A420 Grade WPL6

ASTM/ASME A/SA 420 WPL6 · Low-temperature buttweld fittings of C-steel to –46 °C (–50 °F)

Material group: Unalloyed carbon steel for low-temperature pressure-bearing fittings

ASTM / ASME standard: ASTM A420 / ASME SA-420

Grade: WPL6 (Wrought Pipe Low Temp – Grade 6)

EN equivalent: ≈ P355NL2 (1.1116)

Matching pipe grades: ASTM A333 Gr. 6

Service temperature: –46 °C to +345 °C (standard application per ASME B31.3)

Standards (fittings): ASTM A420 / ASME SA-420 · ASME B16.9 / B16.28

Forms (Nirotec): Elbows · tees · reducers · caps · custom parts

1 Material Equivalents & Comparable Grades

National equivalents

Standard / region	Designation	Material no. / Grade	Remark
ASTM/ASME	A420 / SA-420 WPL6	–	Current designation
ASTM/ASME	A333 Gr. 6	–	Matching pipes
ASTM/ASME	A350 LF2	–	Matching flanges
EN	P355NL2 (≈)	1.1116	European equivalent
EN	P265NL (≈)	1.0451	Lower-strength approximation

Alternative materials

Material	Material no.	Reference / use	Note
A234 WPB	–	Standard C-steel, no low-temp	Sufficient above –29 °C
A420 WPL3	–	3.5% Ni, to –101 °C	Lower temperatures
A420 WPL8	–	9% Ni steel, to –196 °C	LNG range
P355NL2	1.1116	EN equivalent	For EN specifications

2 Chemical Composition

Composition in mass percent (%). Standard: ASTM A420 / SA-420. A420 WPL6 is the standard low-temperature fitting grade to –46 °C – the ASTM counterpart to P355NL2. By far the most commonly specified low-temperature fitting material worldwide (LPG, ammonia, cold petrochemical service).

Element	Symbol	Min. (heat)	Max. (heat)	Max. (product)	Function / remark
Carbon	C	–	0.30	0.30	Strength, weldability
Manganese	Mn	0.29	1.06	1.06	Strength
Phosphorus	P	–	0.050	0.050	Impurity – limit
Sulfur	S	–	0.058	0.058	Impurity – limit
Silicon	Si	0.10	–	–	Deoxidation, min. 0.10 %
Chromium	Cr	–	0.40	0.40	Residual
Copper	Cu	–	0.40	0.40	Residual
Molybdenum	Mo	–	0.15	0.15	Residual
Nickel	Ni	–	0.40	0.40	Residual
Vanadium	V	–	0.08	0.08	Residual

3 Mechanical Properties

Room temperature – minimum requirements (ASTM A420)

Delivery condition: normalised or quenched + tempered. Charpy at –46 °C mandatory.

Property	Symbol	Unit	Minimum value	Remark
Tensile strength	Rm	MPa	415 – 585	–
Yield strength	Rp0.2	MPa	≥ 240	Minimum value
Elongation (long.)	A	%	≥ 22	Longitudinal specimens
Elongation (trans.)	A	%	≥ 14	Transverse specimens
Impact energy (–46 °C)	KV	J	≥ 18	Minimum per A420
Hardness	HB	–	≤ 197	Reference value

Hot yield strength Rp0.2 in MPa (typical values per standard)

Temperature	100 °F	200 °F	400 °F	600 °F
Allow. Stress (ksi)	20.0	20.0	20.0	19.6

4 Physical Properties

Property	Symbol	20 °C	200 °C	400 °C	Unit
Density	ρ	7.85	7.76	7.65	g/cm^3
Modulus of elasticity	E	210	196	180	GPa
Thermal conductivity	λ	52	49	44	W/(m·K)
Coeff. thermal expansion	α	11.5	12.3	13.0	$10^{-6}/K$
Specific heat capacity	cp	470	504	530	J/(kg·K)

