

P355NL2

Material no. 1.1116 · Low-temperature tough pressure-vessel steel to -50 °C

Material group: Weldable fine-grain pressure-vessel steel, low-temperature toughness

Material no. (EN): 1.1116

EN designation: P355NL2

Former DIN designation: TStE 355 / WStE 355

ASTM / ASME equivalent: Pipes: A/SA 333 Gr. 6 · Fittings: A/SA 420 WPL6 · Flanges: A/SA 350 LF2

Service temperature: -50 °C to $+400\text{ °C}$ (continuous service)

Standards (pipes): EN 10216-4 (seamless) · EN 10217-4 (welded)

Standards (fittings): EN 10253-2 · ASME B16.9

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

1 Material Equivalents & Comparable Grades

National equivalents

Standard / region	Designation	Material no. / Grade	Remark
EN	P355NL2	1.1116	Current European designation
DIN (old)	TStE 355 / WStE 355	1.1116	Predecessor designation
ASTM/ASME	A/SA 333 Gr. 6	–	Low-temperature pipes
ASTM/ASME	A/SA 420 WPL6	–	Low-temperature fittings
ASTM/ASME	A/SA 350 LF2	–	Low-temperature flanges
EN 10222-4	P355NL2	1.1116	Forgings

Alternative materials

Material	Material no.	Reference / use	Note
P265NL	1.0451	Lower strength	Sufficient to -40 °C
P460NL2	1.8915	Higher strength, same cold service	High wall loading
A420 WPL6	–	ASTM equivalent	For US specifications
12Ni14	1.5680	Ni-alloyed to -105 °C	LNG range

2 Chemical Composition

Composition in mass percent (%). Standard: EN 10216-4 / EN 10028-3. P355NL2 is a fine-grained weldable structural steel with guaranteed impact energy at $-50\text{ }^{\circ}\text{C}$. Standard material for LPG, ammonia, petrochemical cold service.

Element	Symbol	Min. (heat)	Max. (heat)	Max. (product)	Function / remark
Carbon	C	–	0.18	0.20	Strength, weldability
Silicon	Si	–	0.50	0.55	Deoxidation
Manganese	Mn	1.10	1.70	1.80	Strength, toughness
Phosphorus	P	–	0.020	0.025	Impurity – limit
Sulfur	S	–	0.005	0.007	Very low S for toughness
Aluminium (tot.)	Al	0.020	–	–	Grain refining, $\geq 0.020\text{ }%$
Chromium	Cr	–	0.30	0.35	Residual
Copper	Cu	–	0.35	0.40	Residual
Molybdenum	Mo	–	0.10	0.12	Residual
Nickel	Ni	–	0.80	0.85	Toughness contribution
Nitrogen	N	–	0.012	0.014	Residual
Vanadium	V	–	0.10	0.12	Strength contribution
Niobium	Nb	–	0.05	0.05	Grain refining

3 Mechanical Properties

Normalised – minimum requirements (EN 10216-4)

Valid for wall thicknesses $t \leq 16\text{ mm}$. NL2 = normalised low-temperature (level 2).

Property	Symbol	Unit	Minimum value	Remark
Yield strength 0.2 %	Rp0.2	MPa	≥ 355	$t \leq 16\text{ mm}$
Yield strength 0.2 %	Rp0.2	MPa	≥ 345	$16 < t \leq 40\text{ mm}$
Tensile strength	Rm	MPa	490 – 630	–
Elongation at fracture	A	%	≥ 22	Longitudinal specimens
Impact energy ($-50\text{ }^{\circ}\text{C}$)	KV	J	≥ 27	Mean value (NL2 requirement)
Impact energy ($0\text{ }^{\circ}\text{C}$)	KV	J	≥ 60	Mean value
Hardness	HB	–	≤ 220	Reference value

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

Temperature	100 °C	200 °C	300 °C	400 °C
Rp0.2 (MPa)	315	290	260	220

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	48	45	40	W/(m·K)
Coeff. thermal expansion	α	11.6	12.4	13.1	10 ⁻⁶ /K
Specific heat capacity	cp	470	504	530	J/(kg·K)

