GENERAL REQUIREMENT FOR FORGED OR WROUGHT MATERIALS PSL 1, 2, 3 & 4

1.0 PURPOSE

This document is to define the minimum requirements for processing and certification for forged or wrought products.

2.0 SCOPE

This specification establishes material requirements for forging or wrought products for PSL level 1, 2, 3 & 4. It shall be used in conjunction with specific material specifications (MS) or approved vendor supplied material specifications. This specific Material Specification may amend or modify the requirements of this specification.

3.0 REFERENCE

The latest effective editions of the following specifications are incorporated as reference and form a part of these specifications.

API 6A - Specification for wellhead and Christmas tree Equipment

ASTM A-370 OR IS: 1608: 2005 - Standard Test methods and Definitions for Mechanical Testing of Steel products.

ASTM E-10 - Standard Test Method and Brinell Hardness of Metallic Materials.

ASTM E -18 Standard Test Methods for Rockwell Hardness and Rockwell superficial hardness of Metallic Materials.

4.0 RESPONSIBILITY

This Engineering Manager is responsible for the preparation and controls the material specifications. Quality Control Manager supported by quality management is responsible for the implementation of the material requirements.

5.0 DEFINITIONS

5.1 Heat Treat Lot-

A. Batch Furnace-Material Placed on loading or carry devices and moved as a batch through one heat-treat cycle.

B. Continuous furnace-Group of piece of material with the same nominal size that is moved sequentially through the heat treatment process using the same process parameters.

PROCEDURAL REQUIREMENTS

6.1 MELTING PRACTICE

6.1.1 Steel products shall be made by the electric furnace or basic oxygen furnace process. Additional may be performed by ladle refining, vacuum degassing, vacuum arc remelting (VAR), electro slag remelting (ESR), or argon oxygen decarburization (AOD)

6.1.2 Nickel base alloy primary melting method shall be vacuum induction or electric are furnace with or without AOD (argon-oxygen-decarburization).Secondary Processing shall be electro slag remelting (ESR) or vacuum are remelting (VAR).

6.2 MILL PRACTICE

Product supplied to this specification shall be free from defects which would detrimentally affect serviceability. Such defects include, but are not limited to, cracks, laps, flakes, fissures, slag, porosity, and rolled-in scale.

6.3 HOT WORKING PRACTICE

6.3.1 The material shall pressure vessel quality and shall be formed using a hot Working practice, which produce a wrought structure throughout. Hot working practice shall be documented.

6.3.2 Hot working practice shall produce a minimum reduction ratio of 3:1. When requirements dictate a 4:1 or greater reduction ratio, the reduction ratio shall be specified on the applicable part.

6.4 MATERIAL QUALIFICATION

6.4.1 Minimum tensile, and if required, impact properties tests shall be performed on a qualification test coupon (QTC). Test specimens shall be removed from the QTC after the final QTC heat treatment cycle, and shall be from the same melt, or remelt ingot (s) as the production material/ part (s).

6.4.2 The properties of the QTC shall represent the properties of the material comprising the production material/part(s) it qualifies. A QTC may only qualify material/part(s) produced from the sameheat.The hot working ratio used on the QTC shall be same or less than that used on production material/part(s)

6.4.3 When the QTC is obtained by trepanning or using a sacrificial production. Material/part(s), it may only qualify production material/part(s) having the same or smaller ER as that used to obtain the QTC.

Note: The equivalent Round (ER) of the QTC shall be equal to or exceed that of the material/part(s) being heat-treated. The ER of the material/parts(s) shall be determined using the actual dimensions of the material/part(s) in the as heat-treated condition per the calculation method specified in FIG 1. The QTC shall be a minimum of 7"long for a standard specimen. The maximum ER required shall be 5" (4 x 4 QTC) unless otherwise specified by the specific part requirements. Tensile specimens shall be removed from the QTC such that their longitudinal centerline axis is wholly within the center core 1/4 T envelopes for a solid QTC or within 1/8 inch of the mid-thickness of the thickest section of a hollow QTC (refer to FIG 1). The impact specimens shall be removed such that the notch is within the 1/4 T envelopes.

