ENERGISING QUALITY

# VCS PROJECT CONSULTANTS PVT. LTD.

# STANDARD SPECIFICATION
# FOR
# PORTABLE FIRE EXINTGUISHER

## VPC-SS-ME-3006

| Rev. No | Date | Prepared By | Checked By | Approved By | Authorized By |
|---|---|---|---|---|---|
| 01 | 01.11.2019 | SS | RNR | RNR | SK |
| 00 | 21.03.2018 | SS | RNR | RNR | SK |

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## REVISION RECORD

| Rev. | Revision Date | Prepared by | Checked by | Approved by | Authorized by | Revision Description |
|---|---|---|---|---|---|---|
| 00 | 21.03.2018 | SS | RNR | RNR | SK | Issued for use as standard |
| | | Satish Singh | RN Rai | RN Rai | Suresh Kumar | |
| 01 | 01.11.2019 | SS | RNR | RNR | SK | Format change and document is generally revised. |
| | | Satish Singh | RN Rai | RN Rai | Suresh Kumar | |
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## ABBREVIATION

| | |
|---|---|
| MS | MILD STELL |
| IS | INDIAN STANDARD |
| PESO | PETROLEUM EXPLOSIVE SAFETY ORGANISATION |


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## 1.0 SCOPE

This standard lays down requirements regarding material, shape, construction, method of operation, performance and tests of portable fire extinguisher of Carbon Dioxide type, Dry Chemical Powder Type Fire Extinguisher and water based or foam based (Gas Pressure) Fire Extinguishers.

The extinguisher shall be supplied along with respective extinguishing media duly charged.

## 2.0 CODES AND STANDARDS

IS:5 Colors for ready mixed paints and enamels

IS: 2932 Enamel, synthetic, exterior; a) undercoating, b) finishing - specification

IS: 4308 Dry Chemical Powder for Fighting Band C Class Fires

IS: 4861 Dry Chemical Powder for Fighting Fires in Burning Metals

IS: 4989 Foam concentrate for producing mechanical foam for firefighting specification

IS: 14609 Dry Chemical Powder for Fighting A, B, C Class Fires

IS: 15222 Carbon dioxide as the extinguishing media for fire protection - Specification

IS: 15683 Portable Fire Extinguishers, Performance and Construction - Specification

Note: Latest Edition of all standard documents shall be followed

## 3.0 MATERIAL OF CONSTRUCTION & BASIC REQUIREMENT

3.1 The material, shape, construction, method of operation, performance, contents and test shall comply with IS: 15683.

3.2 Carbon dioxide used in extinguishers shall comply with IS: 15222

3.3 Dry powder conforming to IS: 14609, 1S. 4308 or IS: 4861 shall be used for charging the extinguishers.

3.4 The extinguishing media for water or / and foam based fire extinguishers shall be pure water or water with additives such as wetting agents, viscosity increasing agents, flame retardants or foaming agents etc. as per the requirement. Foam concentration shall be as per the requirements specified in IS: 4989.

## 4.0 APPROVALS

Portable extinguishers shall have approval from PESO, Government of India


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## 5.0 COLOR & MARKING

The color of extinguisher bodies shall be Red conforming to shade no.536 or 538 of IS: 5. The paint shall conform to IS: 2932. Each extinguisher shall be clearly and permanently marked with the information specified in IS: 15683, along with IS certification mark and purchaser's name.

## 6.0 ACCESSORIES

Each extinguisher shall be supplied with MS bracket, screws and spanner as may be necessary. The details of the bracket shall be submitted with the offer.

## 7.0 INSPECTION

Owner's / VCS authorized representative shall have access at all reasonable times to vendor's works where Extinguishers are being manufactured and/or tested. Vendor shall arrange for all tests and inspection facilities for checking material, design and fabrication, workmanship, finish, performance (operating performance and performance required for test fires), and testing as per IS: 15683.

**INFORMATION REQUIRED FROM VENDOR**

Following information shall be furnished by the vendor along with the supply of extinguisher:

Instruction book(s) - Instruction book(s) for guidance of the user including both the operating and normal maintenance procedures shall be supplied. The book(s) shall include an itemized and illustrated part list/spare parts list giving reference number of all the wearing parts.

Approval certificate from PESO as described in clause 4.


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ENERGISING QUALITY

# VCS QUALITY SERVICES PVT. LTD.

## STANDARD SPECIFICATION

## FOR

## HIGH FREQUENCY WELDED LINE PIPE

### VCS – SS – PP – 2008

| | | | | | |
|---|---|---|---|---|---|
| 02 | 24.02.2022 | SR | MC | HK | GW |
| Rev. No | Date | Prepared By | Checked By | Approved By | Authorized By |

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| REVISION RECORD | | | | | | |
|---|---|---|---|---|---|---|
| **Rev.** | **Revision Date** | **Prepared by** | **Checked by** | **Approved by** | **Authorized by** | **Revision Description** |
| 00 | 27.05.2019 | | | | | Issued as Standard Specification |
| | | BS | MC | AD | SK | |
| 01 | 28.01.2020 | | | | | Document formatting, numbering updated from SS-PL-038 to VCS-PP-SS-2008 other detail update as marked |
| | | MB | MC | AD | SK | |
| 02 | 24.02.2022 | | | | | VCS QMS Integration |
| | | SR | MC | HK | GW | |


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## 1. SCOPE

### 1.1 Coverage

This specification establishes the minimum requirements for the manufacture of high frequency welded steel line pipe in accordance with the requirements of API (American Petroleum Institute) Specification 5L, Forty-Sixth Edition, April 2018 and makes restrictive amendments to API Specification 5L. Unless modified and/or deleted by this specification, the requirements of API Specification 5L shall remain applicable.

The sections, paragraphs and annexes contained herein have the same numbering as that of API Spec 5L in order to facilitate reference. Additional requirements, which are not specified in API Spec 5L, have also been numbered and marked as "(New)".

The coverage by this specification is limited to line pipe to be used in onshore pipelines transporting non-sour hydrocarbons in liquid or gaseous phase. The product specification level for line pipe to be supplied as per this specification shall be "PSL 2".

### 1.2 Application of The API Monogram

The Manufacturer shall have a valid license to use API Monogram and line pipes supplied as per this specification shall bear API monogram in accordance with the requirements of Annex A of API Specification 5L, Forty—Sixth Edition, April 2018 for Product Specification Level PSL 2.

### 1.3 (New) Pipe Size

This Specification shall be applied to line pipe of size 4.5" (114.3 mm) OD thru 20" (508.0 mm) OD (both sizes included).

## 2. NORMATIVE REFERENCES

The latest edition (edition in force at the time of issue of enquiry) of following additional references are included in this specification:

ASTM E112-12: Standard Test Methods for Determining Average Grain size

## 6. PIPE GRADE, STEEL GRADE AND DELIVERY CONDITION

### 6.1 Pipe Grade and Steel Grade

6.1.2 Line pipe supplied to this specification shall conform to Product Specification Level 2 (PSL2) as given in Table 1 of this specification and consists of an alpha or alphanumeric designation that identifies the strength level of the pipe. The steel name (designating a steel grade), linked to the chemical composition of the steel, additionally includes a suffix that consists of a single letter (M) that identifies the delivery condition as per Table 3 of this specification.

Table 1 of API Spec 5L stands replaced by Table 1 of this specification.

**Table 1- Pipe grades, steel grades and acceptable delivery conditions**

| PSL | Delivery Condition | Pipe grade/ steel grade [a, b]. |
|---|---|---|
| PSL -2 | Thermomechanical rolled | BM, X42M, X46M, X52M, X56M, X60M, X65M & X70M |
| a Deleted<br>b The suffix (M) for PSL 2 grades belongs to steel grade | | |


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6.2 **Delivery condition**

6.2.2 The delivery condition for starting material shall be in accordance with Table 1 of this specification.

## 8 MANUFACTURING

8.1 Process of Manufacture

Pipe furnished to this specification shall be manufactured in accordance with the applicable requirements and limitations given in Table 2 of API Spec 5L and Table 3 of this specification.

Table 3 of API Spec 5L stands replaced by Table 3 of this specification.

**Table 3 - Acceptable manufacturing routes for PSL 2 pipe**

| Type of Pipe | Starting Material | Pipe forming | Pipe Heat treatment | Delivery condition |
|---|---|---|---|---|
| HFW | Thermomechanical-rolled coil | Cold forming | Heat treating [a] of weld area only | M |
| a See clause 8.8 of this specification for applicable heat treatment | | | | |

High frequency electric welding shall be performed with a minimum welding current frequency of 200 kHz. The welding system shall have an integrated control in which following data as a minimum shall be monitored:

- Welding Temperature
- Welding speed
- Current and Voltage

Abutting edges of the coil shall be milled or machined immediately before welding. The width of the coil shall be continuously monitored.

8.3 **Starting Material**

8.3.2 Line pipe furnished to this specification shall be made from steel produced in basic oxygen or electric arc furnace and cast by continuous casting only.

8.3.3 The steel used for manufacture of pipe shall be fully killed and fine grained with ASTM grain size number 7 or finer as per ASTM E 112.

8.8 **Treatment of Weld Seams In EW And LW Pipes**

8.8.2 **LW pipe and PSL 2 HFW pipe**

The weld seam and the entire Heat Affected Zone (HAZ) shall be heat treated so as to simulate a normalizing heat treatment in order to control the grain structure so that no untempered martensite remains in the weld seam and the HAZ, and the mechanical properties of heat treated zone approximate that of the parent metal.

Heat treatment temperature of the weld seam and the entire HAZ shall be continuously measured and recorded.


