

Teshi Group manufactures 2205 flanges to ASTM A182 F51 and F60 and fittings to ASTM A815, heat treated and tested for ferrite content and detrimental phases before dispatch.

Grades and specifications

Grade	Forged flanges & fittings	Butt weld fittings	Plate	Pipe
2205 (S31803) UNS S31803 · W.Nr. 1.4462	ASTM A182 F51	ASTM A815 WPS31803	ASTM A240	ASTM A790
2205 (S32205) UNS S32205 · W.Nr. 1.4462	ASTM A182 F60	ASTM A815 WPS32205	ASTM A240	ASTM A790

Chemical composition (weight %, maximum unless a range is given)

Grade	C	Mn	Si	Cr	Ni	Mo	N
2205 (S31803)	0.030	2.00	1.00	21.0–23.0	4.5–6.5	2.5–3.5	0.08–0.20
2205 (S32205)	0.030	2.00	1.00	22.0–23.0	4.5–6.5	3.0–3.5	0.14–0.20

Mechanical properties (minimum, room temperature)

Grade	Tensile	Yield (0.2 %)	Elongation	Note
2205 (S31803)	620 MPa (90 ksi)	450 MPa (65 ksi)	25 %	PREN ≈ 33
2205 (S32205)	655 MPa (95 ksi)	450 MPa (65 ksi)	25 %	PREN ≈ 35

Typical applications

- Brackish and produced-water lines
- Chemical process piping and vessels
- Oil and gas gathering and flow lines
- Pulp and paper digesters
- Hydrometallurgical leach circuits

Testing & certification

- Solution annealed and water quenched
- Ferrite content check, typically 35–65 %
- ASTM A923 tests for detrimental intermetallic phases when specified
- Impact testing and PMI as specified

Super Duplex 2507 (F53) & UNS S32760 (F55) Flanges & Fittings

SUPER DUPLEX STAINLESS

Super duplex stainless steels raise chromium, molybdenum and nitrogen to give a pitting resistance equivalent number (PREN) of 40 or more, for seawater, high-chloride brines and sour service where duplex 2205 is not enough.

Teshi Group manufactures super duplex flanges to ASTM A182 F53 and F55 and fittings to ASTM A815, with heat treatment, ferrite and ASTM A923 testing, and PMI on every piece.

Grades and specifications

Grade	Forged flanges & fittings	Butt weld fittings	Plate	Pipe
2507 (S32750) UNS S32750 · W.Nr. 1.4410	ASTM A182 F53	ASTM A815 WPS32750	ASTM A240	ASTM A790
S32760 (Zeron® 100 type) UNS S32760 · W.Nr. 1.4501	ASTM A182 F55	ASTM A815 WPS32760	ASTM A240	ASTM A790

Chemical composition (weight %, maximum unless a range is given)

Grade	C	Mn	Si	Cr	Ni	Mo	Cu	N	W
2507 (S32750)	0.030	1.20	0.80	24.0–26.0	6.0–8.0	3.0–5.0	0.50	0.24–0.32	—
S32760 (Zeron® 100 type)	0.030	1.00	1.00	24.0–26.0	6.0–8.0	3.0–4.0	0.50–1.00	0.20–0.30	0.50–1.00

Mechanical properties (minimum, room temperature)

Grade	Tensile	Yield (0.2 %)	Elongation	Note
2507 (S32750)	800 MPa (116 ksi)	550 MPa (80 ksi)	15 %	PREN ≥ 41
S32760 (Zeron® 100 type)	750 MPa (109 ksi)	550 MPa (80 ksi)	25 %	PREN ≥ 40

Typical applications

- Seawater reverse-osmosis desalination
- Offshore firewater and seawater injection
- Sour service to NACE MR0175 / ISO 15156 when specified
- High-chloride hydrometallurgical leaching
- Subsea manifolds and process piping

Testing & certification

- Solution annealed and water quenched
- ASTM A923 Methods A/B/C when specified
- Ferrite content 40–60 % by ASTM E562 point count
- ASTM G48 ferric chloride pitting test when specified
- Hardness checks for NACE MR0175 / ISO 15156 sour service when specified
- PMI on every piece

Titanium Flanges & Fittings — Grade 1, 2, 5, 7 & 12

TITANIUM

Titanium is around 45 % lighter than steel and is practically immune to seawater, wet chlorine and hypochlorite thanks to a stable, self-healing oxide film.