For QTC"s larger than the ER or greater than 4 x 4,the test specimens need not be removed from a location farther from the QTC surface than would be required if the specified QTC were used.

6.4.4. Test specimens shall be removed from the QTC such that the tensile specimen gauge length and Charpy V-Notch root are the leastv1/4 T from the ends of the QTC.

6.4.5 When sacrificial production material/part(s) is used as a QTC, the test specimens shall be removed from a section of the part meeting the size requirement for a QTC for that production part.

6.4.6 Tensile test shall be conducted per the procedures of ASTM A-370 or IS 1608:2005 Tensile test shall be performed at room temperature unless an elevated temperature is specified. Standard size 0.505 Inch diameter tensile specimen, a sub size 0.252 inch diameter specimen shall be used. A minimum of one test shall be performed .The results shall satisfy the applicable specific MS. If the results of the tensile test are not satisfactory, two additional tensile tests may be performed. The result of each of these tests shall satisfy the applicable requirements.

6.4.7 The heat treated QTC shall be checked for hardness per ASTM-E-10 or E-18. A minimum of one hardness test shall be performed on the OTC.

6.4.8 For material heat treated in a continuous furnace, the QTC shall consist of a sacrificial length cut from the end of the bar. The QTC shall be from the same heat treat lot as the material it represents. for continuous furnaces, a heat lot is defined as a group of bars run though the furnace sequentially at the same zone temperatures, travel speed, and other parameters.

A minimum of one QTC shall be provided for each of material. Tensile and impact tests shall be conducted on the QTC in accordance with paragraphs 5.2 though 5.7. A hardness traverse shall be conducted on a cross-section from QTC, with Brinell hardness readings taken at the surface, the ¼ diameter location, and the center of the bar. In addition to the testing required on the QTC, each bar shall be individually hardness checked. Brinell hardness measurements shall be taken on the surface at two or more locations.

6.5 HEAT TREATMENT

6.5..1 Material/part(s)and QTC shall be heat treated per the process cycle listed in the specific MS Equipment used for heat treatment shall have a temperature uniformity of ±25 ° F or 14 °C (±15 ° F OR 8 °C tempering furnaces) inside the heating chamber. Material/part(s) shall be loaded in the furnace such that the heat treat response of all material /part(S) will be uniform.

6.5.2 The quenching media and agitation should be sufficient capacity for the furnace load.

6.5.3 Material/part (s) shall be traceable to and marked with the heat treat lot (heat treat batch) identification.

6.5.4 When the QTC is not heat treated as part of the same heat treatment lot as the material/part(s) it qualifies, the Austenitizing (or solution zing) temperature for the QTC shall be with in 25 °F (14 °C) of those for the material/part(s).
The tempering temperature of the material/part(s) shall not be lower than 25 °F (14 °C) below that of the QTC. The upper limit shall be no higher than that permitted by the specific MS. The cycle time at each temperature shall not exceed that for the material/part (s)