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8.9 **Cold Sizing and Cold Expansion**

8.9.1 Pipes furnished to this specification shall be non-expanded.

8.11 **Jointers**

8.11.1 Jointers on pipes are not permitted.

**9 ACCEPTANCE CRITERIA**

9.2 CHEMICAL COMPOSITION

9.2.2 For pipes supplied as per this specification, the chemical composition of each heat of steel on product analysis shall be as given in Table 5 of this specification.

Table 5 of API Spec 5L stands replaced by Table 5 of this specification.

**Table 5 - Chemical composition for pipe**

| Element | Mass fraction based upon heat and product analyses (%) | |
|---|---|---|
| C [b] | 0.16 | max. (For Grade BM to X56M) |
| | 0.12[f] | max. (For Grade X60M to X70M) |
| Si | 0.15 [m(new)] | min. |
| | 0.45 | max. |
| Mn [b] | 1.20 | max. (For Grade BM to X46M) |
| | 1.40 | max. (For Grade X52M & X56M) |
| | 1.60 | max. (For Grade X60M & X65M) |
| | 1.70 | max. (For Grade X70M) |
| P | 0.020 | max. |
| S | 0.015 | max. |
| V | 0.05 | max. (For Grade BM to X46M) |
| | [d] | max. (For Grade X52M to X70M) |
| Nb | 0.05 | max. (For Grade BM to X46M) |
| | [d] | max. (For Grade X52M to X70M) |
| Ti | 0.04 | max. (For Grade BM to X46M) |
| | [d] | max. (For Grade X52M to X70M) |
| Al [n (new)] | 0.02 [o(new)] | min. |
| | 0.07 | max. |
| Cr | 0.20 | max. |
| Mo | 0.10 | max. (For Grade BM to X65M) |
| | 0.20 | max. (For Grade X70M) |
| Cu | 0.35 | max. |
| Ni | 0.20 | max. |
| N [n (new)] | 0.012 | max. |
| B | 0.0005 | max. |
| a Based upon product analysis as per clause 9.2.4 and 9.2.5 of API Spec 5L, the $CE_{Pcm}$ | | |


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limits apply if C =< 0.12% and $CE_{IIW}$ limits apply if C > 0.12%. For pipes of all grades, sizes and wall thicknesses, Carbon Equivalent shall comply with the following limits:

$CE_{Pcm}$ =< 0.20 %

$CE_{IIW}$ =< 0.40%

Boron content shall be considered in $CE_{Pcm}$ formula even if it is less than 0.0005%.

b Deleted

c Deleted

d Nb + V + Ti = < 0.15%

e Deleted

f Deleted

g Deleted

h Deleted.

I Deleted

j Deleted

k Deleted

l Deleted

(New)m : Minimum for Si is not applicable for AI killed steel.

(New)n : AI/N shall be minimum 2 (not applicable to titanium-killed steel or titanium-treated steel).

(New)o : Applicable for AI killed steel.

9.2.3 For heat analysis and product analysis, all the elements listed in Table 5 of this specification shall be analysed and reported, even if those are not purposely added but are present as residuals only.

If alloying elements other than those specified in Table 5 of this specification are added to the steel, the limits of the additional components shall be agreed with the Purchaser.

9.3 **TENSILE PROPERTIES**

9.3.2 The finished pipe (after all heat treatment & sizing operations) shall conform to the requirements of Table 7 of API Spec 5L and as modified herein.

The actual yield strength shall be as close as possible to the specified minimum yield strength (SMYS) but in no case it shall exceed the limits specified here under:

| API Spec 5L Grade | Permissible in excess of SMYS, MPa (psi) |
|---|---|
| Up to and including X46M | 131 (19,000) |
| X52M to X60M | 125 (18,000) |
| X65M to X70M | 120 (17,400) |

The ratio of body yield strength and body tensile strength of each test pipe on which yield strength and ultimate tensile strength are determined, shall not exceed 0.90.

The tensile strength of the weld (after heat treatment of the weld seam) shall be equal to or higher than the specified minimum tensile strength of the base metal.


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The minimum elongation of base metal shall be determined in accordance with the formula given in foot note (f) of Table 7 of API Spec 5L, however, minimum elongation in no case shall be less than 20%.

9.6 **Flattening Test**

Acceptance criteria for flattening tests shall be as follows:

a) For HFW pipe of grade ≥ X60 and t ≥ 12.7 mm, there shall be no opening of the weld before the distance between the plates is less than 66% of the original outside diameter. For all other combinations of pipe grade and specified wall thickness, there shall be no cracks or breaks in either weld or parent metal before the distance between the plates is less than 50% of the original outside diameter. Dye penetrant testing shall be used to positively confirm the presence of crack, break or opening.

b) For HFW pipe with a D / t> 10, there shall be no cracks or breaks other than in the weld before the distance between the plates is less than 33% of the original outside diameter.

c) For all pipes, there shall be no evidence of lamination or burnt metal during the entire test before opposite walls of the pipe meet.

Note: The weld extends to a distance of 13 mm on each side of the weld line. The original outside diameter is the specified outside diameter.

9.8 **Cvn Impact Test For PSL 2 Pipe**

9.8.1 **General**

9.8.1.2 From the set of three Charpy V-notch impact test pieces, only one is allowed to be below the specified average absorbed energy value and shall meet the minimum single absorbed energy value requirement as specified in Table 8 of this specification.

9.8.2 **Pipe body tests**

9.8.2.1 The average (set of three test pieces) absorbed energy value (KvT) for each pipe body test shall be as specified in Table 8 of this specification, based upon full sized test pieces at a test temperature of 0°C(32°F) or at a lower test temperature as specified in the Purchase Order/ Material Requisition/Data sheets.

Table 8 of API Spec 5L stands replaced by Table 8 of this specification.

**Table 8 - CVN absorbed energy requirements**

**for pipe body, weld and HAZ of PSL 2 pipe**

| **Pipe Grade** | **Full-size CVN absorbed energy (KvT) [a.b] [J]** | |
|---|---|---|
| | Average | Minimum |
| BM | 40 | 32 |
| X42M | 40 | 32 |
| X46M | 40 | 32 |
| X52M | 40 | 32 |
| X56M | 40 | 32 |
| X60M | 42 | 34 |
| X65M | 45 | 36 |
| X70M | 50 | 40 |

a. The required KvL (longitudinal direction test pieces) values shall be 50% higher than the required KvT values.
b. Testing shall be performed at a test temperature of 0° C (32°F) or at a lower temperature as specified in the Purchase Order /Material Requisition/Data sheets..


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9.8.2.2 The minimum average (set of three test pieces) shear fracture area shall be at least 85 % with one minimum value of 75%, based at a test temperature of 0 °C (32 $^0$F) or at a lower test temperature as specified in the Purchase Order/ Material Requisition/Data sheets.

9.8.3 **Pipe weld and HAZ tests**

The average (set of three test pieces) absorbed energy value (Kv1) for each pipe weld and HAZ test shall be as specified in Table 8 of this specification, based upon full-size test pieces at a test temperature of 0°C (32°F) or at a lower test temperature as specified in the Purchase Order/ Material Requisition/Data sheets

9.10 **Surface Conditions, Imperfections and Defects**

9.10.1 **General**

9.10.1.2 All pipes shall be free from cracks, sweats, leaks and slivers. Pipe containing such defects shall be treated in accordance with clause C.3 b) or c) of API Spec 5L.

9.10.3 **Arc burns**

9.10.3.2 Arc bums shall be treated in accordance with clause C.3 b) or c) of API Spec 5L. As a reference method for confirming the existence of an arc bum, the area shall be buffed with wire brush or sanding disc and etched with 10% solution of ammonium per sulfate or a 5% solution of nital.

However, arc bums can be considered for acceptance, in case the same is re-crystallized by seam heat treatment. In such case, the Manufacturer shall demonstrate the re-crystallization to Purchaser by taking a sample as per clause 10.2.3.8 (New) of this specification.

9.10.4 **Laminations**

Any lamination or inclusion either extending into the face or bevel of the pipe or present within 50 mm from pipe ends shall be classified as defect. Pipes that contain such defects shall be rejected or cut back until no lamination or inclusion is present at the pipe ends and shall be treated in accordance with clause C.3 b) or c) of API Spec 5L.

9.10.5 **Geometric deviations**

9.10.5.2 For dents, the length in any direction shall be ≤0.5 D and the depth, measured as the gap between the extreme point of the dent and the prolongation of the normal contour of the pipe, shall not exceed the following:

a) 3.2 mm for cold-formed dents with sharp-bottom gouges and not encroaching upon the specified minimum wall thickness

b) 6.4 mm for other dents

c) 1 mm at the pipe ends, i.e. within a length of 100 mm at each of the pipe ends.

d) Any dent on weld and heat affected zone (HAZ).

Dents that exceed the above specified limits shall be considered as defect and shall be treated in accordance with clause C.3 b) or c) of API Spec 5L. Acceptable cold-formed dents with sharp-bottom gouges shall be treated in accordance with clause C.2 of API Spec 5L & as modified in this specification.

9.10.6 **Hard Spots**


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Any hard spot larger than 50 mm (2.0 in) in any direction and hardness greater than 248$HV_{10}$ shall be classified as defect and treated in accordance with clause C.3 b) or C.3 c) of API Spec 5L.

9.10.7 **Other surface imperfection**

Other surface imperfections found by visual inspection or non-destructive inspection shall be investigated, classified and treated as follows:

a) Imperfections that have a depth =< 0.05 t and do not encroach on the minimum specified wall thickness shall be classified as acceptable imperfections and shall be treated in accordance with Clause C.1 of this specification.

b) Imperfections that have a depth > 0.05 t and do not encroach on the minimum specified wall thickness shall be classified as defects, and shall be dressed-out by grinding in accordance with Clause C.2 of API Spec 5L and as modified in this specification or shall be treated in accordance with clause C.3 b) or c) of API Spec 5L.

c) Imperfections that encroach on the minimum specified wall thickness shall be classified as defects and treated in accordance with clause C.3 b) or c) of API Spec 5L.