Teshi Group manufactures titanium flanges to ASTM B381 and fittings to ASTM B363 in commercially pure grades 1 and 2, the high-strength Ti-6Al-4V alloy (Grade 5), and the corrosion-enhanced grades 7 and 12, with full heat traceability.

Grades and specifications

Grade	Forged flanges & fittings	Butt weld fittings	Plate	Pipe
Grade 1 UNS R50250 · W.Nr. 3.7025	ASTM B381 F-1	ASTM B363 WPT1	ASTM B265 Gr 1	ASTM B861 / B862 Gr 1
Grade 2 UNS R50400 · W.Nr. 3.7035	ASTM B381 F-2	ASTM B363 WPT2	ASTM B265 Gr 2	ASTM B861 / B862 Gr 2
Grade 5 (Ti-6Al-4V) UNS R56400 · W.Nr. 3.7165	ASTM B381 F-5	Machined from B381 / B348	ASTM B265 Gr 5	On request
Grade 7 (Ti-Pd) UNS R52400 · W.Nr. 3.7235	ASTM B381 F-7	ASTM B363 WPT7	ASTM B265 Gr 7	ASTM B861 / B862 Gr 7
Grade 12 UNS R53400 · W.Nr. 3.7105	ASTM B381 F-12	ASTM B363 WPT12	ASTM B265 Gr 12	ASTM B861 / B862 Gr 12

Chemical composition (weight %, maximum unless a range is given)

Grade	C	Ni	Mo	N	V	Al	Pd	Fe	O	H
Grade 1	0.08	—	—	0.03	—	—	—	0.20	0.18	0.015
Grade 2	0.08	—	—	0.03	—	—	—	0.30	0.25	0.015
Grade 5 (Ti-6Al-4V)	0.08	—	—	0.05	3.5–4.5	5.5–6.75	—	0.40	0.20	—
Grade 7 (Ti-Pd)	0.08	—	—	0.03	—	—	0.12–0.25	0.30	0.25	—
Grade 12	0.08	0.6–0.9	0.2–0.4	—	—	—	—	0.30	0.25	—

Mechanical properties (minimum, room temperature)

Grade	Tensile	Yield (0.2 %)	Elongation	Note
Grade 1	240 MPa (35 ksi)	170 MPa (25 ksi)	24 %	Highest ductility
Grade 2	345 MPa (50 ksi)	275 MPa (40 ksi)	20 %	Industrial workhorse
Grade 5 (Ti-6Al-4V)	895 MPa (130 ksi)	828 MPa (120 ksi)	10 %	High strength
Grade 7 (Ti-Pd)	345 MPa (50 ksi)	275 MPa (40 ksi)	20 %	Reducing acids
Grade 12	483 MPa (70 ksi)	345 MPa (50 ksi)	18 %	Hot brines

Typical applications

- Chlor-alkali brine and wet chlorine lines
- Seawater cooling and desalination
- Naval and marine cooling and ballast systems
- Copper, nickel and cobalt autoclave leaching
- Offshore and subsea piping

Testing & certification

- Chemistry including interstitials (O, N, H) reported on the certificate
- Ultrasonic testing of forgings when specified
- Dimensional inspection to ASME B16.5 / B16.9
- Clean-room handling to avoid iron contamination

Inconel 600, 625 & 825 Flanges & Fittings

NICKEL ALLOYS

Nickel-chromium alloys hold their strength and resist oxidation, carburisation and chloride stress corrosion cracking from cryogenic temperatures to well above 900 °C.

Teshi Group manufactures Inconel 600, 625 and 825 flanges to ASTM B564 and butt weld fittings to ASTM B366, with PMI on every piece and full heat traceability.