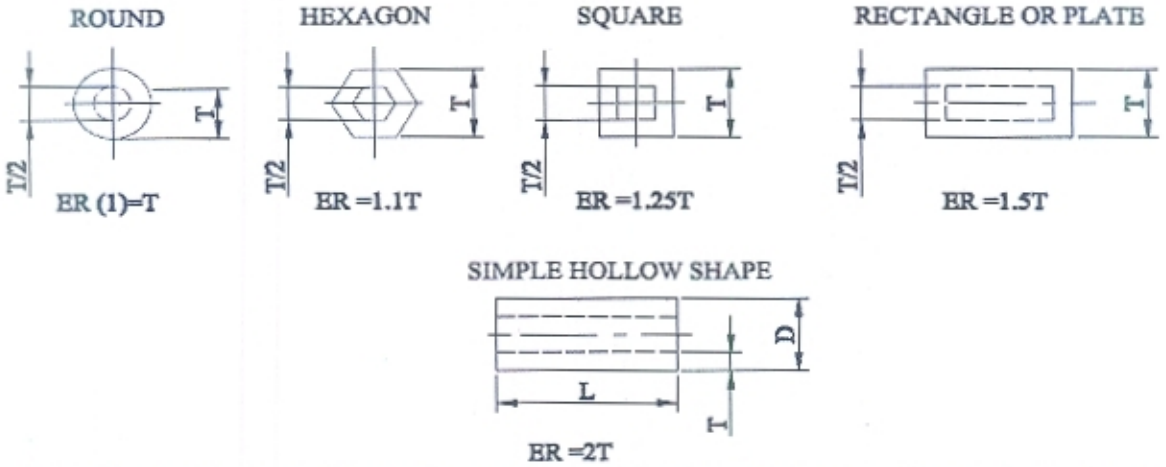
6.6 INSPECTION

Material shall be inspected for injurious imperfections as listed in the following:

6.6.1 Material provided in the rough machined condition shall not exceed 250 AA In surface roughnesses in the machined areas, and shall be free of burrs or injurious imperfections;

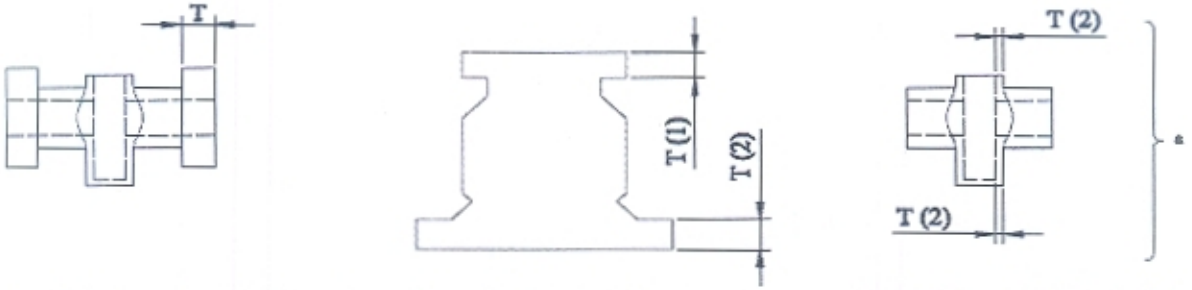
6.6.2 Material shall have e workmanlike finish and shall be free of internal forging burst or hydrogen flakes.

6.6.3 Surface imperfections such as laps, seams folds, tear silver or mechanical marks, abrasion or pits need not be removed unless they infringe on the minimum wall thickness of the material or extend to a depth greater than 1/6 inch.



When L is less than T, consider section as a plate of thickness L, area inside of dashed lines is ¼ T envelope for test specimen removal.
When L is less than D, consider as a plate of T thickness.

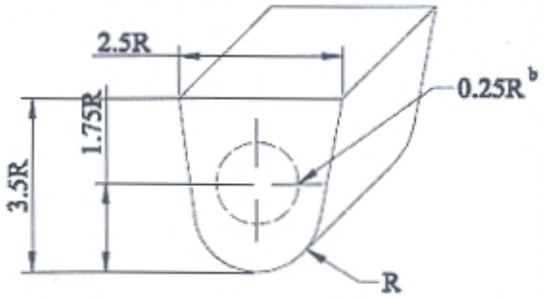
a) SIMPLE GEOMETRIC EQUIVALENT ROUND SECTIONS/SHAPES HAVING LENGTH L



When all internal and external surfaces during heat treatment are with in 13mm (1/2 in) of the final surfaces, ER=1¼T. when all internal and external surfaces during heat treatment are not with in 13mm (1/2 in) of the final surface, then ER=2T on multi flanged components, T shall be the thickness of the thickest flange.
Where T is the thickness when the component is heat treated as in T (2), use the larger of the two indicated dimensions.

a. BODIES WITH SCREWED AND OPEN ENDS.

b) GENERAL FLANGED BODIES FOR COMPLEX-SHAPED WELLHEAD COMPONENTS



b. ENVELOPE FOR TEST SPECIMEN REMOVAL

c) KEEL BLOCK CONFIGURATION, ER=2,3R