9.11 **Dimensions, Mass and Tolerances**

9.11.3 **Tolerances for diameter, wall thickness, length and straightness**

9.11.3.1 The diameter and out-of-roundness shall be within the tolerances given in Table 10 of this specification.

Table 10 of API Spec 5L stands replaced by Table 10 of this specification.

**Table 10 - Tolerances for diameter and out-of-roundness**

| Specified outside Diameter (D) mm (inch) | Diameter tolerances [d] | | Out-of-roundness [e (new)] | |
|---|---|---|---|---|
| | Pipe except the end [a] | Pipe end [a,c] | Pipe except the end [a] | Pipe end [a,c] |
| D ≤168.3 (6 5/8) | ± 0.0075 D | -0.4 mm to + 1.6mm | 0.020D | 0.015 D up to a maximum of2.0mm |
| 168.3 (6 5/8) < D ≤ 273.1 (10 3/4) | ± 0.0075 D | ±0.005 D | 0.020D | 2.0mm |
| D > 273.1 (10 3/4) | ± 0.0075 D up to a maximum of ±3.0mm | ± 1.6mm | 0.020D | 3.0mm |

a The pipe end includes a length of 100 mm at each of the pipe extremities.
b Deleted
c The diameter tolerance and out-of-roundness tolerance shall apply on inside diameter. The inside diameter, based on circumferential measurement, shall be calculated as ID = (D – 2t).
d For determining compliance to the diameter tolerances, the pipe diameter is defined as the circumference of the pipe in any circumferential plane divided by Pi (π).
e (New) Out-of-roundness tolerances apply to maximum and minimum diameters as measured with bar gage, caliper, or device measuring actual, maximum and minimum diameters.

9.11.3.2 In addition to API requirements, the wall thickness of each pipe shall be checked along the circumference at both ends and at the mid location of pipe body at 12 0' clock, 3 0' clock, 6


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0' clock and 9 0' clock positions. The tolerances for wall thickness shall be as given in Table 11 of this specification.

Table 11 of API Spec 5L stands replaced by Table 11 of this specification.

**Table 11- Tolerances for wall thickness**

| Wall thickness (mm) | Tolerances c, d (mm) |
|---|---|
| t < 15.0 mm | +0.20 t<br>-0.0t |
| t ≥ 15.0 mm | +3.0 mm<br>-0.0 mm |
| a Deleted<br>b Deleted<br>c The + ve tolerance for wall thickness does not apply to the weld area.<br>d See 9.13.2 of API Spec 5L and as modified herein for additional restrictions. | |

9.11.3.3 All pipes shall be supplied with length between 11.5 m and 12.5 m. However pipe with length between 10.0 m and 11.5 m can also be accepted for a maximum of 5% of the ordered quantity. The minimum average length of the entire ordered quantity in any case shall be 12.0 m. Overall length tolerance shall be (-) Zero and (+) One pipe length to complete the ordered quantity. Table 12 of API Spec 5L stands deleted.

9.11.3.4 The tolerances for straightness shall be as follows:

a) The total deviation from a straight line over the entire pipe length, as depicted in Figure 1 of API Spec 5L shall not exceed 12 mm.

b) The local deviation from straight line, as depicted in Figure 2 of API Spec 5L, in 1.0 m (3.0 ft) portion at each pipe end shall be ≤ 3.0 mm (0.120 in),

9.12 **Finish of Pipe Ends**

9.12.5 **Plain ends**

9.12.5.6

(New) During removal of inside burrs at the pipe ends, care shall be taken not to remove excess metal and not to form an inside cavity on bevel. Removal of excess metal beyond the minimum wall thickness as indicated in clause 9.11.3.2 of this specification shall be a cause for re-bevelling. In case root face of bevel is less than that specified, the pipe ends shall be re-bevelled and rectification by filing or grinding shall not be done.

9.12.5.7

(New) **Bevel Protectors**

Both pipe ends of each pipe shall be provided with metallic or high impact plastic bevel protectors as per Manufacturer's standard. Bevel protectors shall be of a design such that they can be re-used by coating applicator for providing on externally anti-corrosion coated pipes subsequent to coating of line pipe.


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9.16

(New) **Reverse Bend Test**

All pipes shall meet the minimum acceptance criteria for Reverse Bend Test as follows:

A specimen which fractures completely prior to the engagement of mandrel and specimen as specified in clause 10.2.4.9 (New) of this specification, or which reveals cracks or ruptures in the weld or heat affected zone longer than 4 mm shall be rejected. Cracks less than 6 mm long at the edges of the specimen shall not be cause for rejection. Dye penetrant testing shall be used to positively confirm cracks or openings.

## 10 INSPECTION

10.1 Types of Inspection and Inspection Documents

10.1.3 Inspection documents for PSL 2 pipes

10.1.3.1 Inspection certificate 3.2 in accordance with EN 10204 shall be issued for each dispatched pipe by Purchaser's authorized representative.

### 10.2 Specific Inspection

#### 10.2.1 Inspection frequency

10.2.1.2 For PSL 2 pipe, the inspection frequency shall be as given in Table 18 of this specification.

Table 18 of API Spec 5L stands replaced by Table 18 of this specification.

**Table 18 - Inspection frequency of pipe**

| Sl. no. | Type of inspection | Frequency of inspection |
|---|---|---|
| 1 | Heat analysis [a] | One analysis per heat of steel |
| 2 | Product analysis [b] | Two pipes per lot (maximum 100 pipes) per heat |
| 3 | Tensile testing of the pipe body | Two pipes per test unit of not more than 100 pipes per heat |
| 4 | Tensile testing of the longitudinal weld seam of pipe [c] | Two pipes per test unit of not more 100 pipes per heat |
| 5 | CVN impact testing of the pipe body | Once per test unit of not more than 50 pipes |
| 6 | CVN impact testing of the weld and HAZ of pipe | Once per test unit of not more than 50 pipes |
| 7 | Flattening test of pipe | As shown in Figure 6 a) of API Spec 5L |
| 8 | Reverse Bend Test (New) | Same as Figure 6 a) of API Spec 5L |
| 9 | Hardness testing | Any hard spot exceeding 50 mm (2.0 in) in any direction |


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| | | |
|---|---|---|
| 10 | Hydrostatic testing | Each pipe |
| 11 | Weighing of pipe | Each pipe shall be measured and recorded |
| 12 | Wall thickness measurement [d] | Each pipe |
| 13 | Pipe diameter and out-of roundness [d] | Each pipe |
| 14 | Length | Each length of pipe shall be measured and recorded |
| 15 | Straightness [d] | Each pipe |
| 16 | Tolerances for the weld seam [d]<br><br>a) Radial offset of coil edges<br><br>b) Height of flash and<br><br>c) Depth of groove after trimming of inside flash | Each pipe |
| 17 | Visual inspection | Each pipe |
| 18 | Metallographic testing (including Vicker's hardness test) of the longitudinal seam weld of pipe as defined in clause 10.2.5 of this specification | At least one finished pipe from each lot of 50 pipes per heat or at least once per operating shift (12 hrs max.) whichever is occurring more frequently and whenever changes of grade, diameter or wall thickness are made and whenever significant excursions from operating heat treatment conditions are encountered and at the beginning of the production of each combination of specified outside diameter and specified wall thickness. |
| 19 | Other dimensional testing | Random testing, with the details left to the discretion of the manufacturer |
| 20 | Non-destructive inspection | In accordance with Annex E of API Spec 5L and as modified herein |

a Where the steel mill is not a part of an integrated pipe mill, heat analysis shall be reported by the Manufacturer prior to start of pipe production.

b Pipes selected shall be such that one at the beginning of the heat and one at the end of the heat are also represented.

c Pipe produced by each welding machine shall be tested at least once per week.

d Measurement shall be recorded at least 3 times per operating shift (12 hrs maximum).

e "Test unit" is as defined in clause 3.1.60 of API Spec 5L.


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10.2.2 **Samples and test pieces for product analysis**

Samples shall be taken, and test pieces prepared, in accordance with ISO 14284 or ASTM E1806. Samples used for product analysis shall be taken from finished pipes only.

Samples for product analysis from coil may be used provided the traceability of samples is guaranteed.

10.2.3 **Samples and test pieces for mechanical tests**

10.2.3.1 General

In addition to API Spec 5L requirements, samples and test pieces for various types of tests shall be taken from Figure 5 b) and Figure 6 a) of API Spec 5L and Figure 10.2.4.9.1 & 10.2.5.3 of this specification, whichever is applicable, and as given in Table 20 of this specification.

Table 20 of API Spec 5L stands replaced by Table 20 of this specification.

| **Sample Location** | **Type of test** | **Number, Orientation and location of test pieces per sample [a]** | |
|---|---|---|---|
| | | **Specified outside diameter, D mm (in)** | |
| | | < 219.1 mm (8.625 in) | ≥219.1 mm (8.625 in) |
| Pipe body | Tensile | 1 L90 | 1T180 |
| | CVN | 3T90 | 3T90 |
| Seam Weld | Tensile | --- | IW[b] |
| | CVN | 3W and 3HAZ | 3W and 3HAZ |
| | Hardness | 1W (As shown in figure 10.2.5.3 of this specification) | |
| Pipe body and weld | Flattening | As shown in figure 6 a) of API Spec 5L | |
| | Reverse Bend | As shown in figure 10.2.4.9.1 of this specification | |

a See figure 5 (b) of API Spec 5L for an explanation of the symbols used to designate orientation and location.

b Test specimen shall be tested for ultimate tensile strength only.

