



**PTT Exploration and Production Public Company Limited**

**PTTEP Engineering General Specification**  
(Engineering and Development Group)

**Standard**


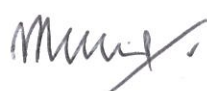

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**Materials and Manufacture of Forged Pipes, Forged  
Reducers, and Flat Forgings for Carbon Steel Pipelines  
(Mild, Intermediate and Sour Service)**

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**Document No: 10008-STD-6-PLR-010-R00**

**October 2017**

<b>DOCUMENT REGISTER</b>				
<b>Document Title:</b>		Materials and Manufacture of Forged Pipes, Forged Reducers, and Flat Forgings for Carbon Steel Pipelines (Mild, Intermediate and Sour Service)		
<b>Document Reference No:</b>		10008-STD-6-PLR-010-R00		
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Revision History						
Rev	Description of Revision	Date				
Old	Materials and Manufacture of Forged Pipes, Forged Reducers, and Flat Forgings for Carbon Steel Pipelines (Mild, Intermediate and Sour Service) Refer: PEGS-0710-PLR-020	13-Sep-13				
R00	Revision note : New document code and formatting <table border="1"> <thead> <tr> <th><i>Item No./Clause</i></th> <th><i>Description of Change</i></th> </tr> </thead> <tbody> <tr> <td>All</td> <td>Update document number and template align to PTTEP Library standard</td> </tr> </tbody> </table>	<i>Item No./Clause</i>	<i>Description of Change</i>	All	Update document number and template align to PTTEP Library standard	13-Nov-17
<i>Item No./Clause</i>	<i>Description of Change</i>					
All	Update document number and template align to PTTEP Library standard					

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## 1.0 INTRODUCTION

PEGS (PTTEP Engineering General Specification) is the PTT Exploration and Production PCL internal publishes standard. The objective of PEGS is to promote the best practices collecting from all PTTEP execution projects and to standardize those best practice to the future projects.

Every 5 years or upon request by the internal user, PEGS will be reviewed by related subject experts to reach decisions/agreements, then the document will be updated and publish to PTTEP intranet website. This is to ensure that all lesson learns from users can be applied to the future projects as the benefit to PTTEP.

## 2.0 PURPOSE

This specification defines the general technical requirements for the manufacture by the hot forging process of pipes, reducers and flat products to be used in carbon steel pipelines. For example, such products may be used as pig traps forged components, such as barrels, necks, reducers and door closures.

## 3.0 SCOPE

This specification defines the general technical requirements for the manufacture by the hot forging process of pipes, reducers and flat products to be used in carbon steel pipelines. For example, such products may be used as pig traps forged components, such as barrels, necks, reducers and door closures.

Forged flanges and tees are dealt with other separate General Specifications.

These products are intended for use in Mild, Intermediate and Severe Sour Service (where applicable) as per [10008-STD-6-COR-032](#), PEGS-0842-COR-032 and NACE MR-01-75 / ISO 15156 and the requirements of present specification.

Design requirements are not part of the present specification.

Data requirements properties of forgings will be summarized by COMPANY or CONTRACTOR of Basic Engineering (where applicable) according to the Table (to be filled up) of Appendix 1 of this specification.

This Specification shall be used in conjunction with a Project Particular Specification (PPS) detailing the particular characteristics of the forgings, the additional tests and requirements (if any) or the possible modifications to the present specification, based on the specification design conditions of the pipeline project.

No deviation from the requirements stated in the present specification shall be permitted unless prior written approval has been obtained from COMPANY.

## **4.0 RESPONSIBLE ACTION PARTIES**

This specification is distributed under the responsibility of the relevant department and divisions in PTTEP engineering entity in accordance with the procedures, approved by the line management.

This specification is applicable for all PTTEP operated assets and new project at the time of the study phase or pre-project or project sanction phase apply.

## 5.0 DEFINITIONS

A number of different terms are commonly used to describe the work stages, processes, and approvals which take place during the early stages of a development. This can often be a source of confusion so the following section is intended to show the PTTEP preferred terminology as used in this document.

