

X20CrMoV11-1

Material no. 1.4922 · Martensitic creep-resistant 12 % chromium steel

Material group: Martensitic creep-resistant chromium steel (12 % Cr steel)

Material no. (EN): 1.4922

EN designation: X20CrMoV11-1

Former DIN designation: X20CrMoV12-1 (DIN 17175)

ASTM / ASME equivalent: No direct equivalent – similar in application to Grade 91 (P91/T91), but different chemistry

Service temperature: Up to +570 °C (continuous) · creep certified up to ~600 °C

Standards (pipes): EN 10216-2 · DIN 17175 (withdrawn) · VdTÜV 511

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

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

1 Material Equivalents & Comparable Grades

National equivalents

Standard / region	Designation	Material no. / Grade	Remark
EN	X20CrMoV11-1	1.4922	Current European designation
DIN (old)	X20CrMoV12-1	1.4922	DIN 17175 (withdrawn)
VdTÜV	X20CrMoV12-1	–	VdTÜV data sheet 511
GOST (RU)	20Kh12VNMF / EI756	–	Russian equivalent
JIS (Japan)	SUS 410J1	–	Approximation

Alternative materials

Material	Material no.	Reference / use	Note
P91 / X10CrMoVNb9-1	1.4903	Higher creep strength, more modern grade	Preferred for new plants
P92 / X11CrMoWVNb9-1-1	1.4901	Highest creep strength	Ultra-supercritical plants
10CrMo9-10	1.7380	Lower temperature class	Up to 530 °C
13CrMo4-5	1.7335	Easier to process	Up to 500 °C

2 Chemical Composition

Composition in mass percent (%). Standard: VdTÜV 511 / DIN 17175. X20CrMoV11-1 is the classic 12 % chromium steel with Mo and V – for decades the backbone of European coal-fired power plants. Today largely replaced by P91/P92 in new plants, but heavily present in existing fleets.

Element	Symbol	Min. (heat)	Max. (heat)	Max. (product)	Function / remark
Carbon	C	0.17	0.23	0.24	Hardenability, strength
Silicon	Si	–	0.50	0.50	Deoxidation
Manganese	Mn	–	1.00	1.00	Strength, toughness
Phosphorus	P	–	0.025	0.030	Impurity limit
Sulfur	S	–	0.015	0.020	Impurity limit
Chromium	Cr	10.0	12.5	12.5	Corrosion / oxidation resistance
Molybdenum	Mo	0.80	1.20	1.20	Creep strength
Nickel	Ni	0.30	0.80	0.80	Toughness
Vanadium	V	0.25	0.35	0.35	Precipitation strengthening

3 Mechanical Properties

Quenched + tempered – minimum requirements (VdTÜV 511)

X20 is quenched and tempered (austenitised at 1020–1070 °C, oil quenched, tempered at 720–780 °C). Values apply to this condition.

Property	Symbol	Unit	Minimum value	Remark
Yield strength 0.2 %	Rp0.2	MPa	≥ 490	Q+T, t ≤ 60 mm
Tensile strength	Rm	MPa	690 – 840	–
Elongation at fracture	A	%	≥ 17	Longitudinal specimens
Impact energy (20 °C)	KV	J	≥ 41	Mean value
Hardness	HB	–	≤ 248	Q+T

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

Temperature	100 °C	300 °C	400 °C	500 °C	550 °C	570 °C	600 °C
Rp0.2 (MPa)	470	430	400	360	320	295	260

4 Physical Properties

Property	Symbol	20 °C	200 °C	400 °C	600 °C	Unit
Density	ρ	7.70	7.66	7.60	7.51	g/cm ³
Modulus of elasticity	E	215	207	190	165	GPa
Thermal conductivity	λ	25	26	27	28	W/(m·K)
Coeff. thermal expansion	α	10.8	11.4	11.9	12.3	10 ⁻⁶ /K
Specific heat capacity	cp	460	500	560	620	J/(kg·K)