10.2.3.2 Test pieces for the tensile test

Rectangular test pieces, representing the full wall thickness of the pipe, shall be taken in accordance with ASTM A370 and as shown in Figure 5 b) of API Spec 5L.


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Longitudinal tensile tests for pipe body with specified outside diameter, D < 219.1 mm (8.625 inch) shall be carried out on a strip specimen representing full wall thickness of the pipe prepared according to ASTM A370.

Transverse tensile test for pipe body with specified outside diameter, D ≥ 219.1 mm (8.625 inch) shall be carried out on flattened rectangular test pieces.

For tensile test piece, both inside and outside flash of weld in excess of pipe wall thickness shall be removed from the test piece either by grinding or machining.

10.2.3.3 **Test pieces for the CVN impact test**

In addition to the API Spec 5L requirements, following shall also be applicable:

The test pieces shall be prepared in accordance with ASTM A370. Non-flattened test pieces shall be used. The axis of the notch shall be perpendicular to the pipe surface.

Charpy V-notch impact testing shall be performed on full-sized test pieces. However, if preparation of full size test piece is not possible, then standard sub-sized test pieces shall be prepared as per ASTM A370.

Lower pipe sizes wherein preparation of transverse sub-sized specimen is not possible, CVN impact testing shall be carried out on longitudinal test specimen [see Note 'a' of Table 8 of this specification].

10.2.3.7 **Test pieces for flattening test**

The test pieces shall be prepared in accordance with ISO 8492. The length of each test piece shall be >= 60 mm.

Minor surface imperfections may be removed by grinding.

10.2.3.8 **Test pieces for Macro graphic and metallographic tests**

(New) Test piece for metallographic testing shall be taken transverse to the longitudinal weld seam as indicated in Figure 10.2.5.3 of this specification. The test piece shall be suitably ground, polished and etched to reveal the macro-structure.

10.2.3.9 **Test pieces for Reverse bend test**

(New) Ring specimen of width between 100 mm to 115 mm shall be taken from the pipe. Reverse bend test shall be carried out as per clause 10.2.4.9 (New) of this specification.

10.2.4 **Test methods**

10.2.4.3 CVN impact test

The Charpy test shall be carried out in accordance with ASTM A370.

10.2.4.7 **Flattening test**

In addition to the API Spec 5L requirements, following shall also be applicable:

The flattening test shall be carried out in accordance with ISO 8492.

10.2.4.9 **Reverse bend test**


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(New) The mandrel shall be plunged into the test piece prepared in accordance with clause 10.2.3.9 (New) of this specification, with the weld in contact with the mandrel, to such a depth that the angle of engagement between mandrel and specimen reaches 60° as shown in figure 10.2.4.9.1 of this specification. If the combination of diameter & wall thickness of pipe and radius of mandrel is such that the angle of engagement cannot reach 60°, then the mandrel shall be plunged into the specimen until opposite walls of the specimen meet.

**Selection of Mandrel**

The reverse bend test shall be carried out with a mandrel, whose radius (R), or width (A) shall be calculated for any combination of diameter, wall thickness and grade with the following formula:

$$A = 2R = \frac{1.4\,(D-t)\,t}{e\,(D-2t) - 1.4t} - t$$

Where,

D - Specified outside diameter of pipe, mm

t - Specified wall thickness of pipe, mm

1.4 - Peaking factor

e - Strain

Minimum value of 'e' shall be as per Table 23 of API Spec 5L reproduced as below:

**Table 23 — Strain Values for Guided-bend Test**

| Pipe grade | Strain value *'e'* |
|---|---|
| Gr. B | 0.1375 |
| X42 | 0.1375 |
| X46 | 0.1325 |
| X52 | 0.1250 |
| X56 | 0.1175 |
| X60 | 0.1125 |
| X65 | 0.1100 |
| X70 | 0.1025 |

10.2.5 **Macro graphic and metallographic tests**

10.2.5.3 The test piece shall be visually examined using a minimum 40X magnification to provide evidence that heat treatment of weld zone is adequate and there is no untempered martensite or detrimental oxides from the welding process present along the weld seam. The metallographic examination shall be documented on micrographs (at 10X to 20X magnification). In case imperfections or defects are observed, it will become a cause for re- evaluation of welding parameters and heat treatment as deemed necessary by Purchaser's Representative.


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Vickers hardness tests shall be carried out on each test piece taken for metallographic examination in accordance with ISO 6507-1, at locations indicated in Fig. 10.2.5.3 of this specification. Indentation in the HAZ shall start as close to the fusion line as possible. The resulting Vickers hardness value at any point shall not exceed $248HV_{10}$. The maximum difference in hardness between the base metal and any reading taken on the weld or heat affected zone shall be less than $80HV_{10}$. Modalities of retest shall be in accordance with clause 10.2.12.7 of API Spec 5L.

10.2.6 **Hydrostatic test**

10.2.6.1 Test pressure shall be held for a minimum period of 15 seconds for all sizes and grades of pipes.

10.2.6.2 In addition to the requirements of API Spec 5L, following shall also be applicable:

The pressure gauge used for hydrostatic testing shall have a minimum range of 1.5 times and maximum range of 4 times the test pressure. The test-pressure measuring device shall be calibrated by means of a dead-weight tester only. The test configuration shall permit bleeding of trapped air prior to pressurization of the pipe.

10.2.6.5 The test pressure for all sizes and grades of pipe shall be such that hoop stress (fibre stress) generated is at least 95% of SMYS, computed based on the Equation (6) indicated in clause 10.2.6.5 of API Spec 5L. Table 26 of API Spec 5L stands deleted.

10.2.7 **Visual inspection**

10.2.7.1 Each pipe shall be visually examined for entire external surface and internal surface to the extent feasible and shall be free of defects in finished condition. Visual examination shall be carried out in a sufficiently illuminated area; minimum 1000 1x. If required additional lights shall be used to obtain good contrast and relief effect between imperfections and backgrounds.

10.2.8 **Dimensional testing**

10.2.8.1 Diameter measurements shall be made with a circumferential tape only.

10.2.8.7 The measuring equipment requiring calibration or verification under the provisions of API Spec 5L shall be calibrated with manual instruments at least once per operating shift (12 hours maximum). Such calibration records shall be furnished to Purchaser's Representative on request.

10.2.10 **Non-destructive inspection**

Non-destructive inspection shall be performed in accordance with Annex E of API Spec 5L and as modified herein.

10.2.11 **Reprocessing**

This clause of API Spec 5L stands cancelled.

10.2.12 **Retesting**

10.2.12.1 Recheck analyses

Modalities of recheck analysis shall be as per API Spec 5L as applicable to the lot being tested (see Table 18 of this specification). However, during individual testing, each pipe shall be fully analysed to meet the requirements of Table 5 of this specification.


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10.2.12.9 **Reverse bend retests**

(New) Reverse bend retest provisions shall be same as specified for flattening retests in clause 10.2.12.3 of API Spec 5L.

## 11 MARKING

### 11.1 General

11.1.1 Pipe manufactured in accordance with this specification shall be marked by the manufacturer as per the requirements of API Spec 5L and as modified herein. Marking shall be in English language and International System (SI) of Units.

11.1.5 (New) Marking shall also include Purchase Order number, item number, pipe number and heat number.

### 11.2 Pipe markings

11.2.1 k) (New) Actual length in metres and actual pipe weight in kg shall be marked

11.2.3 c) (New) Paint used for stencil marking shall withstand a temperature (New) up to 250°C expected to be experienced during further external anti-corrosion coating operations of line pipe by coating applicator.

11.2.4 The pipe number shall be placed by cold rolling or low stress dot marking or vibro-etching on the outside surface of the pipe at an approximate distance of 50 mm from both ends. In case of non-availability of either cold rolling or low stress dot marking facility in pipe mill, an alternative marking scheme of a permanent nature may be proposed by the Manufacturer.

11.2.8 A colour code band shall be marked on inside surface of finished pipe for identification of pipes of same diameter but different wall thickness, as indicated in the Purchase Order. The colour code band shall be 50 mm wide and shall be marked at a distance of 150 mm from the pipe ends.

## 12 COATINGS AND THREAD PROTECTORS

12.1.1 Unless otherwise specified in the Purchase Order, the pipes shall be delivered bare, free of any trace of oil, stain, grease and paint. Varnish coating shall be applied on the marking area.

Bevels shall be free of any coating.

## 13 RETENTION OF RECORDS

In addition to the records indicated in API Spec 5L, the Manufacturer shall retain the records of all additional tests and calibration records mentioned in this specification including the hard copy records of ultrasonic testing carried out on pipe/coil as well as pipe ends.

## 15 PRODUCTION REPORT

(New) The Manufacturer shall provide one electronic copy and six hard copies of production report in English language indicating at least the following for each pipe. International system of units (SI) shall be adopted.

- Pipe number


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- Heat number from which pipe is produced
- Pipe length and weight
- Pipe grade

The Manufacturer shall provide one electronic copy and six hard copies of acceptance certificates which shall include the results of all tests required as per this specification and performed on delivered material giving details of, but not limited to, the following:

- All test certificates as per clause 10.1.3 of API Spec 5L and as modified herein.
- Records of qualification of welders and procedures for repair welding.
- Certified reports of dimensional inspection, surface imperfections & defects.
- Data on test failures, rejected heats/lots, etc.
- All other reports and results required as per this specification.

The certificates shall be valid only when signed by the Purchaser's Representative. Only those pipes, which have been certified by the Purchaser's Representative, shall be dispatched from the pipe mill.

In the event of small quantities of pipes supplied against this specification, the production report may consist of only test certificates required as per clause 10.1.3 of API Spec 5L and as modified herein and other test reports/results required as per this specification.