Grades and specifications

Grade	Forged flanges & fittings	Butt weld fittings	Plate	Pipe
Alloy 600 UNS N06600 · W.Nr. 2.4816	ASTM B564 N06600	ASTM B366 WPNCI	ASTM B168	ASTM B167
Alloy 625 UNS N06625 · W.Nr. 2.4856	ASTM B564 N06625	ASTM B366 WPNCMC	ASTM B443	ASTM B444
Alloy 825 UNS N08825 · W.Nr. 2.4858	ASTM B564 N08825	ASTM B366 WPNICMC	ASTM B424	ASTM B423

Chemical composition (weight %, maximum unless a range is given)

Grade	C	Mn	Si	Cr	Ni	Mo	Cu	Nb	Ti	Fe
Alloy 600	0.15	1.00	0.50	14.0–17.0	72.0 min	—	0.50	—	—	6.0–10.0
Alloy 625	0.10	—	—	20.0–23.0	58.0 min	8.0–10.0	—	3.15–4.15 (Nb+Ta)	—	5.0
Alloy 825	0.05	—	—	19.5–23.5	38.0–46.0	2.5–3.5	1.5–3.0	—	0.6–1.2	22.0 min

Mechanical properties (minimum, room temperature)

Grade	Tensile	Yield (0.2 %)	Elongation	Note
Alloy 600	550 MPa (80 ksi)	240 MPa (35 ksi)	30 %	Annealed
Alloy 625	827 MPa (120 ksi)	414 MPa (60 ksi)	30 %	Annealed
Alloy 825	586 MPa (85 ksi)	241 MPa (35 ksi)	30 %	Annealed

Typical applications

- Furnace, heater and high-temperature process piping
- Sour gas and oil well equipment (825, 625)
- Sulphuric and phosphoric acid service (825)
- Seawater and chloride service (625)
- Chemical and petrochemical reactors

Testing & certification

- PMI on every piece
- Intergranular corrosion testing to ASTM G28 when specified
- Ultrasonic testing of forgings when specified
- EN 10204 3.1 certificate; 3.2 on request

Hastelloy C-276, C-22, Monel 400 & Alloy 20 Flanges & Fittings

NICKEL ALLOYS

When stainless and duplex steels are not enough, nickel-molybdenum and nickel-copper alloys handle wet chlorine, hydrochloric and hydrofluoric acids, ferric chlorides and hot sulphuric acid.

Teshi Group manufactures Hastelloy C-276 and C-22, Monel 400 and Alloy 20 flanges and fittings to ASTM B564, B462 and B366 for severe chemical, petrochemical and pollution-control service.

Grades and specifications

Grade	Forged flanges & fittings	Butt weld fittings	Plate	Pipe
Hastelloy C-276 UNS N10276 · W.Nr. 2.4819	ASTM B564 N10276	ASTM B366 WPHC276	ASTM B575	ASTM B622
Hastelloy C-22 UNS N06022 · W.Nr. 2.4602	ASTM B564 N06022	ASTM B366 WPHC22	ASTM B575	ASTM B622
Monel 400 UNS N04400 · W.Nr. 2.4360	ASTM B564 N04400	ASTM B366 WPNC	ASTM B127	ASTM B165
Alloy 20 UNS N08020 · W.Nr. 2.4660	ASTM B462 N08020	ASTM B366 WP20CB	ASTM B463	ASTM B464 / B729

Chemical composition (weight %, maximum unless a range is given)

Grade	C	Mn	Si	Cr	Ni	Mo	Cu	W	Nb	Co	Fe
Hastelloy C-276	0.010	—	—	14.5–16.5	Balance	15.0–17.0	—	3.0–4.5	—	2.5	4.0–7.0
Hastelloy C-22	0.015	—	—	20.0–22.5	Balance	12.5–14.5	—	2.5–3.5	—	2.5	2.0–6.0
Monel 400	0.3	2.0	0.5	—	63.0 min	—	28.0–34.0	—	—	—	2.5
Alloy 20	0.07	—	—	19.0–21.0	32.0–38.0	2.0–3.0	3.0–4.0	—	8×C – 1.00	—	—

