MATERIAL SPECIFICATION FOR CARBON STEEL ASTM A-350 Gr LF-2 FORGING 36,000 MINIMUM YIELD, IMPACT TESTED AT -45°C OR LOWER 27J/20J

1.0 PURPOSE

1.1 It is the purpose of material specification to list in a concise from of the material requirements for ASTM A-350 Gr. LF2 carbon steel forgings for use in oil field services.

1.2 This material specification is intended to aid the purchasing department in procuring and the vendor in supplying a material which meets the needs of its intended use, and the quality control department in the inspection and release of incoming material.

2.0 SCOPE

2.1 This material specification covers forgings in the annealed or normalized condition other requirements are met as specified.

3.0 Chemical composition:

The material shall confirm to the following chemical composition:-

ELEMENTS	COMPOSITION RANGE (%)
Carbon (C)	0.30 max
Manganese (Mn)	0.60 – 1.35
Silicon (Si)	0.15 – 0.30
Sulphur (S)	0.025 max
Phosphorus (P)	0.025 max
Nickel (Ni)	0.40 max *
Chromium (Cr)	0.30 max * [a]
Molybdenum (Mo)	0.12 max * [a]
Copper (Cu)	0.40 max *

* The sum of copper, nickel, chromium, vanadium and molybdenum shall not exceed 1.00% on heat analysis

[a] The sum of chromium and molybdenum shall not exceed 0.32% on heat analysis

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4.0 Mechanical Properties:

The material produced to this specification shall confirm to the following properties.

MECHANICAL PROPERTIES	RANGE
TENSILE STRENGTH	70,000 PSI (483 MPa) Min.
YIELD STRENGTH	36,000 PSI (248 MPa) Min.
ELONGATION IN 50mm Dia	21% Min.
REDUCTION IN AREA	30% Min
HARDNESS	197 BHN max

Tensile shall be performed at room temperature. One tension test shall be made for each heat as forged components.

5.0 IMPACT TESTING

Impact testing shall be performed at -45 °C. Average 27 joules each set of three specimens with one minimum value of 20 joules.

6.0 HEAT TREATMENT:-

After hot working and before reheating for heat treatment, forging shall be allowed to cool substantially below the transformation range (less than 590° C).

6.1 **The forgings shall either be normalized.**

6.2 **NORMALIZING:** heat to a temperature that produces an austenitic structure, holding sufficient time to attain uniform temperature throughout. Cool uniformly in still air.

7.0 DOCUMENTATION REQUIRED

7.1 Each shipment shall be accompanied by material certifications for each lot of material, the certifications must be positively relatable to the lot of material represented.
- **a)** Mill certificate of raw material.
- **b)** Chemical certificate for each lot of forging.

7.2 Mechanical properties certification as per section 4.0.
7.3 Impact testing certification as per section 5.0.
7.4 Certification of heat treatment including cycle time, temperature, cooling media, hardness and graphs.
7.5 Calibration certificate of furnace.
7.6 Ultrasonic test report certification of raw material.

8.0 TESTING TO BE CARRIED OUT BY SARA SAE

8.1 At the time of lifting forgings re-verification of chemical properties.
8.2 Recheck of tensile strength, yield strength, elongation, reduction in area, hardness, impact testing and UT testing.
8.3 MPI testing after machining.

SARA SAE PRIVATE LIMITED UNIT-II 71 Pittam Road DEHRADUN (Uttarakhand)