### 5.1 LANGUAGE

In this document, the words should and shall have the following meanings:

<b>Shall</b>	Indicates a course of action with a mandatory status. The term “shall” shall be used if a requirement is considered to be necessary to claim compliance with a PEGS document.
<b>Should</b>	Indicates a preferred course of action. Should is a non-mandatory word and is not forbidden, but use in the body of the text should be the exception. Where none mandatory terms are used, each paragraph within these clauses shall also have an associated commentary paragraph that provides the rationale for why the stated choices and modifications are appropriate and circumstance under which the stated choices and modifications might be different.

### 5.2 TERMINOLOGY

Terminology	Description
<b>Approval</b>	The authorization in writing given by the COMPANY to the Contractor to proceed the work without releasing in any way the Contractor from any of his obligations to conform with the technical specifications, requisitions, etc. The words “Approve”, “Approved” and “Approval” shall be construed accordingly
<b>Certifying Authority (CA)</b>	The independent body (approved by COMPANY) under direct Contract with either COMPANY or CONTRACTOR to carry out certification tasks as required by the Contract.
<b>Company</b>	PTT Exploration and Production Public Company Limited and affiliates.
<b>Contractor</b>	Per contract: Contractor – ‘The contractor who is a PARTY to this CONTRACT and where the context so requires including, SUBCONTRACTORS utilized by CONTRACTOR for the performance of the WORK’
<b>Inspector</b>	The COMPANY’s or Supplier’s representative(s), (as applicable), or member(s) from an Inspection Agency duly appointed by the COMPANY or the Contractor or the Supplier (as applicable) to act as its representative(s) for the purpose of the contract.
<b>Manufacturer</b>	The company or its sub-contractors selected by the COMPANY or the Contractor or the Supplier (as applicable) as the Manufacturer of the said material.
<b>Mill</b>	The plants, yards, mills, workshops, laboratories or other locations where the fabrication, inspections and testing of materials are to be performed complete or in part.
<b>PPS</b>	Designates Project Particular Specification detailing the additional tests and requirements or the possible modifications to the present specification, based on the particular design conditions or the local legislation of the project.
<b>Purchaser</b>	The COMPANY or the Contractor or the Supplier (as applicable) which have placed the Purchase Order to the Supplier/Vendor/Manufacturer.

Terminology	Description
<b>Supplier</b>	The company or its sub-contractors designated by CONTRACTOR or COMPANY (where applicable), as defined on the Purchase Order or Contract, as being the selected Supplier of the said forgings. In this specification, the company in charge of the forging manufacture is conventionally designated as the Supplier
<b>Supplier/Vendor</b>	The company designed on the Purchase Order form or Contract as being the selected supplier of the said materials.

### 5.3 COMMON ACRONYMS

Set out below in alphabetical order are common acronyms as found within this document:

<b>CA</b>	Certifying Authority
<b>DAC</b>	Distance Amplitude Correction
<b>EI</b>	Elongation
<b>HIC</b>	Hydrogen Induced Cracking
<b>MPI</b>	Magnetic Particles Inspection
<b>MPQT</b>	Manufacturing Procedure Qualification Test
<b>MPS</b>	Manufacturing Procedure Specification
<b>NCR</b>	Non-Conformance Report
<b>NDT</b>	Non-Destructive Inspection
<b>PPS</b>	Project Particular Specification
<b>PWHT</b>	Post Weld Heat Treatment
<b>QCP / ITP</b>	Quality control Plan / Inspection and Test Plan
<b>SSC</b>	Sulphide Stress Cracking
<b>TQ</b>	Technical Query
<b>TS</b>	Tensile Strength
<b>UT</b>	Ultrasonic Test
<b>YS</b>	Yield Strength

## 6.0 REFERENCES

The reference documents listed below, including Industry Codes and Standards and COMPANY specifications, form an integral part of this Engineering General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published on the effective date of a contract.

The overall order of precedence of the applicable documents shall be:

1. Applicable Laws, Rules and Regulations of the country in which the system/equipment will be operated (if any);
2. Purchase Order/ Service Order/ Contract Documents (Only applicable for direct purchase by COMPANY);
3. Project Particular Specification (PPS), and relevant data sheet(s) if any;
4. COMPANY General Specification;
5. Codes and Standards in reference.