Mechanical properties (minimum, room temperature)

Grade	Tensile	Yield (0.2 %)	Elongation	Note
Hastelloy C-276	690 MPa (100 ksi)	283 MPa (41 ksi)	40 %	Universal corrosion
Hastelloy C-22	690 MPa (100 ksi)	310 MPa (45 ksi)	45 %	Oxidising media
Monel 400	483 MPa (70 ksi)	172 MPa (25 ksi)	35 %	HF, seawater
Alloy 20	551 MPa (80 ksi)	241 MPa (35 ksi)	30 %	Hot H ₂ SO ₄

Typical applications

- Wet chlorine and chlorine dioxide service (C-276, C-22)
- Flue-gas desulphurisation and pollution control
- Hydrofluoric acid alkylation and seawater (Monel 400)
- Hot sulphuric acid piping (Alloy 20)
- Pharmaceutical and fine-chemical reactors

Testing & certification

- PMI on every piece
- ASTM G28 intergranular corrosion testing when specified
- Solution annealing per specification
- EN 10204 3.1 certificate; 3.2 on request

Copper-Nickel 90/10 & 70/30 Flanges & Fittings for Marine Piping

COPPER-NICKEL

Copper-nickel alloys resist seawater corrosion and biofouling, which is why they are the standard choice for ship and naval seawater systems, firemain and offshore cooling.

Teshi Group manufactures copper-nickel 90/10 and 70/30 flanges and fittings for shipyards and marine projects, to EEMUA 145 / 146 dimensions and ASTM material specifications, or to naval drawings.

Grades and specifications

Grade	Forged flanges & fittings	Butt weld fittings	Plate	Pipe
Cu-Ni 90/10 UNS C70600 · W.Nr. 2.0872	EEMUA 145 / to drawing	EEMUA 146	ASTM B171	ASTM B466 / B467
Cu-Ni 70/30 UNS C71500 · W.Nr. 2.0882	EEMUA 145 / to drawing	EEMUA 146	ASTM B171	ASTM B466 / B467

Chemical composition (weight %, maximum unless a range is given)

Grade	Mn	Ni	Cu	Fe	Zn	Pb
Cu-Ni 90/10	1.0	9.0–11.0	Balance	1.0–1.8	1.0	0.05
Cu-Ni 70/30	1.0	29.0–33.0	Balance	0.40–1.0	1.0	0.05

Mechanical properties (minimum, room temperature)

Grade	Tensile	Yield (0.2 %)	Elongation	Note
Cu-Ni 90/10	275 MPa (40 ksi)	105 MPa (15 ksi)	—	Seawater systems
Cu-Ni 70/30	360 MPa (52 ksi)	125 MPa (18 ksi)	—	Higher velocity

Typical applications

- Ship and naval seawater cooling, ballast and firemain systems
- Offshore platform seawater and firewater
- Desalination and condenser cooling
- Hydraulic and instrumentation lines

Testing & certification

- Chemistry and mechanical tests per specification
- Hydrostatic testing of fabricated assemblies
- Dimensional inspection to EEMUA 145 / 146 or drawing
- Inspection by the shipyard or classification agency when specified

Austenitic Stainless Steel Flanges & Fittings — 304L to 310S

AUSTENITIC STAINLESS

Austenitic stainless steels are the everyday choice for corrosive process lines, with grades tuned for low carbon (L), molybdenum for chlorides (316, 317L), stabilisation for high temperature (321, 347) and oxidation resistance (310).

Teshi Group manufactures stainless steel flanges to ASTM A182 and butt weld fittings to ASTM A403 in all common grades, dual-certified where the chemistry allows.