## 16 INSPECTION OF FIELD TESTS & WARRANTY

(New) Purchaser shall be reimbursed by Manufacturer for any pipe furnished on this order that fails under field hydrostatic test if such failure is caused by a material/ manufacturing defect in the pipe. The reimbursement cost shall include pipe, labour and equipment rental for finding, excavating, cutting out and installation of replaced pipe in position. The field hydrostatic test pressure will not exceed that value which will cause a calculated hoop stress equivalent to 95 percent of specified minimum yield strength.

In case Manufacturer so desires, he will be advised at least two weeks in advance so that his Representative may witness the hydrostatic test in field, however, the testing and leak (if any) finding and repair operation shall not be postponed because of absence of the Manufacturer's Representative.


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## Annex B

## Manufacturing Procedure Qualification for PSL 2 Pipe

### B.1 INTRODUCTION

B.1.1 This annex specifies additional provisions that apply for the PSL 2 pipes ordered as per this specification.

B.1.2 Two lengths each of completely finished pipes from two different heats (i.e. a total of four pipe lengths) shall be selected at random for testing as per clause B.5.1 of this specification to verify that the manufacturing procedure results in the quality of pipes which are in complete compliance with this specification. The pipes thus tested shall be considered to be the test pipes required per heat or per lot as per relevant clauses of this specification.

These manufacturing procedure qualification tests (MPQT) shall be repeated upon any change in the manufacturing procedure as deemed necessary by Purchaser's Representative. The manufacturing procedure qualification tests shall be carried out on pipes for each wall thickness, each diameter and each grade of steel.

B.1.3 Verification of the manufacturing procedure shall be by qualification in accordance with clause B.3, B.4 and B.5 of API Spec 5L and as modified herein.

Note: In the event of small quantities of pipes (i.e. less than 50 numbers) ordered against this specification, like those for bends and other similar applications, as specifically called out in the Purchase Order, the manufacturing procedure qualification test as per clause B.5.1 of this specification shall not be carried out. Pipes in such case shall be accepted based on regular production tests.

### B.3 CHARACTERISTICS OF THE MANUFACTURING PROCEDURE SPECIFICATION

Before pipe production commences, Manufacturing Procedure Specification (MPS) for manufacturing of pipes and Statistical process control charts shall be prepared by pipe manufacturer (including all information as per clause B.3 a), b) and e) of API Spec 5L) and submitted for approval of the Purchaser.

### B.5 MANUFACTURING PROCEDURE QUALIFICATION TESTS (MPQT)

B.5.1 For the qualification of the manufacturing procedure, all tests & inspections specified in Table 18 and clause B.5.2 of this specification shall be conducted on all the pipes selected for testing as per clause B.1.2 of this specification.

B.5.2 The Manufacturer shall submit to Purchaser a report giving the results of all tests mentioned below. The report shall be agreed and signed by Purchaser's Representative, prior to start of regular production.

The various tests to be conducted on each pipe shall be as follows. The test method and acceptance values shall be as per this specification unless specified differently in this Annex.

a. **Visual Examination**

All pipes shall be examined visually for dimensional tolerances and apparent surface defects.

b. **Ultrasonic Examination**


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The weld seam of all pipes shall be examined ultrasonically by automatic ultrasonic equipment.

c. **Mechanical Properties**

The mechanical properties of all pipes shall be tested and shall meet the requirements of this specification. Purchaser's Representative will select the places in pipe from where the test pieces shall be extracted.

The following tests shall be conducted:

i. Flattening test

Two (2) flattening test pieces shall be extracted; one test piece shall be tested with weld at 0° and other at 90°.

ii. Tensile test

Tensile tests shall be conducted on:

For pipe with specified outside diameter, D < 219.1 mm (8.625 inch):

- Two (2) longitudinal test pieces from base metal

For pipe with specified outside diameter, D ≥ 219.1 mm (8.625 inch):

- Two (2) transverse test pieces from base metal

- Two (2) transverse test pieces from the longitudinal weld seam

iii. Metallographic tests

Six (6) weld cross-section test pieces, three (3) from each end of pipe weld seam shall be taken for metallographic examination. Two of these shall be tested for hardness at room temperature after etching, one from each pipe

iv. CVN impact testing

CVN impact test shall be performed on test pieces extracted as follows:

- Four sets of three (3) transverse test pieces each from base metal

- One set of three (3) transverse test pieces with weld in middle

- One set of three (3) transverse test pieces with HAZ in middle

The minimum average (set of three test pieces) absorbed energy value (KvT) at the test temperature specified in clause 9.8 and Table 8 of this specification shall be complied with for test pieces extracted from base metal, weld and HAZ.

v. Fracture toughness testing

Four (4) sets of CVN base metal test pieces shall be tested at - 40°C, - 10°C, 0°C and + 20° C for shear area and absorbed energy to produce full transition curve. The minimum average (set of three test pieces) shear fracture area at the test temperature specified in clause 9.8 of this specification shall be complied with. For other temperatures, the value shall be for information only.


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## Annex C

## Treatment of surface imperfections and defects

### C.1 TREATMENT OF SURFACE IMPERFECTIONS

Surface imperfection not classified as defect as per this specification shall be cosmetically dressed-out by grinding.

### C.2 TREATMENT OF DRESSABLE SURFACE DEFECTS

C.2.3 Complete removal of defects shall be verified by local visual inspection and by suitable non-destructive inspection. To be acceptable, the wall thickness in the ground area shall be in accordance with clause 9.11.3.2 of this specification.


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## Annex E

## Non-destructive inspection for Pipe

The Purchaser reserves the right to depute its Representative(s) to perform inspection and witness tests in all phases of manufacturing and testing starting from steelmaking to finished line pipe ready for shipment. Manufacturer shall comply with the provisions regarding inspection notice, plant access, compliance and rejection mentioned in the Annex Q (New) of this specification. The Manufacturer shall give the Purchaser reasonable notice of the starting date of normal production and the work schedule. Any action or omission on part of Purchaser's Representative shall not relieve the Manufacturer of his responsibility and obligation to supply material in strict accordance with this specification.

### E.1 QUALIFICATION OF PERSONNEL

E.1.1 All personnel performing NDT activities shall be qualified in the technique applied, in accordance with latest edition of ISO 9712, ISO 11484 or ASNT No. ASNT-TC-1A or equivalent

All NDT shall be performed in accordance with written procedures. These procedures shall have prior approval of the Purchaser.

**Inspector Qualification**

Acceptable qualification for NDT inspectors shall be as specified below:

(i) For UT

For UT, at least one Level III qualified inspector shall be available to the mill for overall supervision. Level III inspectors shall be ASNT Level III or ACCP Professional Level III and certified in applicable method.

A level II inspector is required for shift supervision, manual weld inspection and calibration of all systems (both manual and automated).

(ii) For all other NDT methods

Evaluation of indications Level II & Level III inspector

### E.3 METHODS OF INSPECTION

E.3.1 **General**

E.3.1.1 The electric weld of the pipe shall be inspected by ultrasonic methods (Refer Table E.1 of API Spec 5L) for full length (100%) for the entire thickness, using automatic ultrasonic equipment in accordance with clause E.5 of API Spec 5L and as modified in this specification.

E.3.1.3 Location of NDT equipment in the manufacturer's facility shall be such that final inspection of weld seam of pipe shall be performed after hydrostatic testing.

E.3.2 **Pipe End Inspection - Welded Pipe**

E.3.2.1 Pipe ends including weld at the pipe ends not covered by automatic ultrasonic equipment shall be inspected by manual ultrasonic equipment with same sensitivity and capability as


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automatic equipment, or, such non-inspected pipe end shall be cut-off. Records in accordance with E.5.4 of API Spec 5L shall be maintained.

E.3.2.3 Ultrasonic inspection in accordance with the method described in ISO 10893-8 shall be used to verify that the SO mm (2.0 in) wide zone at each pipe end is free of any laminar imperfections in the circumferential direction.

E.3.2.4(New) Bevel face of each pipe end shall be magnetic particle inspected for the detection of laminar imperfections in accordance with ISO 10893-5

E.5 **ULTRASONIC AND ELECTROMAGNETIC INSPECTION**

E.5.1.1 In addition to the API Spec 5L requirements, all automatic ultrasonic equipment shall have an alarm device, which continuously monitors the effectiveness of the coupling. The equipment for the automatic inspection shall allow the localization of both longitudinal and transverse defects corresponding to the signals exceeding the acceptance limits of the reference standard. The equipment shall be fitted with a paint spray or automatic marking device and alarm device for areas giving unacceptable ultrasonic indications. All ultrasonic testing equipment shall be provided with recording device. In addition, an automatic weld tracking system shall be provided for correct positioning of the probes with respect to weld centre.

E.5.2. **Ultrasonic and electromagnetic inspection reference standards**

E.5.2.1 The reference standard (calibration pipe) shall have the same specified diameter and wall thickness as specified for the production pipe being inspected.

E.5.2.2 Reference standards shall be of sufficient length to permit calibration of ultrasonic inspection equipment at the speed to be used in normal production.

The reference standard (calibration pipe) shall also be of the same material, type and have the same surface finish and heat treatment as the pipe being inspected.

E.5.2.3 **Reference standards**

E.5.2.3.1 **Reference standards for pipe weld UT:**

(New) Reference standard shall contain as reference indicators i.e. machined notches as given in

Table E.7 of this specification

Table E.7 of API Spec 5L stands replaced by Table E.7 of this specification.

**Table E.7 — Reference Indicators**

| Item | Reference indicators | | |
|---|---|---|---|
| | Number of notches and orientation [a] | | Notch Type [b] |
| | OD | ID | |
| Weld Seam | 1L | 1L | N10 |

a The symbol indicates the orientation of the notch i.e. L = Longitudinal. Reference indicators shall be located as per Figure E.I of this specification.

b Dimensions of Notch type N10 shall be 0.1 t x 50 mm x 1 mm (Depth x maximum Length


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x maximum width), where, 't' is the specified wall thickness. The depth tolerance is ± 15% of the specified notch depth or ± 0.05 mm, whichever is greater.

