AISI 4130 LOW ALLOY STEEL CHROMIUM MOLYBDENUM STEEL FORGING

Rev	Reason of Change	Date	Prepared By	Reviewed By	Approved By	Status
0	Initial release	15.11.22	Alok	Pankaj	K.C. Raturi	Released

1.0 SCOPE

1.1. This specification details the technical requirements of material bought in accordance with this specification.

1.2. Material within the scope of this specification shall be fully in accordance with API 6A (including Annex M)
and NACE MR-01-75/ISO 15156 latest edition requirements.

2.0 REQUIREMENTS

2.1 The requirements of specification SES 26-590, SES 26-740 & SES 26-744 shall apply in addition to the following specific requirements.

2.2 The raw material supplier shall assure that Sara Sae does not receive material with greater than background level of radioactivity.

3.0 Chemical composition: Chemical composition limits are listed below. An analysis of each heat of steel is made by the manufacturer, preferably from a ladle sample taken at or near the time of pouring. The listed elements shall be reported in weight percent.

ELEMENT	COMPOSITION	ELEMENT	COMPOSITION
CARBON (C)	0.28 – 0.33	CHROMIUM	0.80-1.10
MANGANESE (Mn).	0.40 – 0.60	MOLYBDENUM	0.15– 0.25
SILICON (Si).	0.15- 0.35	NICKEL	0.25 (max.)
SULPHUR (S).	0.025 max.	Cu	0.35 (max.)
PHOSPHORUS (P).	0.025 max.		

3.1 All tolerances and limits applicable to chemical ranges shall be those defined by ASTM A29/A29M unless stated otherwise.

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4.0 Mechanical Properties: Mechanical property requirements are listed below. Each heat shall be tested and the listed mechanical properties shall be reported.

MECHANICAL PROPERTIES	RANGE
TENSILE STRENGTH, PSI	100,000 (690 MPa) Min.
YIELD STRENGTH, PSI	75,000 (518 MPa) Min.
ELONGATION IN 2" Gage Length	18 % Min.
REDUCTION IN AREA	35% Min.
BRINELL HARDNESS	197-235 BHN
HRC	22 Max
VPN	247 Max

Note: - A minimum of two Brinell hardness tests shall be performed on QTC for API 16C Products

4.1 Charpy V-notch Impact testing: Impact testing shall be performed at -46 °C Average 42 joules min 32 Sgl Max. Its shall be below the required minimum average. Acceptance for charpy V-notch impact testing is per ASTM A-370.

(i) Lateral expansion 0.38mm minimum.

5.0 Heat treatment:

Heat treat to achieve required mechanical properties, in accordance with API 6A latest edition

5.1. Normalise (optional)

5.2.1. Heat to 870°C minimum.

5.2.2. Cool to ambient temperature via air cooling.

5.3. Austenitise

5.3.1. Heat to 840°C minimum.

5.3.2. Cool to ambient temperature via oil cooling or faster.

5.4. Temper

5.4.1. Heat to 650°C minimum.

5.4.2. Cool to ambient temperature via air cooling or faster.

5.5. Material shall be held at temperature for a minimum of 15 minutes after the core has reached temperature specified.

5.6. Heat treatment charts must be traceable to the Cast No. and supplied as stated in 5.5.2.5.

6. SPECIAL REQUIREMENTS

6.1. PROCESS REQUIREMENTS

6.1.1. All material shall be produced in accordance with the requirements of ASTM A29/29M & API 6A PSL3 latest editions, by a manufacturer approved in accordance with SARA

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requirements and holding ISO 9001 QMS certification.

6.1.2. Steel produced in accordance with this specification should be fully killed, fine grained and produced by electric melting processes or by basic oxygen steelmaking that is followed by secondary refining processes.

6.1.3. All forging material shall be forged in open or closed dies by hammering or pressing and shall be free of harmful defects which could affect the service life, such as forge cold shuts, stress cracks, laps, folds or any other process related defects.