5 Corrosion Resistance

Medium / environment	Remark	Resistance
Low-temperature service (to –46 °C)	Standard application	++
Cryogenic hydrocarbons	LPG, ethane, propane	++
Fully refrigerated ammonia	–33 °C standard, oxygen-free	++
Dry hydrocarbons	Resistant	+
Dry technical gases	Compressed air, N_2	+
Atmosphere / humid air	Surface rust – coating recommended	o
Acids of any kind	No resistance	–
Sour gas (H_2S)	Not NACE qualified without special review	–
Chloride-bearing media	Corrosion risk	–

++ excellent resistance	+ good resistance	o limited resistance	– not resistant

A420 WPL6 is an unalloyed carbon steel without corrosion protection – its strength lies in guaranteed toughness at low temperatures, not corrosion resistance.

6 Typical Applications

Industry / plant	Typical application	Operating condition
Petrochemical / refining	Low-temperature process piping	Down to –46 °C, ASME B31.3
LPG plants	Propane/butane storage and piping	–42 °C standard
Ammonia plants	NH_3 liquefaction, storage	–33 °C to –46 °C
Pressure vessel construction	Nozzles, connecting piping	ASME VIII
Refrigeration	Industrial cold piping	Standard application

Industry / plant	Typical application	Operating condition
Cold-climate offshore	Topside, subsea in cold climate	NORSOK compatible

7 Forms Available at Nirotec

Component	Standard (EN)	Standard (ASME/ASTM)	Remark
Elbows	≈ EN 10253-2 (P355NL2)	ASME B16.9 · A420 WPL6	LR/SR, 90°/45°
Tees	≈ EN 10253-2	ASME B16.9 · A420 WPL6	Equal and reducing branch
Reducers	≈ EN 10253-2	ASME B16.9 · A420 WPL6	Concentric and eccentric
Caps	≈ EN 10253-2	ASME B16.9 · A420 WPL6	Hemispherical caps
High-pressure forged fittings	–	ASME B16.11 · A420 WPL6	SW / NPT up to Class 9000
Custom parts	Per drawing	Per drawing	Special-form components on request

8 Standards, Approvals & Codes

Standard / code	Title / application
ASTM A420 / ASME SA-420	Wrought fittings of C- and low-alloy steel, low-temperature
ASTM A333 Gr. 6	Matching pipes for A420 WPL6
ASTM A350 LF2	Matching flanges
ASME B16.9	Factory-Made Wrought Buttwelding Fittings
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B31.3	Process Piping (for low-temperature)
PED 2014/68/EU	Pressure Equipment Directive (CE for EU supply)

9 Processing Notes

Weldability

Parameter	Specification / recommendation	Remark
Preheat	Not required (< 25 mm)	For larger thicknesses 50–100 °C
Post-weld heat treatment	Stress relief 595–650 °C	Mandatory for pressure-bearing parts
Filler metal	AWS A5.18 ER70S-2 / S-6	Low-hydrogen electrodes preferred
Welding processes	GTAW, GMAW, SMAW	Low-hydrogen processes preferred
Interpass temperature	< 315 °C	Standard practice for C-steel

- Delivery condition: normalised or quenched + tempered – Charpy at –46 °C (–50 °F) is mandatory
- Identification per ASTM A420: manufacturer, A420, WPL6, standard, heat, heat-treatment status
- Not for sour service (H_2S) without separate NACE qualification
- Strictly observe PWHT temperature – above that loss of low-temperature toughness
- For NACE MR0175: hardness verification ≤ 248 HV / 22 HRC required

10 Inquiry & Contact

For a project-specific inquiry we ideally require:

- Standard and type (e.g. ASME B16.9 LR 90° in A420 WPL6)
- Lowest operating temperature and possible NACE requirement
- Dimensions: NPS, wall thickness / schedule
- Quantity and required delivery date
- Required documentation (EN 10204 type 3.1 / 3.2, Charpy –46 °C, NDT)
- Applicable code (ASME B31.3 typical)

Nirotec GmbH & Co. KG

Otto-Hahn-Str. 4 · 59423 Unna · Germany

Tel.: +49 (0) 2303 / 985-0 · info@nirotec.de · www.nirotec.de