5 Corrosion Resistance

Medium / environment	Remark	Resistance
High-pressure steam (main steam)	Standard application up to 540 °C	++
Steam atmosphere	Stable Cr oxide layer	++
Hot water, treated	Feed water, boiler water	+
High-temperature oxidation (air)	Resistant up to ~600 °C	+
Steam at very high temperature	Magnetite / hematite formation > 580 °C	o
Atmosphere / humid air	Moderate corrosion without protection	o
Acids of any kind	Not resistant	-
Chloride-bearing media	Corrosion risk	-
Sulphur-bearing atmosphere	Sulphidation at high temperatures	-

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

X20CrMoV11-1 is a high-temperature strength material – not a corrosion-resistant alloy. Primary use in dry steam at high temperatures.

6 Typical Applications

Industry / plant	Typical application	Operating condition
Conventional coal-fired plants	Main steam and reheater piping	Up to 540 °C, high pressure
Existing plant maintenance	Spare parts for older HP systems	Maintenance and repair
Combined-cycle plants	Steam system components	Up to 540 °C
Chemical process engineering	High-temperature pressure piping	Up to 570 °C
Waste incineration	Superheater headers	High wall temperatures

Industry / plant	Typical application	Operating condition
High-temperature valves	Bodies, connecting elements	Pressure + temperature loaded

7 Forms Available at Nirotec

Component	Standard (EN)	Standard (ASME/ASTM)	Remark
Elbows	EN 10253-2 (analog.)	ASME B16.9 (analog.)	LR/SR, 90°/45°, custom angles
Tees	EN 10253-2 (analog.)	ASME B16.9 (analog.)	Equal and reducing branch
Reducers	EN 10253-2 (analog.)	ASME B16.9 (analog.)	Concentric and eccentric
Caps	EN 10253-2 (analog.)	ASME B16.9 (analog.)	Hemispherical caps
Weld neck flanges	EN 1092-1 Type 11	ASME B16.5 (analog.)	PN 25 – PN 400
Custom parts	Per drawing	Per drawing	Special components on request

8 Standards, Approvals & Codes

Standard / code	Title / application
EN 10216-2	Seamless tubes for pressure purposes – alloy steels, high temperature
EN 10222-2	Forgings for pressure equipment – creep-resistant alloy steels
DIN 17175 (withdrawn)	Seamless tubes of creep-resistant steels
VdTÜV 511	X20CrMoV12-1 – material data sheet
AD 2000-W13	High-temperature steels for pressure vessels
PED 2014/68/EU	Pressure Equipment Directive
ASME B31.1	Power piping (for equivalent applications)

9 Processing Notes

Weldability

Parameter	Specification / recommendation	Remark
Preheat	300–400 °C mandatory	Prevents martensite cracking
Post-weld heat treatment	Tempering 720–780 °C, controlled	Minimum 2–4 h hold time
Filler metal	EZ CrMoV 12 1 per DIN 8575	Matching CrMoV filler
Welding processes	GTAW, SMAW, SAW	GTAW recommended for root pass
Interpass temperature	≥ 300 °C, ≤ 400 °C	Maintain throughout welding

Parameter	Specification / recommendation	Remark
Mf temperature	≈ 200–250 °C	Martensite finish point

- Delivery condition: quenched + tempered – essential for mechanical properties
- Welding is demanding: preheat and immediate PWHT mandatory
- For repairs: tempering state of base material must be known
- Identification per EN 10216-2: heat no., 1.4922, standard, dimensions, condition
- For sustained service > 540 °C: consider carbide coarsening and strength decrease

10 Inquiry & Contact

For a project-specific inquiry we ideally require:

- Standard and type (e.g. EN 10253-2 in 1.4922)
- Confirm: new build or spare part for existing plant
- Dimensions: DN / NPS, wall thickness or schedule
- Quantity and required delivery date
- Required documentation (EN 10204 type 3.1 / 3.2, NDT, hardness verification after PWHT)
- Project-specific specification (plant operator, TÜV requirements)

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