6.2. NON-DESTRUCTIVE TESTING

6.2.1. Unless otherwise agreed/stipulated, the following NDE requirements are to be followed:

6.2.1.1. Forged/rolled bar - 100% UT inspected in accordance with SARA Procedure 26-701/761.

6.2.1.2. Open die blocks/blanks - 100% UT inspected in accordance with SARA Procedure 26-701/761.

6.2.1.3. Closed die forgings - 100% MPI or DPI inspected (where applicable) in accordance with SARA SSE/QAD/MT-1/97 respectively.

6.2.2. All non-destructive testing shall be performed by operators qualified to BSEN ISO 9712 Level II minimum.

6.3. MECHANICAL TESTING

6.3.1. Mechanical Testing shall be carried out on each cast of material and heat treatment batch in accordance with API 6A PSL3 and ASTM A370 latest editions. All test pieces used shall be from the product or a forged test coupon, which has been subjected to the same amount of deformation and represents typical forging ratio in cross section to the component. The test bar used shall provide representative testing that can qualify the whole product unless otherwise stated on the procurement documentation.

6.3.2. Where prolongations are used to qualify the product, test specimens shall be taken from the cut end of the prolongation.

6.3.3. **NOTE** Welding on the QTC is not allowed, except for attachment-type welds.

6.3.4. **Tensile Testing**

6.3.4.1. Tensile tests shall be performed in accordance with ASTM A370 or BSEN ISO 6892-1, using full-size rounded specimens.

6.3.4.2. A minimum of one tensile specimen shall be tested according to minimum values specified in section 3.

6.3.4.3. If the results of tensile testing do not meet the requirements of section 3 then a retest of two additional specimens from the same batch shall be made, each of which shall meet the minimum vales specified in section 3.

6.3.5. **Impact Testing**

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6.3.5.1. Impact tests shall be performed in accordance with ASTM A370 or BSEN ISO 148-1 using Charpy 'V' Notch Technique, using full-size specimens in the longitudinal direction as far as possible, unless specified otherwise. The values specified in this specification apply to full-size specimens.

6.3.5.2. A minimum of 3 impact specimens shall be tested according to minimum values specified in section 3. The average of the 3 values shall be above the minimum specified, with no more than one of the three results below the minimum average. In no case shall an individual impact value fall below the single value specified

6.3.5.3. If a test fails then a retest of three additional specimens from the same batch shall be made, each of which shall exhibit an impact value equal to or exceeding the minimum average.

6.3.6. **Hardness Testing**

6.3.6.1. Hardness testing shall be performed in accordance with ASTM A370, BSEN ISO 6506-2, BSEN ISO 6507-2 or BSEN ISO 6508-2 on the outside surface of material after all heat treatment.

6.3.6.2. Proper grinding shall be carried out prior to testing, to ensure any oxide or scale is removed.

6.3.7. The test house shall be independent of the production / processing department. Where a subcontract test house is used, the facility must be approved by SARA in line with the supplier approval process.

6.4. IDENTIFICATION

6.4.1. All material shall be uniquely identified by the relevant heat/cast/batch number.

6.4.2. All closed die forgings shall be hard stamped with the batch number.

6.4.3. The heat/cast/batch number must be clearly legible.

6.4.4. The batch number marked on components represents the heat number and the original cast number.

If more than one heat treatment load is required per batch number, the number shall be post fixed by a number relevant to the heat treatment load.

e.g. Batch number 1234 required two loads to complete heat treatment:

First Load – Batch Number 1234
Second Load – Batch Number 1234/2

6.4.5. Mechanical test results are required for each heat treatment load.

6.4.6. All documentation must be traceable to and from this number.

6.5. DOCUMENTATION

6.5.1. Unless otherwise specified on the Purchase Order, certification to BSEN 10204 3.1 minimum shall be provided.

6.5.2. The following Documentation must accompany or precede delivery of each batch of

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components:

6.5.2.1. Certified Copy of Original Mill Certificate.

6.5.2.2. Independent Test House Certificate (where applicable).

6.5.2.3. Supplier Certificate showing all Mechanical and Chemical results, Heat Treatment Details, (i.e. times, temperatures, conditions, quench medium), Purchase Order Number, SARA Spec and Part Number.

6.5.2.4. NDE Reports and Operator Qualifications.

6.5.2.5. Heat Treatment Charts / Reports

6.5.3. **NOTE** Failure to comply with these requirements may result in rejection of material.

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