**E.5.2.3.2 Reference standards for coil/ pipe body UT:**

(New) Reference standard for the ultrasonic inspection of coil or pipe body (except the coil edges/pipe ends) shall contain continuous machined notch of following dimension:

a) width, w : 8 mm, with a tolerance +0.8/ - 0.0 mm

b) depth, d : 0.25 1< d < 0.5 t, where 't' is the specified wall thickness

Reference standard for the ultrasonic inspection of coil edges (area adjoining weld seam)/ pipe ends shall have 6.4 mm (1/4 inch) diameter FBH of a depth 0.5 t, where 't' is the specified wall thickness.

E.5.3 **Instrument standardization**

E.5.3.2 The instrument shall be calibrated with appropriate reference standard (refer E.5.2 of API Spec 5L and as modified herein) at following intervals:

- Once at the beginning of each operating shift (12 hours maximum).
- Once in between of each operating shift i.e, 3 hrs to 4 hrs after the first
- Every time there is change in probes or working condition of the UT machine.
- Every time the running of the system gives rise to doubts on its efficiency.

If during the above calibration verification, it is found that the equipment has not functioned satisfactorily in the opinion of the Purchaser's Representative, all the pipes or coils already inspected after the previous verification shall be inspected again at Manufacturer's cost.

E.5.5 **Acceptance Limits**

E.5.5.2 For ultrasonic inspection of pipe/coil, any imperfection that produces an imperfection greater than the acceptable limits shall be treated as following:

a) Locations showing indications above the acceptance limits during automatic ultrasonic inspection may be re-examined by manual ultrasonic method. If no defects are located during re-examination, the original findings may be ignored. Additional scanning may be requested by Purchaser's Representative to check questionable areas.

E.5.6 **Disposition of defects found by Ultrasonic and electromagnetic inspection**

Disposition of any imperfection in pipe/coil that produces an indication greater than the acceptable limits as specified in Table E.9 (New) of this specification shall be classified as defect and shall be given disposition as specified in (e) or (f) of E.10 of API Spec 5L.

E.7 **RESIDUAL MAGNETISM**

E.7.2 The longitudinal magnetic field shall be measured on all sizes of pipes. Measurement on pipe in stack shall not be considered valid. Such measurements shall be taken on the root face or square cut face of finished plain-end pipes.


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E.7.3 Measurements shall be made using Hall - effect gaussmeter only.

E.7.4 Measurements shall be made on each end of a pipe for 5% of the pipes produced but at least once per 4 hr per operating shift (12 hrs maximum).

E.7.6 Four readings shall be taken approximately 90° apart around the circumference of each end of the pipe. The average of the four readings shall not exceed 2.0 mT (20 gauss) and no single reading shall exceed 2.5 mT (25 gauss). All residual magnetism measurements shall be recorded.

## E.8 LAMINAR IMPERFECTIONS IN THE PIPE BODY OF EW, SAW AND COW PIPE

E.8.1 The coil, except the longitudinal coil edges (area adjoining weld seam), shall be ultrasonically tested for laminations using an oscillating or straight running pattern of probes in accordance with ISO 10893-9 amended as follows:

The distance between adjacent scanning tracks shall be sufficiently small to ensure detection of minimum allowed imperfection size. The minimum coverage during automatic ultrasonic inspection shall be ≥ 20 % of the coil surface uniformly spread over the area.

Acceptance limit for laminar imperfection in the coil, except the longitudinal edges, shall be as per Table E.9 (New) of this specification. Disposition of defects shall be as per clause E.5.6 of this specification.

Table 3 of ISO 10893-9 stands replaced by Table E.9 (New) of this specification.

## E.9 LAMIMAR IMPERFECTIONS ALONG THE STRIP/ PLATE EDGES OR PIPE WELD SEAM OF EW, SAW AND COW PIPES

The longitudinal edges of the coil (area adjoining weld seam) shall be 100% ultrasonically inspected in accordance with ISO 10893-9 amended as follows:

UT shall be performed over 25 mm wide zone along each side of the trimmed longitudinal edges of the coil.

Acceptance limit for laminar imperfection in the longitudinal edges of the coil shall be as per Table E.9 (New) of this specification. Disposition of defects shall be as per clause E.5.6 of this specification.

Table 2 of ISO 10893-9 stands replaced by Table E.9 (New) of this specification.

**Table E.9 - Acceptance criteria for laminar imperfection in coil/ pipe body (New)**

| Location | Maximum individual imperfection | | Minimum imperfection size considered | | | Maximum population density[a] |
|---|---|---|---|---|---|---|
| | Area $mm^2$ | Length[b] mm | Area $mm^2$ | Length[b] mm | Width[c] mm | |
| Coil, except the longitudinal edges | 1000 | 100[d] | 300 | 35 | 8 | 10 (per 1.0 m x 1.0m) |
| Longitudinal edges of the | 500 | 40 | ---- | 20 | -- | 4 |


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| | | | | | | |
|---|---|---|---|---|---|---|
| coil | | | | | | (per 1.0 m length) |

a Number of imperfections of size smaller than the maximum imperfection size and greater than the minimum imperfection size.

b Length is the dimension at right angles to the scan track.

c Width is the dimension parallel to the scan track.

d Any planar imperfection which is not parallel to the coil surface is not acceptable.

e For an imperfection to be larger than the minimum imperfection size, the minimum area, minimum length and minimum width given for the coil/ pipe body, all have to be exceeded.

E.10 **DISPOSITION OF PIPES CONTAINING DEFECTS**

a) The repaired area shall be 100% rechecked by magnetic particle or ultrasonic inspection to ensure complete removal of defects. However for repair of cosmetic type of defects, MPI may not be conducted if so directed by Purchaser's Representative on case to case basis. The pipes having a thickness less than the minimum allowed in accordance with this specification, after repair by grinding shall be treated for disposition in accordance with (c) or (d) of clause E.10 of API Spec 5L.

E.11 **ROTARY ULTRASONIC INSPECTION OF PIPE (ALTERNATIVE METHOD)**

(New) As an alternative, full pipe may be ultrasonically inspected after welding of longitudinal seam by rotary ultrasonic testing method (pipe in rotating condition) in accordance with ISO 10893-8 amended as follows:

The coverage area during ultrasonic inspection shall be 100 % of the pipe body including weld seam, sides of the weld seam and pipe ends.

The reference standard for the weld seam as per clause E.5.2.3.1 and Table E.7 of this specification shall be used for the rotary ultrasonic testing.

If the manufacturer opts for rotary ultrasonic testing of full pipe in accordance with this clause, then, the requirement for ultrasonic inspection as per clause E.3.1.1, E.3.2.3, E.8 and E.9 of API Spec 5L and as modified herein shall not be applicable.


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## Annex G

## PSL 2 Pipe with Resistance to Ductile Fracture Propagation

### G.1 INTRODUCTION

G.1.1 This annex specifies additional provision that apply for pipes ordered as per this specification.

### G.2 ADDITIONAL INFORMATION TO BE SUPPLIED BY THE PURCHASER

G.2.1 CVN minimum average absorbed energy value (based on full-sized test pieces) for each test as per G.3.2 shall be as per table G of this specification for BM, weld and HAZ.

Table G.1, G.2 & G.3 of API specification 5L stands replaced by Table G of this specification.

**Table G-CVN Absorbed Energy Requirements for Pipe Body, Weld and HAZ of PSL2 Pipe.**

| Pipe Grade | Full size CVN Absorbed Energy ($K_vT$)[a.b {J}] | |
|---|---|---|
| | Average | Minimum |
| BM | 40 | 32 |
| X42M | 40 | 32 |
| X46M | 40 | 32 |
| X52M | 40 | 32 |
| X56M | 40 | 32 |
| X60M | 42 | 34 |
| X65M | 45 | 36 |
| X70M | 50 | 40 |

a. The required $K_vL$ (Longitudinal direction test pieces) value shall be 50% higher than the required $K_vT$ values.
b. Testing shall be performed at a test temperature of 0˚C (32°F) or at a lower temperature as specified in the purchase order.


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## Annex Q (New)

## Purchaser Inspection

### Q.1 INSPECTION NOTICE

Advance notice shall be given by the manufacturer prior to the start of production to the purchaser to inspect/witness the manufacturing activities including tests.

### Q.2 PLANT ACCESS

The inspector representing the purchaser shall have unrestricted access, at all times while work of the contract of the purchaser is being performed, to all parts of the manufacturer's works that will concern the manufacture of the pipe ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy the inspector that the pipe is being manufactured in accordance with this specification. All inspections should be made at the place of manufacture prior to shipment, unless otherwise specified on the purchase order, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

### Q.3 COMPLIANCE

The manufacturer is responsible for complying with all of the provisions of this specification. The purchaser may make any investigation necessary to be satisfied of compliance by the manufacturer and any reject any material that does not comply with this specification.

### Q.4 REJECTION

If the Purchaser Representative rejects pipes repeatedly for any recurring cause, this shall be adequate reason to refuse final inspection of subsequent pipes until the cause has been investigated and corrective action taken by the Manufacturer.