Grades and specifications

Grade	Forged flanges & fittings	Butt weld fittings	Plate	Pipe
304 / 304L UNS S30400 / S30403 · W.Nr. 1.4301 / 1.4306	ASTM A182 F304 / F304L	ASTM A403 WP304 / WP304L	ASTM A240	ASTM A312
316 / 316L UNS S31600 / S31603 · W.Nr. 1.4401 / 1.4404	ASTM A182 F316 / F316L	ASTM A403 WP316 / WP316L	ASTM A240	ASTM A312
317L UNS S31703 · W.Nr. 1.4438	ASTM A182 F317L	ASTM A403 WP317L	ASTM A240	ASTM A312
321 / 321H UNS S32100 / S32109 · W.Nr. 1.4541	ASTM A182 F321 / F321H	ASTM A403 WP321	ASTM A240	ASTM A312
347 / 347H UNS S34700 / S34709 · W.Nr. 1.4550	ASTM A182 F347 / F347H	ASTM A403 WP347	ASTM A240	ASTM A312
310 / 310S UNS S31000 / S31008 · W.Nr. 1.4845	ASTM A182 F310	ASTM A403 WP310S	ASTM A240	ASTM A312

Chemical composition (weight %, maximum unless a range is given)

Grade	C	Mn	Si	Cr	Ni	Mo	Nb	Ti
304 / 304L	0.08 / 0.030	2.00	1.00	18.0–20.0	8.0–11.0 / 8.0–12.0	—	—	—
316 / 316L	0.08 / 0.030	2.00	1.00	16.0–18.0	10.0–14.0	2.00–3.00	—	—
317L	0.030	2.00	1.00	18.0–20.0	11.0–15.0	3.0–4.0	—	—
321 / 321H	0.08	2.00	1.00	17.0–19.0	9.0–12.0	—	—	5×(C+N) – 0.70
347 / 347H	0.08	2.00	1.00	17.0–20.0	9.0–13.0	—	10×C – 1.10	—
310 / 310S	0.25 / 0.08	2.00	1.00–1.50	24.0–26.0	19.0–22.0	—	—	—

Mechanical properties (minimum, room temperature)

Grade	Tensile	Yield (0.2 %)	Elongation	Note
304 / 304L	515 MPa (75 ksi)	205 MPa (30 ksi)	30 %	304L: 485 / 170 MPa
316 / 316L	515 MPa (75 ksi)	205 MPa (30 ksi)	30 %	316L: 485 / 170 MPa
317L	—	—	—	Higher Mo for pitting
321 / 321H	515 MPa (75 ksi)	205 MPa (30 ksi)	30 %	Ti-stabilised
347 / 347H	515 MPa (75 ksi)	205 MPa (30 ksi)	30 %	Nb-stabilised
310 / 310S	515 MPa (75 ksi)	205 MPa (30 ksi)	30 %	Oxidation resistant

Typical applications

- Chemical, fertiliser and pharmaceutical process piping
- Food, water and utility lines
- Refinery hydrotreater and high-temperature lines (321, 347)
- Furnace and kiln piping (310S)
- Cryogenic service

Testing & certification

- Solution annealed
- Intergranular corrosion test to ASTM A262 Practice E when specified
- PMI and dimensional inspection
- EN 10204 3.1 certificate

Chrome-Moly Alloy Steel Flanges & Fittings — F5 to F91

ALLOY STEEL

Chromium-molybdenum steels keep their strength and resist creep and hydrogen attack at high temperature, which makes them standard for steam, boiler, refinery heater and hot-blast service.

Teshi Group manufactures chrome-moly flanges to ASTM A182 and fittings to ASTM A234, normalised and tempered with recorded furnace charts, and supplies them with IBR certification for boiler service.

Grades and specifications

Grade	Forged flanges & fittings	Butt weld fittings	Plate	Pipe
F5 (5Cr-½Mo) UNS K41545 · W.Nr. 1.7362	ASTM A182 F5	ASTM A234 WP5	ASTM A387 Gr 5	ASTM A335 P5
F9 (9Cr-1Mo) UNS K90941 · W.Nr. 1.7386	ASTM A182 F9	ASTM A234 WP9	ASTM A387 Gr 9	ASTM A335 P9
F11 Cl.2 (1¼Cr-½Mo) UNS K11572 · W.Nr. 1.7335	ASTM A182 F11 Cl.2	ASTM A234 WP11 Cl.1	ASTM A387 Gr 11	ASTM A335 P11
F22 Cl.3 (2¼Cr-1Mo) UNS K21590 · W.Nr. 1.7380	ASTM A182 F22 Cl.3	ASTM A234 WP22 Cl.1	ASTM A387 Gr 22	ASTM A335 P22
F91 (9Cr-1Mo-V) UNS K90901 · W.Nr. 1.4903	ASTM A182 F91	ASTM A234 WP91	ASTM A387 Gr 91	ASTM A335 P91