Any conflict between any of the Contract Documents, or between this specification and any other Contract Documents, shall be reported to COMPANY for decision. In such a case, and unless otherwise agreed or decided by COMPANY, it is understood that the more stringent requirement shall apply.

Exceptions to, or deviations from this specification are not permitted unless previously accepted in writing by COMPANY. For this purpose, requests for substitutions or changes of any kind shall be completed with all pertinent information required for COMPANY assessment. COMPANY's approval, nevertheless, will not, in any way, relieve the responsibility of the Contractor to meet the requirements of the industry Codes and Standards referred to and amended herein, in the event of conflict.

## 6.1 PTTEP INTERNAL REFERENCES

Internal documents applicable to this document are indicated in the table below.

Document Number	Document Title
10008-STD-6-GEN-005 , PEGS-12060-ADM-006	Quality Requirement for Vendor
10008-STD-6-PLR-005 , PEGS-12059-PLR-017	Seamless pipe for Carbon Steel pipelines (Mild, Intermediate and Severe Sour Service)
10008-STD-6-COR-032 , PEGS-0842-COR-032	Materials for Sour Service (to be used only for the definition of sour service regions)

## 6.2 INTERNATIONAL STANDARDS

International standards applicable to this document are indicated in the table below i.e. ISO, IEC or ITU.

Document Number	Document Title
ISO 148-1	Charpy impact test (V-notch)
ISO 6507-1	Hardness test – Vickers test – Part 1: HV5 to HV10
ISO/TS 29001	Quality systems: model for quality assurance in production, installation and ser...

## 6.3 CODE AND OTHER STANDARDS

Codes, standards and regional legislation applicable to this document are indicated in the table below.

Document Number	Document Title
ASME B31.4	Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
ASME B31.8	Gas transmission and distribution piping system 2003 edition
ASME V	Boiler and Pressure Vessel Code. Section V. Non-Destructive Examination
ASTM A 370	Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 388/A 388 M	Ultrasonic Examination of Heavy Steel Forgings
ASTM A 694/A 694 M	Specification for Forgings, Carbon and Alloy Steel for Pipe Flanges, Fittings, Valves and Parts for High Pressure Transmission Services
ASTM A 956	Test Method for Leeb Hardness (Equotip Hardness)
ASTM E 23	Method for Notched Bar Impact Testing of Metallic Materials
ASTM E 384	Test Method for Micro-indentation Hardness of Materials
ASTM E 709	Magnetic Particle Examination

Document Number	Document Title
ASTM E45	Standard Test Methods for Determining the Inclusions Content of Steel
EFC Publication No.16	Guidelines or material requirements for carbon and low alloy steels for H <sub>2</sub> S Containing environments in oil and gas production.
EN 10 204	Metallic Products – Types of inspection documents
EN 473 or ISO 9712	Qualification and certification of non-destructive testing personnel
NACE MR-01-75/ISO 15 156-2	Materials for use in H <sub>2</sub> S Containing environments – Part 2
NACE TM-01-77	Testing of Metals for Resistance to Sulfide Stress Cracking at ambient temperature
NACE TM-02-84	Evaluation of Pipeline Steels for Resistance to Stepwise Cracking

## **7.0 REQUIREMENTS FOR MATERIALS AND MANUFACTURE OF FORGED PIPES, FORGED REDUCERS, AND FLAT FORGINGS FOR CARBON STEEL PIPELINES**

### **7.1 PROJECT PARTICULAR SPECIFICATION (PPS)**

The PPS will include the following and any additional pertinent information:

- The required steel grade(s) and mechanical properties of material(s) as per Table (to be filled up) of Appendix 1 of present specification,
- The type of sour service (Mild, Intermediate or Severe Sour Service) and type of pipeline effluent as per Table (to be filled up) of Appendix 1 to clarify the H<sub>2</sub>S test conditions and hardness requirements (refer to General Specification in reference),
- If a Simulated PWHT is required on forgings prior to testing (refer to section 7.4.4.5 – Simulated PWHT)),
- The size and number of testing rings (if different according to CONTRACTOR requirements) (refer to section 7.4.6 – Material Rings for Welding Tests),
- Reference to the approved fabrication drawing(s) as a basis of the dimensional requirements, (refer to section 7.7 – Dimensional Inspection),
- The bevel ends details (refer to section 7.7 – Dimensional Inspection),
- Type of Mill Certificate, if different from 3.3 (refer to section 7.10.1 – Mill Certificates),
- The number of originals and copies required for the final documentation (refer to section 7.10.2 – Production report)

### **7.2 QUALITY ASSURANCE / QUALITY CONTROL**

The Supplier shall operate a Quality Assurance (QA) system in accordance with ISO / TS 29001, or equivalent, approved by a COMPANY recognized authority. The Quality Assurance Manual shall be submitted to COMPANY prior to the start of work and made available to the Inspector at all times.

Four weeks prior to commencement of the steel making and manufacture, the Supplier shall prepare and submit to COMPANY a quality Control Plan (QCP), otherwise called Inspection and Test Plan (ITP), which describes the tests and inspections to be performed at each single step of the manufacturing process of steel and forgings. The QCP (or ITP) shall set forth “witness”, “hold”, “review” and “monitor” points.

### 7.3 APPROVAL OF SUPPLIER'S PROCEDURES

The Supplier shall submit the following documentation for review and approval one month prior to commencement of steel manufacture and forgings fabrication:

- a) Aimed chemical composition of forging material(s).
- b) Manufacturing Procedure Specification (MPS), describing all proposed forging operations, heat treatment, inspection and non-destructive testing in their correct sequence. This document will also mention the characteristics of equipment used to carry out above mentioned operations.
- c) Sketch showing the rough forging piece(s) before final machining and, when applicable, the prolongation(s) or the test blank(s) with exact location and orientation of test specimens (refer to section 7.4.4.1– Sampling and Frequency of Testing).
- d) Material heat treatment(s) and recording procedures, including number and location of thermocouples.
- e) Welding end preparations
- f) Dimensional inspection procedure
- g) Non-destructive inspection procedures
- h) H<sub>2</sub>S corrosion test procedures (the proposed laboratory shall have prior approval of COMPANY)
- i) Quality Control Plan / Inspection and Test Plan
- j) Handling, storage and packing procedures
- k) Proposed measures for temporary corrosion prevention

Once approved, these procedures shall not be altered without the approval of COMPANY.

### 7.4 FORGING MATERIAL AND TESTING

#### 7.4.1 APPLICABLE STEEL GRADE(S)

Forging material steel grade(s) shall comply with ASTM A694 and the requirements stated in the present specification.

#### 7.4.2 MANUFACTURING PROCESS

1. Steel shall be made by the Electric Furnace of Basic Oxygen Converter, and shall be fully killed and made to fine grain practice.
2. Inclusion control with respect to content, distribution and shape shall be carried out by desulphurising, degassing and calcium injection, in order to provide resistance of steel to sour environments.
3. The material shall be hot forged within the range 850-1180 °C to bring it as close as possible to the shape and size of final product. All parts of forging shall undergo a minimum total reduction ratio of at least 5 to 1 during the forging process.
4. All products shall be quenched and tempered after hot forging and rough machining. Rough machining means that the product is machined near to its final dimensions with an extra thickness of less than 10mm against nominal finished thickness of product.
5. For water quenched forgings, the time from removal of forging from the furnace until it is immersed in quenching water shall not exceed 90 seconds. The start and end temperature of quenching water shall be recorded and shall not exceed 40 °C.

#### 7.4.3 CHEMICAL COMPOSITION

Unless alternative compositions are proposed by the Supplier and approved at the bid stage by the COMPANY, the chemical analysis shall comply with the following for ladle and product.