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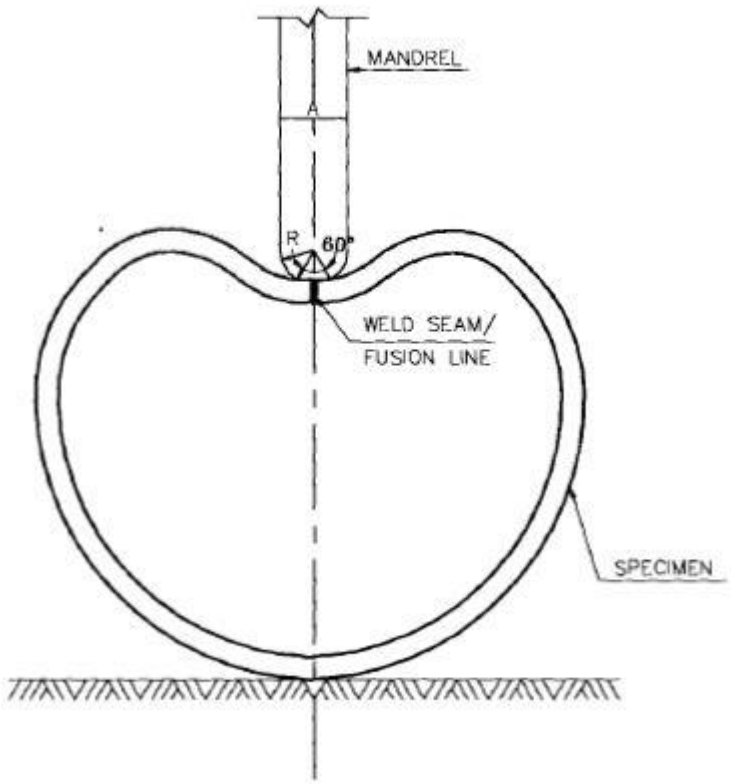


**FIGURE: 10.2.4.9.1**

**REVERSE BEND TEST**


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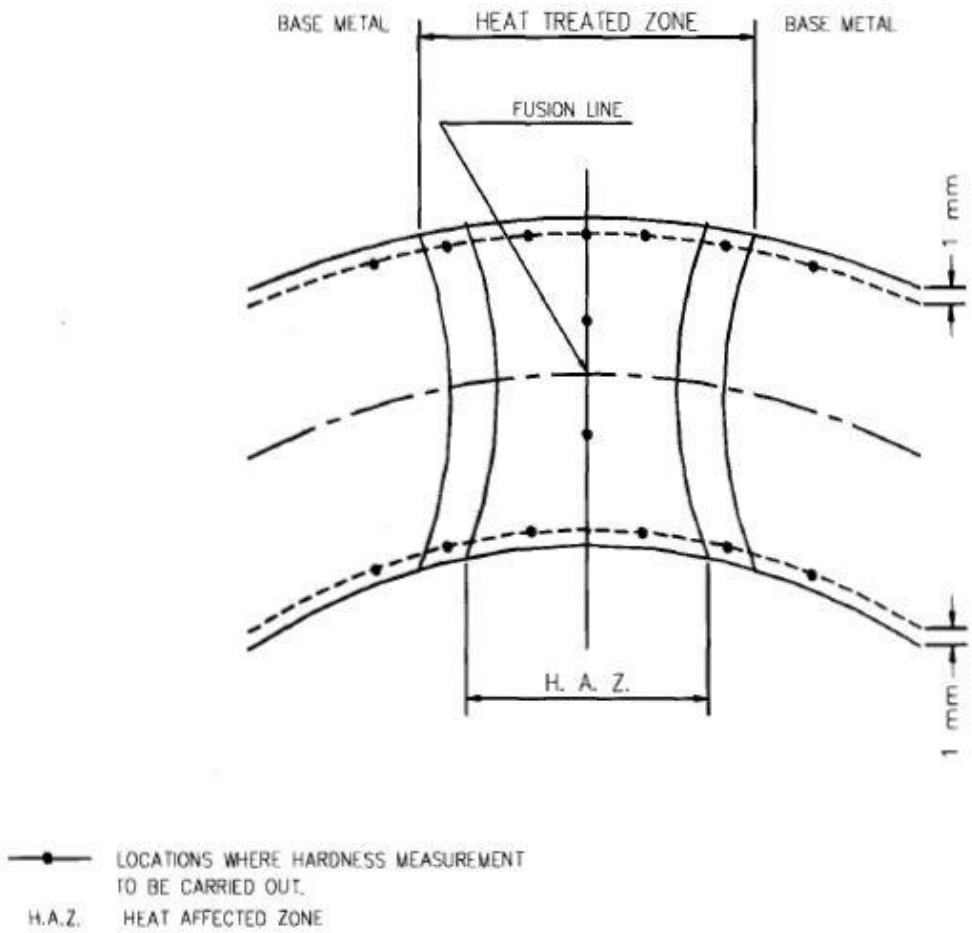


**FIGURE: 10.2.5.3**

**METALLOGRAPHIC SPECIMEN AND LOCATIONS FOR HARDNESS MEASUREMENT**


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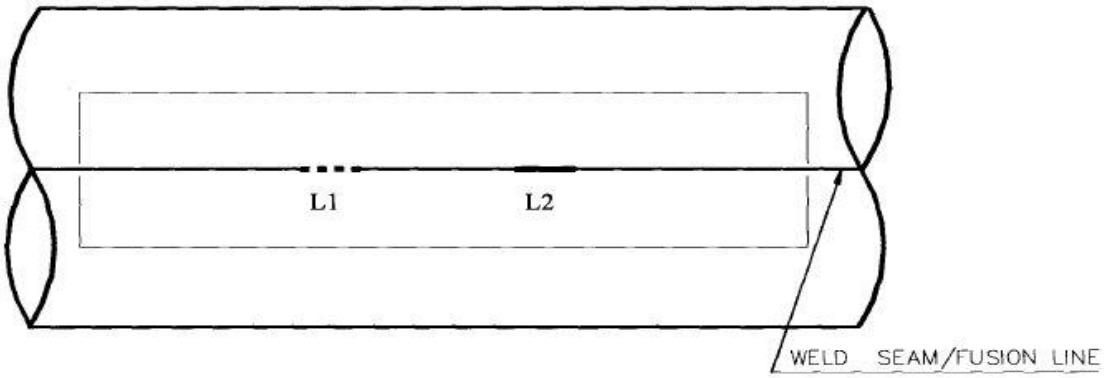


| | | |
|---|---|---|
| L1 | - | Longitudinal inside notch (N10) at weld line |
| L2 | - | Longitudinal outside notch (N10) at weld line |

**FIGURE: E.1**

**REFERENCE STANDARD FOR UT OF LONGITUDINAL WELD SEAM**


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ENERGISING QUALITY

# VCS QUALITY SERVICES PVT.LTD.

# STANDARD SPECIFICATION
# FOR
# LONG RADIUS BENDS

## VPC-SS-PP-2009

| Rev. No | Date | Prepared By | Checked By | Approved By | Authorized By |
|---|---|---|---|---|---|
| 02 | 28.01.2020 | MB | MC | AD | SK |

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| REVISION RECORD | | | | | | |
|---|---|---|---|---|---|---|
| **Rev.** | **Revision Date** | **Prepared by** | **Checked by** | **Approved by** | **Authorized by** | **Revision Description** |
| 00 | 23.06.2017 | | | | | Issued as Standard |
| | | AS | SM | AD | SK | |
| 01 | 12.06.2019 | | | | | Re-issued as Standard |
| | | BS | MC | AD | SK | |
| 02 | 28.01.2020 | | | | | Document formatting, Doc numbering updated from SS-PL-013 to VPC-SS-PP-2009 & other detail update as marked |
| | | MB | MC | AD | SK | |
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## ABBREVIATIONS:

| | |
|---|---|
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| API | American Petroleum Institute |
| BHN | Brinell hardness number |
| HAZ | Heat Affected Zone |
| MSS-SP | Manufacturers Standardization Society - Standard Practice |
| NB | Nominal Bore |
| NDT | Non Destructive Testing |
| OD | Outside Diameter |
| OLAC | Online Accelerated Cooling |
| SAW | Submerged Arc Welded |
| SMYS | Specified Minimum Yield Strength |
| TMCP | Thermo Mechanical Control Process |


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## 1.0 SCOPE

This specification covers minimum requirements for manufacture, testing and supply of long radius bends, made from carbon steel line pipe, for use in onshore pipeline systems handling hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

This specification shall be used for fabrication of long radius bends of radii R=6D & R=3D.

## 2.0 REFERENCE DOCUMENTS

Fabrication, testing and supply of hot induction bends shall comply with the applicable sections of the latest edition (edition enforce at the time of issue of enquiry, unless specified otherwise) of the following codes and standards including their addenda.

**AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)**

| | | |
|---|---|---|
| B31.4 | : | Pipeline Transportation System for Liquids and Slurries |
| B 31.8 | : | Gas Transmission and Distribution Piping Systems. |
| B16.25 | : | Butt Welding Ends. |
| B16.49 | : | Factory-Made wrought Steel Butt welding Induction Bends for transportation and distribution systems. |

**AMERICAN PETROLEUM INSTITUTE (API)**

| | | |
|---|---|---|
| Specification 5L | : | Specification for Line Pipe. |

**AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**

| | | |
|---|---|---|
| A370 | : | Standard Test Methods and Definitions for Mechanical Testing of Steel Products. |

**MANUFACTURERS STANDARDIZATION SOCIETY (MSS)**

| | | |
|---|---|---|
| SP-75 | : | Specification for High Test Wrought Butt Welding Fittings. |

**OIL INDUSTRY SAFETY DIRECTORATE (OISD)**

| | | |
|---|---|---|
| Std. 141 | : | Design and Construction Requirements for Cross Country Hydrocarbon Pipelines. |
| Std. 214 | : | LPG Cross Country Pipeline |
| Std. 226 | : | Natural Gas transmission Pipeline and City Gas Distribution Network |


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**PURCHASER'S SPECIFICATIONS FOR LINE PIPE**

| | | |
|---|---|---|
| VPC-SS-PP-2045 | : | Standard Specification for Longitudinal Seam Submerged Arc Welded Line Pipe. |
| VPC-SS-PP-2036 | : | Standard Specification for Seamless Line Pipe |
| VPC-SS-PP-2008 | : | Standard Specification for HFW Line Pipe |

In case of conflict between various requirements of this specification and reference standards mentioned above, more stringent requirement shall apply unless otherwise agreed by Purchaser.