Chemical composition (weight %, maximum unless a range is given)

Grade	C	Mn	Si	Cr	Mo	N	Nb	V
F5 (5Cr-½Mo)	0.15	0.30–0.60	0.50	4.0–6.0	0.44–0.65	—	—	—
F9 (9Cr-1Mo)	0.15	0.30–0.60	0.50–1.00	8.0–10.0	0.90–1.10	—	—	—
F11 Cl.2 (1¼Cr-½Mo)	0.10–0.20	0.30–0.80	0.50–1.00	1.00–1.50	0.44–0.65	—	—	—
F22 Cl.3 (2¼Cr-1Mo)	0.05–0.15	0.30–0.60	0.50	2.00–2.50	0.87–1.13	—	—	—
F91 (9Cr-1Mo-V)	0.08–0.12	—	—	8.0–9.5	0.85–1.05	0.03–0.07	0.06–0.10	0.18–0.25

Mechanical properties (minimum, room temperature)

Grade	Tensile	Yield (0.2 %)	Elongation	Note
F5 (5Cr-½Mo)	485 MPa (70 ksi)	275 MPa (40 ksi)	20 %	Refinery heaters
F9 (9Cr-1Mo)	585 MPa (85 ksi)	380 MPa (55 ksi)	20 %	Hydrogen service
F11 Cl.2 (1¼Cr-½Mo)	485 MPa (70 ksi)	275 MPa (40 ksi)	20 %	Steam lines
F22 Cl.3 (2¼Cr-1Mo)	515 MPa (75 ksi)	310 MPa (45 ksi)	20 %	Boiler headers
F91 (9Cr-1Mo-V)	585 MPa (85 ksi)	415 MPa (60 ksi)	20 %	Supercritical boilers

Typical applications

- Boiler, superheater and steam headers (IBR)
- Supercritical and ultra-supercritical power plants (F91)
- Blast-furnace hot-blast stoves and mains
- Refinery heaters and hydrogen service
- Petrochemical high-temperature lines

Testing & certification

- Normalised and tempered with recorded furnace charts
- Hardness testing of every heat treatment lot
- UT and MPI as specified; PMI on every piece
- IBR Form III-C certification when specified

Carbon Steel, Low-Temperature & High-Yield Pipeline Flanges

CARBON STEEL

Carbon steel covers most piping by volume: A105 for general service, A350 LF2 and LF3 where impact toughness is needed at low temperature, and A694 high-yield grades matched to API 5L line pipe.

Teshi Group manufactures carbon steel flanges and fittings in all three families, normalised where required and supplied with EN 10204 3.1 certificates, Charpy results for low-temperature grades and IBR certification when specified.

Grades and specifications

Grade	Forged flanges & fittings	Butt weld fittings	Plate	Pipe
A105 / A105N UNS K03504 · W.Nr. ~1.0460	ASTM A105 (N = normalised)	ASTM A234 WPB	ASTM A516 Gr 70 / IS 2062	ASTM A106 Gr B / API 5L
A350 LF2 Cl.1 UNS K03011 · W.Nr. ~1.0566	ASTM A350 LF2 Cl.1	ASTM A420 WPL6	ASTM A516 Gr 70	ASTM A333 Gr 6
A350 LF3 UNS K32025 · W.Nr. —	ASTM A350 LF3	ASTM A420 WPL3	ASTM A203	ASTM A333 Gr 3
A694 F42 – F70 UNS — · W.Nr. —	ASTM A694 F42 to F70	MSS SP-75 WPHY 42–70	—	API 5L X42 – X70