5 Corrosion Resistance

Medium / environment	Remark	Resistance
Low-temperature service (to -50 °C)	Standard application	++
LPG (liquid propane/butane)	Cryogenic application	++
Liquid ammonia (NH ₃)	-33 °C standard, oxygen-free	++
Dry hydrocarbons	Resistant	+
Treated water	Feed water, condensate	+
Atmosphere / humid air	Surface rust – coating recommended	o
Acids	Not resistant	-
Sour gas (H ₂ S)	Not NACE qualified without special review	-
Chloride-bearing media	Corrosion risk	-

++ excellent resistance

+ good resistance

o limited resistance

- not resistant

P355NL2 is the classic low-temperature pressure-vessel steel for the -50 °C range – not corrosion-resistant, but with guaranteed toughness.

6 Typical Applications

Industry / plant	Typical application	Operating condition
Petrochemical / refining	Low-temperature process piping	Down to $-50\text{ }^{\circ}\text{C}$
LPG plants	Propane/butane storage and piping	$-42\text{ }^{\circ}\text{C}$ standard
Ammonia plants	NH_3 liquefaction, storage	$-33\text{ }^{\circ}\text{C}$ to $-50\text{ }^{\circ}\text{C}$
Pressure vessel construction	Tanks, nozzles, connecting piping	AD 2000 / ASME VIII
Refrigeration	Industrial cooling and cryogenic plants	Moderate cold service
Cold-climate offshore	Norwegian / arctic applications	NORSOK compatible

7 Forms Available at Nirotec

Component	Standard (EN)	Standard (ASME/ASTM)	Remark
Elbows	EN 10253-2	ASME B16.9 · A/SA 420 WPL6	LR/SR, $90^{\circ}/45^{\circ}$
Tees	EN 10253-2	ASME B16.9 · A/SA 420 WPL6	Equal and reducing branch
Reducers	EN 10253-2	ASME B16.9 · A/SA 420 WPL6	Concentric and eccentric
Caps	EN 10253-2	ASME B16.9 · A/SA 420 WPL6	Hemispherical caps
Weld neck flanges	EN 1092-1 Type 11	ASME B16.5 · A/SA 350 LF2	PN 10 – PN 400
Custom parts	Per drawing	Per drawing	Special components on request

8 Standards, Approvals & Codes

Standard / code	Title / application
EN 10216-4	Seamless tubes for pressure purposes – low-temperature steels
EN 10217-4	Welded tubes for pressure purposes – low-temperature steels
EN 10222-4	Forgings for pressure vessels – fine-grain steels
EN 10253-2	Butt-welding fittings – unalloyed and ferritic steels
EN 1092-1	Flanges and their joints
AD 2000-W10	Steels for low temperatures
PED 2014/68/EU	Pressure Equipment Directive
ASME B31.3	Process piping

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 550–600 °C	Mandatory for pressure-bearing parts
Filler metal	S2/S3 Ni 0.5 (EN ISO 14341)	Low hydrogen
Welding processes	GTAW, GMAW, SMAW, SAW	All standard processes suitable
Interpass temperature	≤ 250 °C	Standard practice

- Delivery condition: normalised (N) – essential for guaranteed impact energy at –50 °C
- Charpy test at –50 °C is a standard inspection – must be confirmed on certificate
- Identification per EN 10216-4: heat no., 1.1116 / P355NL2, standard, dimensions
- For PWHT > 620 °C: possible strength loss, verify Charpy
- Not for sour service (H₂S) without NACE special review

10 Inquiry & Contact

For a project-specific inquiry we ideally require:

- Standard and type (e.g. EN 10253-2 in 1.1116 / P355NL2)
- Lowest operating temperature (e.g. –50 °C, –46 °C)
- Dimensions: DN / NPS, wall thickness or schedule
- Quantity and required delivery date
- Required documentation (EN 10204 type 3.1 / 3.2, NDT, Charpy verification)
- Project-specific specification

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