Element	Weight % max.	
	Ladle	Product
Aluminum (total)	0.050	0.050
Calcium	0.006	0.006
Carbon	0.15	0.17
CE (IIW)	0.43	0.44
Chromium	0.30	0.30
Copper	0.30	0.30
Cr + Mo + Cu + Ni	1.00	1.00
Hydrogen	2 ppm	2 ppm
Manganese	1.30	1.40
Molybdenum	0.35	0.35
Nb + V + Ti	0.15	0.15
Nickel	1.00	1.00
Niobium	0.06	0.06
Nitrogen	0.012	0.012
Oxygen	0.003	0.003
Pcm	0.23	0.24
Phosphorus	0.020	0.020
Silicon	0.35	0.40
Sulphur	0.005	0.005
Titanium	0.04	0.04
Vanadium	0.06	0.06

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

$$P_{cm} = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B$$

No alloying additions of elements other than those listed above shall be made without prior approval of the COMPANY.

The Supplier shall perform analysis for all the elements listed above and any other intentionally added elements.

The Supplier shall carry out a chemical analysis on each cast of steel used and, also, on two products per heat.

If any part of the product analyses fails to meet the requirements stated above, the whole cast shall be rejected or each individual product shall be fully analyzed and all products failing to meet the requirements shall be rejected.

#### **7.4.4 MECHANICAL PROPERTIES**

##### **7.4.4.1 SAMPLING AND FREQUENCY OF TESTING**

- a) Specimens shall be cut at mid-thickness from prolongations of a completed production forging. However, when thickness exceeds 100 mm, then the specimens may be located at 50 mm minimum from product surface. When specimens are cut from rough machined products, the sketch showing location of specimens as regard to rough forging shall have prior approval of the COMPANY (see section 7.4.2.4 above).
- b) The sampling requirement shall be one full set of tensile and Charpy impact test per each steel source, steel cast, forging size and heat treatment batch. Grouping of product sizes and materials may be agreed with the COMPANY at the bid stage.

##### **7.4.4.2 TENSILE TESTS**

Round bar tensile tests shall be carried out in accordance with ISO 6892 or ASTM A 370. Each test shall consist of one or two specimens as follows. The largest practical test specimen size shall be used.

- a) Pipes and Reducers:  
One tensile test transverse to longitudinal axis of pipe or reducer.
- b) Flat products:  
One radial test and one tangential test.

The required test results shall be as stated in the following table.

Mechanical properties	Flange material grade (ASTM A 694)							
	F 36	F 42	F 46	F 52	F 56	F 60	F 65	F 70
Minimum Yield Strength (0.2% proof stress) (MPa)	245	290	320	360	390	415	450	485
Minimum TS (MPa)	415	415	435	460	490	520	535	570
Minimum Elongation in 2 inches (%)	25	25	25	25	22	20	20	18
Max YS/TS	≤ 0.85	≤ 0.85	≤ 0.85	≤ 0.85	≤ 0.85	≤ 0.85	≤ 0.85	≤ 0.85
Max. Vickers Hardness (5 or 10 kg)	200	250	250	250	250	250	250	250

The table of Appendix 1 shall be filled up accordingly for any projects.

#### 7.4.4.3 IMPACT TESTS

Charpy V-notch tests shall be carried out in accordance with ASTM A 370 and ASTM E 23. Each impact set shall consist of three specimens with notch oriented perpendicularly to the forging surface. Full size specimens (10 mm x 10 mm) shall be used.

a) Pipes and Reducers:

One set transverse to longitudinal axis of pipe or reducer.

b) Flat products:

One radial set and one tangential set.

The required test results shall be as stated in the following table.

Grade (A 694)	Minimum Average Value (Joules)	Minimum Individual value (Joules)	Minimum Shear Area Avge (Single)
F 36	28	22	85% (75%)
F 42	40	30	85% (75%)
F 46	40	30	85% (75%)
F 52	40	30	85% (75%)
F 56	40	30	85% (75%)
F 60	40	30	85% (75%)
F 65	54	40	85% (75%)
F 70	54	40	85% (75%)

Note: Lateral expansion of broken specimens shall be recorded for information only.

The table of Appendix 1 shall be filled up accordingly for each order.

#### **7.4.4.4 HARDNESS SURVEY**

A VICKERS hardness survey shall be carried out on each produced forging after final heat treatment and final machining, in accordance with ASTM E 384, ASTM A 956, or equivalent, using a 5 or 10 kg load. A minimum of eight equi-spaced readings shall be carried out on the inside surface of each pipe/reducer and on the surface in contact with effluent for each flat forged product.

