

20X12BHMΦ (ЭП428) is a **martensitic heat-resistant steel** developed in Russia for high-temperature applications (up to **600–650°C**). It is widely used in **power generation, gas turbines, and aerospace** due to its **creep resistance, high strength, and oxidation resistance**.

International Equivalents

Country	Standard	Equivalent Grade
USA	ASTM A565	AISI 422
EU	EN 10095	DIN X20CrMoV12-1
Japan	JIS G4311	SUH 600
China	GB/T 1221	1Cr12WMoV

Applications

- **Power Plants:** Turbine blades, rotors, bolts.
- **Aerospace:** Jet engine components.
- **Oil & Gas:** High-pressure valve parts.

Equivalent or Similar Grades - Chemical Composition

Element	20X12BHMΦ, ЭП428	AISI 422	X20CrMoV12-1	SUH 616
C	0.17–0.23	0.20–0.25	0.17–0.23	0.15–0.25
Cr	11.0–13.0	11.0–13.0	10.0–12.5	10.0–13.0
Ni	0.50–0.90	0.50–1.00	0.30–0.80	≤1.00
Mo	0.70–1.00	0.75–1.25	0.80–1.20	0.80–1.20
V	0.20–0.40	0.20–0.40	0.25–0.35	0.20–0.40
W	0.70–1.10	–	–	–
Mn	0.50–0.90	≤1.00	0.30–0.80	≤1.00
Si	0.30–0.60	≤0.75	0.15–0.50	≤0.75

Key Features:

- **High Cr (11–13%)** provides **oxidation resistance** at high temperatures.
- **Mo & V** enhance **creep strength** by forming stable carbides.
- **W (Tungsten)** in **20X12BHMΦ** improves **hot hardness** (unique to Russian grade).

Mechanical Properties

Room Temperature (Delivery Conditions: +A, +QT, +HT)

Condition	σ_x (MPa)	$\sigma_{0.2}$ (MPa)	δ (%)	HB	Impact (J)
Annealed (+A)	650-850	≥ 490	≥ 15	200-250	≥ 40
Quenched & Tempered (+QT)	880-1080	≥ 735	≥ 12	270-330	≥ 30

High-Temperature Strength (500-650°C)

Temp (°C)	σ_x (MPa)	Creep Limit (10 ⁵ h, MPa)
550	550-650	120-150
600	450-550	80-100
650	350-450	40-60

Physical Properties

Property	Value
Density (g/cm ³)	7.8
Melting Point (°C)	1450-1500
Thermal Conductivity (W/m·K)	26.0 (20°C), 28.5 (600°C)
Coefficient of Expansion (10 ⁻⁶ /K)	11.5 (20-600°C)

Heat Treatment

- **Annealing (A):** 850-900°C → slow cooling (for machinability).
- **Quenching (Q):** 1000-1050°C → oil/air cooling.
- **Tempering (T):**
 - **Standard Tempering:** 650-700°C → air (for balanced strength/toughness).
 - **High-Temperature Tempering:** 720-780°C → improved ductility.

Processing Performance

Machining

- **Pre-annealing** recommended for better machinability.
- **Carbide tools** preferred due to high hardness.

Welding

- **Preheating:** 250–300°C (to avoid cracking).
- **Post-Weld Heat Treatment (PWHT):** 700–750°C → slow cooling.
- **Filler Metals:** Matching electrodes (e.g., ЦЛ-17 in Russian standards).

SpecialSteel