Chemical composition (weight %, maximum unless a range is given)

Grade	C	Mn	Si	P	S	Ni
A105 / A105N	0.35	0.60–1.05	0.10–0.35	0.035	0.040	—
A350 LF2 Cl.1	0.30	0.60–1.35	0.15–0.30	0.035	0.040	—
A350 LF3	0.20	0.90	0.20–0.35	—	—	3.3–3.7
A694 F42 – F70	0.26	1.60	—	0.025	0.025	—

Mechanical properties (minimum, room temperature)

Grade	Tensile	Yield (0.2 %)	Elongation	Note
A105 / A105N	485 MPa (70 ksi)	250 MPa (36 ksi)	22 %	Max 187 HB
A350 LF2 Cl.1	485 MPa (70 ksi)	250 MPa (36 ksi)	22 %	Charpy at –46 °C
A350 LF3	485 MPa (70 ksi)	260 MPa (38 ksi)	22 %	Charpy at –101 °C
A694 F42 – F70	—	—	—	Yield = grade number in ksi (F52 = 52 ksi / 360 MPa)

Typical applications

- General refinery, process and utility piping (A105N)
- LNG, ammonia and low-temperature service (LF2, LF3)
- Oil and gas transmission pipelines (A694)
- Steel plant water, air and gas mains
- Boiler and steam service with IBR certification

Testing & certification

- Normalising where specified (A105N)
- Carbon equivalent limit (e.g. CE ≤ 0.43) when the project specifies it
- Charpy V-notch impact testing for LF grades
- Hardness, dimensional and visual inspection
- IBR certification when specified

Dimensional standards & manufacturing range

Standard	Covers	Teshi Group range
ASME B16.5	Pipe flanges and flanged fittings	NPS ½"-24", Class 150–2500; RF, FF, RTJ, tongue-and-groove, male-female
ASME B16.47 Series A / B	Large-diameter flanges (MSS SP-44 / API 605)	NPS 26"-60", Class 75–900
ASME B16.36	Orifice flanges	Class 300–2500, with pressure taps and jack screws
ASME B16.48	Line blanks — spectacle blinds, spades and spacers	To match ASME B16.5 flanges
ASME B16.9 / B16.28	Factory-made wrought butt weld fittings	NPS ½"-48", Sch 5S to XXS
ASME B16.11	Forged socket weld and threaded fittings	NPS ½"-4", Class 2000, 3000, 6000, 9000
MSS SP-97 / SP-83 / SP-95	Branch outlets, unions, swage nipples and bull plugs	Weldolet, Sockolet, Thredolet, Elbolet
EN 1092-1 / DIN	European metric flanges	PN 6 to PN 40 standard; higher ratings to drawing
IS 6392 / BS 10	Indian and British standard flanges	Including large plate flanges to drawing
ASTM A193 / A194 / A320	Stud bolts and nuts	Cut to length for each flange class and facing

Dimension charts for each standard are published free at www.teshigroup.com/dimensional-standards/ and compiled in the Teshi Group Dimensional Standards Manual (TG-DS-000).

Traceability, testing & certification

- Raw material only from approved mills, received against the mill test certificate and recorded by heat number.
- Heat number, grade, size, rating and standard hard-stamped on every piece and traced through each production stage.
- PMI on every alloy and stainless piece; hardness on every heat treatment lot.
- Dimensional inspection against the governing ASME, EN or IS tables on every lot.
- NDT (UT, MPI, DPT), IGC (ASTM A262, G28, A923), Charpy impact and hydrostatic tests as specified.
- EN 10204 3.1 certificate as standard; 3.2 with the third-party agency your order names; IBR certification for boiler service.

This data book summarises published specifications for convenience and does not replace the current edition of the governing standard, which takes precedence. Verify requirements against your project specification before design, purchase or fabrication. Zeron® is a registered trademark of Rolled Alloys; Inconel®, Incoloy® and Monel® are trademarks of Special Metals Corporation; Hastelloy® is a trademark of Haynes International. Teshi Engineers & Sales Promoters (P) Ltd accepts no liability for errors or omissions.