Hardness shall not exceed the maximum individual hardness shown in table in section 7.4.4.2 above, at any point. The Inspector reserves the right to ask for hardness checks at any other locations on the forging, e.g. when any doubt occurs about consistency of results.

Hardness testing shall be performed using a portable equipment approved by COMPANY.

#### **7.4.4.5 SIMULATED PWHT**

Forged products that are subject to a PWHT later on (e.g. forgings that are included in big traps or riser and dogleg where welds are PWHT), shall be supplied with additional tests made on material after a simulated PWHT at an approved soaking temperature for one hour per 25 mm thickness. Soaking temperature of simulated PWHT shall not be less than 25 °C of the tempering temperature nor not less than 280 °C ±10 °C.

All heat treatment charts shall be approved, dated and signed by the Inspector and the CA.

#### **7.4.5 H<sub>2</sub>S CORROSION TESTS**

Hydrogen Induced Cracking (HIC) and Sulfide Stress Cracking (SSC) tests shall be carried out in accordance with Appendices 7 and 6 respectively of [10008-STD-6-PLR-005](#), PEGS-12059-PLR-017, using specimens cut in extension rings. The number of specimens shall be one set of three specimens of max. thickness 30 mm (cut at forging mid-thickness) for HIC tests and two sets (one set sub-surface at forging internal and one set at forging mid-thickness) of three specimens for SSC tests. All specimens shall be cut longitudinally to pipe/reducer axis and tangentially for flat forgings. The three specimens of each set shall be cut at three equispaced locations around the forging circumference.

All SSC tests shall be made at 80% (option with NACE TM-01-77) or 90% (option with EFC 16), where applicable, of actual yield strength of tested material. Test duration shall be 96 hours for HIC tests and 30 days for SSC tests. Acceptance criteria shall be as stated in the said appendices.

H<sub>2</sub>S corrosion tests shall be made once per steel source / steel grade / steel cast / forging size and heat treatment batch, on the thickest product of each lot, this product being selected in agreement with COMPANY.

Grouping of forgings may be agreed with COMPANY at the bid stage.

The H<sub>2</sub>S corrosion test laboratory shall have prior approval of COMPANY.

H<sub>2</sub>S corrosion tests are not required for Mild Sour Service materials.

#### **7.4.6 MATERIAL RINGS FOR WELDING TESTS**

The Supplier shall supply test rings to CONTRACTOR for qualification tests of welding procedures. The rings shall be of the same steel cast and size as the forging and, also, shall have been forged and heat treated in the same way as the related supplied forgings.

Test rings shall have a minimum length of 350 mm. Three rings, or more at CONTRACTOR's option, shall be required for each forging size and material grade. Both ends of the rings shall be beveled as per the related forging of the order.

Identification marking of test rings shall be agreed with CONTRACTOR.

#### **7.5 NON-DESTRUCTIVE TESTING (NDT)**

##### **7.5.1 GENERAL**

The Inspector and Certifying Authority shall have access to the mill at all times when work is in progress and shall be at liberty to inspect the manufactured items at any stage and to reject any part not complying with this specification.

Sufficient inspection shall be made at all stages of the work by the Supplier to ensure that the materials, manufactured items and testing comply in all respects with the requirements of this specification.

The Inspector inspection and CA shall not relieve the Supplier from his responsibility, being understood that the Supplier shall remain responsible for the quality and inspections.

##### **7.5.2 NON-DESTRUCTIVE TESTING (NDT)**

###### **7.5.2.1 GENERAL**

The Supplier shall submit detailed inspection and NDT procedures for review and approval. This shall, also, detail the full extent of the inspections.

The Supplier shall establish, before commencing production, an identification system such that each forging can be fully identified against the Mill test certificates.

The NDT personnel used shall be fully certified level 2 minimum as per EN 473 Std. or CSWIP and subject to approval of the Inspector. The Inspector reserves the right to retest and reject any of the NDT personnel at any time.

