

Specification of ASTM A350 Grade LF2

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ASTM A350 / A350M – Standard Specification for **Carbon and Low-Alloy Steel Forgings** requiring notch toughness testing for **low-temperature service**.

This specification covers several grades of carbon and low-alloy steel forged or ring-rolled flanges, forged fittings and valves intended primarily for low-temperature service and requiring notch toughness testing. They are made to specified dimensions, or to dimensional standards, such as the ASME and API Specifications referenced in Section 2. Although this specification covers some piping components machined from rolled bar and seamless tubular materials

Melting Process -- The steel shall be produced by any of the following primary processes: openhearth, basic oxygen, electric-furnace, or vacuuminduction melting (VIM). The primary melting may incorporate separate degassing or refining, and may be followed by secondary melting using electrosag remelting (ESR), or vacuum-arc remelting (VAR).

ASTM A350 LF2 Composition

Element	Composition, wt. % (Grade LF2)
Carbon, max	0.3
Manganese	0.60 – 1.35
Phosphorus, max	0.035
Sulfur, max	0.04
Silicon ^a	0.15 – 0.30
Nickel	0.40 max ^b
Chromium	0.30 max ^{b,c}
Molybdenum	0.12 max ^{b,c}
Copper	0.40 max ^b
Niobium ^e	0.02 max ^d
Vanadium	0.08 max
Nitrogen	...

When vacuum carbon - deoxidation is required by Supplementary Requirement S3, the silicon content shall be 0.12 % maximum

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

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

By agreement, the limit for niobium (columbium) may be increased up to 0.05 % on heat analysis and 0.06 % on product analysis

Niobium and columbium are interchangeable names for the same element and both names are acceptable for use in A01.22 specifications

ASTM A350 LF2 Mechanical Property:

Property	LF2 Classes 1 and 2
Tensile strength, ksi [MPa]	70 - 95 [485 - 655]
Yield strength, min, ksi [MPa] ^b	36 [250]
Elongation:	22
- Standard round specimen, or small proportional gauge specimen, min % in 4D gauge length	30
- Strip specimen for wall thickness ⁵ / ₁₆ in. [7.94 mm] and over and for all small sizes tested in full section; min % in 2 in. [50 mm]	48 t +15
- Formula for calculating minimum elongation for strip specimens thinner than ⁵ / ₁₆ in. [7.94 mm]; min % in 2 in. [50 mm]	1.9 t +15
t = actual thickness in inches	
t = actual thickness in mm	
Reduction of area, min, % ^c	30
See 7.4 for hardness tests.	NACE MR 0175 Compliance

Heat Treatment:

Condition	Description
Normalized	Heating above critical range then air cooled
Normalized and Tempered	Normalizing followed by controlled tempering
Quenched and Tempered	Optional for special cases or higher classes

- Heat treatment is **mandatory** to meet low-temperature impact requirements.

ASTM A350 LF2 Charpy V - Notch Energy

Requirements for Standard Size [10 by 10 mm]

Specimens

Grade	Minimum Impact Energy Required for Average of Each Set of Three Specimens, ft·lbf [J]	Minimum Impact Energy Permitted for One Specimen only of a Set, ft·lbf [J]
LF2, Class 1	15 [20]	12 [16]
LF2, Class 2	20 [27]	15 [20]

Standard Impact Test Temperature for Standard Size [10 by 10 mm] Specimens

Grade	Test Temperature, °F [°C]
LF2 Class 1	−50 [−46]
LF2 Class 2	−0 [−18]

Minimum Equivalent Absorbed Energy ft·lbf (J) for Various Specimen Sizesⁿ

Standard C57:H61	$\frac{3}{4}$ size [10 by 7.5 mm]	$\frac{2}{3}$ size [10 by 6.6 mm]	$\frac{1}{2}$ size [10 by 5 mm]	$\frac{1}{3}$ size [10 by 3.3 mm]	$\frac{1}{4}$ size [10 by 2.5 mm]
15 [20]	12 [16]	10 [14]	8 [11]	5 [7]	4 [6]
13 [18]	10 [14]	9 [12]	7 [10]	5 [7]	4 [6]
12 [16]	10 [14]	9 [12]	7 [10]	4 [6]	3 [5]
10 [14]	8 [11]	7 [10]	5 [7]	3 [5]	3 [5]

Certification & Documentation

- Mill Test Certificate per EN 10204 3.1 or 3.2
- Includes:
 - Chemical & mechanical test reports
 - Charpy impact results
 - Heat treatment condition
 - NDE results (if applicable)

Available Product Forms

- Forged flanges (ASME B16.5, B16.47)
- Forged fittings (ASME B16.11, MSS SP-75)
- Pressure parts (per ASME Sect. VIII Div. 1/2)