###### **7.5.2.2 EXTENT OF INSPECTION**

Forging shall be subject to the following inspections:

- 100% visual inspection of internal and external surfaces
- 100% Magnetic Particle Inspection of machined surfaces
- 100% ultrasonic inspection.

Final NDT shall be carried out after final heat treatment, with the forging in the finish-machined condition.

### **7.5.2.3 VISUAL INSPECTION**

Forging shall comply with the workmanship, finish and appearance requirements of ASTM A 694 Std.

### **7.5.2.4 MAGNETIC PARTICLE INSPECTION (MPI)**

MPI shall be carried out over the entire surface area of the forgings in accordance with Article 25 of ASME V or ASTM E 709, using wet particles and the AC electromagnetic yoke method.

No liner indication shall be permitted.

### **7.5.2.5 ULTRASONIC INSPECTION**

Ultrasonic testing shall be carried out in accordance with ASTM A 388 / A 388 M. The entire volume of the forging shall be subject to UT (straight-beam and angle-beam examinations).

#### **a) Straight Beam Examination**

The reference block calibration method shall be used. The reference block of thickness representative of that of the tested forging shall comprise flat-bottom holes of 3 mm dia. Distributed through the thickness at different depths with a minimum of a hole at 5 mm from both internal and external surfaces and a hole at mid-thickness to develop a calibration reference curve (DAC curve) and adjust the sensitivity.

All indications that exceed the DAC reference curve when examined with the gain setting used to produce the DAC reference curve shall be cause for rejection.

#### **b) Angle Beam Examination**

Indications which are equal to or exceed those obtained from a 60 deg. V-notch 25 mm long and having a depth no greater than 5% of the actual thickness under examination in the forging or 2 mm (whichever is smaller) shall be unacceptable.

## **7.6 REPAIR OF DEFECTS**

Minor surface defects on forgings shall be ground out leaving a smooth gradual profile provided that the wall thickness is not reduced below the minimum specified value obtained by proper calculations. Any ground areas (except for cosmetic grinding) shall be examined by Magnetic Particle Inspection. Forgings containing larger defects shall be rejected.

Repair welding of forging shall not be permitted.

## 7.7 DIMENSIONAL INSPECTION

The forgings shall be checked for dimensional as per approved fabrication drawings. Results shall be reported by the Supplier and approved by the Inspector and the CA.

The drawings shall state the tolerances of all dimensions.

Welding neck ends:

The Supplier shall note that the transition welding neck ends between a component and other items where the material thickness or yield strength is unequal shall be according to ASME B31.8, Appendix I, or B31.4. chapter V (where applicable), or equivalent recognized code.

## 7.8 PROTECTION OF FORGINGS

The bevelled ends (if any) and other critical surfaces of forgings shall be protected by a peel-off varnish. In case of beveled ends, forgings shall be fitted with bevel protectors of a type Approved by CONTRACTOR.

## 7.9 MARKING OF FORGINGS

Marking shall be such that complete traceability is demonstrated in all stages of manufacture. Each forging shall be clearly identified and paint marked with the following data:

- PTTEP Exploration and Production Co., Ltd
- Name of Project
- Purchase Order no.
- Manufacturer's name/ Mill Name/ Mark/ Logo
- Steel grade (as per ASTM A 694)
- Item No. / Requisition No.
- Heat number
- Pressure-temperature rating
- Nominal dimensions
- Theoretical weight (in kg).

Marking shall be approved by the Inspector prior to forging production.

Die stamping of each forging shall be mutually agreed between COMPANY, CONTRACTOR and Supplier. It shall include, as a minimum, heat No, steel grade, size and item No.

## 7.10 DOCUMENTATION

### 7.10.1 MILL CERTIFICATES

Mill certificates shall be 3.2 (or 3.1B where specified in the PPS) according to EN 10204 Std. Mill certificates shall be issued by the forging manufacturer, and signed, dated and stamped by the Inspector and CA.

Mill certificates shall make reference to ASTM A 694 together with the present specification.

Mill certificates shall show the following:

- Manufacturer's name
- Product serial number / Requisition no.
- Dimensions and rating
- Purchase Order number
- Cast number
- Test number
- Chemical analysis (ladle and product) including carbon Equivalent and Pcm
- Mechanical test results
- Non-Destructive tests performed with results
- Heat treatment batch with number and temperature / soaking time details
- Any additional tests and inspections carried out

### 7.10.2 PRODUCTION REPORT

Upon completion of forging manufacture, the Supplier shall produce a production report which shall include the following minimum information and documents:

- Manufacturing Procedure Specification (MPS) of forgings.
- Report of forging Manufacturing Procedure Qualification Tests (MPQT)
- Production test report (mechanical tests, NDT reports, dimensional reports, etc.)
- Mill certificates of forgings.
- Quality Control Plan
- Heat treatment charts signed, dated and stamped by the Inspector and CA, showing date of treatment and clear definition of the scales used.
- Sketch showing test specimen removal and identification (see section 7.4).
- H<sub>2</sub>S corrosion test reports
- Compilation of concessions / deviations, if any, granted by COMPANY

- One original plus five copies (unless otherwise stated in the PPS) of the final documentation shall be submitted, plus three CD-Rom of the Production Report.
- The Inspector and Certifying Authority shall stamp (rubber stamp), sign and date the original documents. The copies shall be stamped (as a minimum) by the Inspector and CA.

### **7.10.3 SCHEDULE**

1. The forgings shall be dispatched only after a Release Certificate has been issued by the Certifying Authority and CONTRACTOR.
2. Mill Certificates shall be supplied at the time of dispatch of the forgings.
3. The full production report as above shall be transmitted to COMPANY without delay after completion of forging production. The latest date of submission of this report shall be three weeks max. after dispatch of the forgings.

### **7.10.4 DOCUMENTATION TO SUBMIT BY THE SUPPLIER AT BID STAGE**

1. Full technical features of raw materials: sourcing, aimed chemical composition (including Carbon Equivalent and Pcm), shape and dimensions, etc.
2. A simplified Manufacturing Procedure Specification (MPS) giving the main features of manufacturing process, forging process, forging ratio, parameters that are monitored and / or recorded, sampling of test specimens, etc.
3. Final heat treatment.
4. Nominated laboratory for conducting the H<sub>2</sub>S embrittlement tests.
5. Past experience of laboratory on HIC and SSC tests as per this specification (including the laboratory preliminary or typical procedures).
6. Quality Assurance Certification (ISO / TS 29001)
7. Manufacturer's / Supplier's past experience records in Manufacturing forgings similar to those of the order.
8. Deviations to present specification, if any.

### **7.11 TECHNICAL QUERIES / NON-CONFORMANCE REPORTS**

1. Any Supplier's / CONTRACTOR's requests for clarifications or deviations to COMPANY specifications shall be submitted to COMPANY only through Technical Queries (TQ), the format of which shall have prior approval of COMPANY.

A deviation to specification shall not be considered as accepted if it has not been submitted to and accepted by COMPANY through a Technical Query.

2. Approval given by the COMPANY to any Supplier's / CONTRACTOR's work procedures, specifications, equipment, etc. shall not release in any way the Supplier's / CONTRACTOR's from his obligation to meet COMPANY specification.

3. Any work performance or test result which is found, at a later date, not in conformance with COMPANY specifications or agreed procedure shall be subject to a Non-Conformance Report (NCR).

## 8.0 APPENDICES

Appendix 1. Data and Material Properties (to be filled up by CONTRACTOR)

Fluid (Oil / Dry gas / Wet gas / Condensate / Water / etc ...)	
Hardness max.(HV5 or HV10)	
Hydrostatic Test Pressure (barg)	
Impact Test (10x10mm) Test temperature (°C) (1) Energy, min.average (Joules) Energy, min.single (Joules)	
Material Steel Grade (ASTM A 694)	
Minimum Yield Strength (YS) Tensile Strength (TS) Min. Max. YS/TS max. EI% mini.	
Simulated Post Weld Heat Treatment (S.PWHT) (Yes / No)	
SSC / HIC Tests (Yes / No)	
Type of Service (10008-STD-6-COR-032, PEGS-0842-COR-032)	



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