## 3.0 MATERIALS

Bends shall be fabricated from steel line pipe manufactured in accordance with the latest revision of the Company's Specifications referred in Section 2.0 above. The type of pipe to be used for fabrication of bends shall be as indicated in the Purchase Order. Pipes with positive wall thickness tolerances shall be used for fabrication of bends.

The finished product shall be evaluated for mechanical properties and micro structural stability.

Mechanical testing of test bends performed during the bend manufacturing procedure qualification as per Clause 9.0 of this specification shall ensure that, all bends made according to the Company approved bend manufacturing procedure, have the required mechanical properties. Destructive testing of production bend is not required. However, Company reserves the right to require destructive testing whenever production bending parameters or heat treatment parameters deviate from those established in the Company approved bend manufacturing procedure. However, deviations accepted during pipe production with respect to mechanical properties of line pipe shall be applicable for the bends.

## 4.0 MANUFACTURE

### 4.1 GENERAL

Material grade, bend size, bend radius and bend angle shall be as indicated in the Purchase Order/MR /Data sheet. The bending radius for bends shall be either six times the specified outside diameter (R=6D) or three times the specified outside diameter (R=3D), as applicable. The specified bend radius shall be measured at the bend neutral axis.

### 4.2 MANUFACTURING PROCEDURE

4.2.1 BENDING PROCESS

Bends shall be manufactured by high frequency continuous induction heating and forming method. A minimum of four temperature-monitoring probes shall be in continuous operation throughout all operations. The pipe to be bent shall be cleaned to remove any loose mill scale etc. Once the bending operation has commenced no stoppage shall be permitted until the entire bend has been completed. If bending temperature, bending rate,


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cooling medium volume or heat treatment temperature deviates from the Company approved bend manufacturing procedure, then the bend shall be discarded and another bend shall be made in its place. Cost of such discarded pipes shall be borne by the Manufacturer.

Heat treatment shall be carried out for all finished bends, only in case, it is established during bending procedure qualification that heat treatment is required to meet the specification requirements. Post hot bending heat treatment shall be carried out to the same cycle that the original material received for its production in order to bring the metallurgical condition back to its original state and heat treatment procedure shall be such that the mechanical properties and steel microstructure of the finished bends comply with the minimum requirements specified in the applicable line pipe specification referred under clause 2.0. Heat treatment procedure shall be submitted and prior approval of company shall be obtained on heat treatment procedure.

When Thermo mechanically Control Process (TMCP) and online accelerated Cooling (OLAC) steels are used, specific approval of the proposed heat treatment shall be obtained before bending process is employed. Heat treatment shall be carried out for all finished bends in case it is established during bending procedure qualification that heat treatment is required to meet the specification requirements.

Unless otherwise specified differently in the Purchase Order, the bevels at the ends shall be as per the relevant pipe specification.

## 4.3 INTERNAL TRANSITIONS

Bends shall have internal transitions at the tangent ends machined to suit the mating pipe in accordance with the specified wall thickness and the requirements of ASME B31.8/B 31.4.

## 4.4 CIRCUMFERENTIAL JOINTS

Bends shall not have any circumferential joints.

## 4.5 LOCATION OF WELD SEAM

When bending SAW or High Frequency Welded Pipes, the longitudinal seam shall be located in the plane of minimum deformation or neutral axis. Acceptable tolerance on location of the longitudinal weld seam shall be ± 5°.

## 4.6 WELD END BEVELS

Unless otherwise specified in Purchase Order, the bevels at the weld ends shall be as per ASME B 31.4/ ASME B 31.8. All cut pipe ends shall be bevelled by machining. The excess weld material at the inside of the bend in case of bends made from SAW pipes, shall be removed over a distance of 100 mm at both ends, but shall not result in reduction of bend wall thickness below the minimum specified wall thickness requirement.

## 4.7 REPAIRS

No repair by welding is allowed on any part of the bends.


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## 4.8 DEVIATIONS FROM ORIGINAL CONTOUR

Bulges, dents and flat areas shall not appear within 100 mm of each end of the bend. For the remaining part of these deviations from the original contour of the pipe are permitted provided these deviations do not exceed 2% of nominal outside diameter or 6.0 mm whichever is less. The same shall not extend (in any direction) over a distance of more than 25% of nominal outside diameter of the bend. Dents at the pipe weld seam shall not be acceptable irrespective of the size.

## 4.9 TANGENT LENGTH

All bends shall be provided with a tangent length at both ends. Tangent length shall be minimum 500 mm or equal to pipe outside diameter whichever is more.

In case, the total length of the bend arc (R=6D) including tangents exceeds one pipe length, tangent length shall be restricted to accommodate complete bend within one pipe length. In no case, tangent length shall be less than 250 mm.

## 4.10 TOLERANCES

The dimensions of bends shall be controlled to make sure that they are manufactured according to the tolerances indicated below, in addition to the requirements of MSS-SP-75. However, the ends of finished pipe bend shall meet the dimensional tolerances of the relevant pipe specification referred in Clause 2.0.

Following tolerances shall be applicable for Bend Angle and Bend Radius:

- Weld Seam : ± 5°.
- Bend Angle : ± 0.5° from the specified angle.
- Bend Radius : ± 1% of Bending Radius. of bending nominal radius (radius as indicated in Clause 4.1 above
- Wall Thickness : As per (A) below.
- Out of Roundness : As per (B) below.
- Off Plane : As per (C) below.

A. WALL THICKNESS

The Manufacturer shall measure the wall thickness of the pipe before bending along both the inside and outside radii of the bend between and including the start and stop points of the bend arc angle, at intervals approximately equal to pipe diameter or 300 mm whichever is less. The wall thickness shall be measured ultrasonically after bending at the same locations as measured before bending. In addition, the wall thickness of the tangents shall also be measured. These measurements shall be taken at four equally spaced locations around the pipe circumference. The measured wall thickness shall be at least equal to:

**Method-1**

$t_{min}$ = 0.95 (ta - Δ t).

ta = Actual wall thickness before bending.


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Δ t = 0.35 mm for ta < 10 mm.

= 0.5 mm for ta ≥ 10 mm.

Maximum percentage thinning allowed 10% & 18% for 6D and 3D bends respectively.

**Method-2**

Wall thinning & minimum thickness required shall be calculated as per BS 8010

More Stringent/ Largest value among above method shall be selected as minimum wall thickness required after bending.

When the pipes are free issue (or thickness of pipes is specified in MR) the thickness of finished bend shall comply with the requirement of 4.10 or as specified in data sheet whichever is higher. When pipes for manufacturing LR bends are to be procured by manufacturer and thickness of finished LR bends is specified in the MR, thickness specified of the bends shall be the minimum thickness achieved after bending with tolerance as (-) 0.0. Manufacturer shall procure pipes to achieve $t_{min}$ of LR bends. Higher value of $t_{min}$ shall be selected among as described in 4.10 above & as specified in data sheet.

B. **Out of roundness tolerance on the body and ends of the bend shall be as follows:**

**Body**

Measurements of the outside diameter shall be taken in the plane of the bend at locations where wrinkles are present ($OD_{max}$.) and at locations where wrinkles are not present ($OD_{min}$). Out of roundness shall be considered acceptable, if the value of (($OD_{max}$-$OD_{min}$)/$OD_{nom}$.) does not exceed 2.0%.

The measurements shall be made over the circumference of the bend either at distances approximately equal to pipe diameter or 300 mm whichever is less. Minimum three measurements shall be taken for each bend.

**Ends**

Out-of-roundness over a length of 100 mm from the end shall comply with the requirements of relevant company specification referred in Clause 2.0.

In case multiple bends are to be manufactured from single pipe, out of roundness tolerances applicable on pipe body shall be acceptable as end tolerances for bend ends fabricated from original body of line pipe.

C. **Off Plane**

Off-Plane of bends shall not exceed (θ /90) x 10 mm, where θ is the bend angle in degree or the tolerance limit specified in MSS-SP-75, whichever is less. The measurement shall be in accordance with MSS-SP-75.

D. S**quareness**

Bevel and squareness of bend ends shall comply with the requirements of relevant company specification referred in Clause 2.0.


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# 5.0 INSPECTION AND TESTS

## 5.1 GENERAL

The manufacturer shall perform all inspection and tests as per the requirements of this specification and MSS-SP-75 prior to shipment, at his Works. Such inspection and tests shall be as a minimum, but not limited to, the following:

- Verify that the unfinished product arriving at Manufacturer's shop is in full compliance with the pipe specification as referred in Clause 2.0 of this specification.
- Visual Inspection.
- Dimensional and tolerances check as per MSS-SP-75 and requirements of Clause 4.0 of this specification.
- Check heat treatment, if carried out, as required and maintain its records.
- Temperature against time recorder charts for each induction heating.
- The non-destructive inspection on the finished bend shall be carried out as given below:
    - All seam welds of bends manufactured from SAW pipes shall be 100% radiographed and seam welds of bends manufactured from HEW pipe shall be 100% ultrasonically tested. The acceptance criteria shall be same as given in applicable pipe specification referred under clause 2.0 of this specification.
    - The full circumference of both ends of each bend after bevelling shall be ultrasonically tested for laminations over a length of 100 mm and acceptance limits shall be as per pipe specification as referred in Clause 2.0 of this specification.
    - The finished bends shall be magnetic particle inspected on the outside and inside radii to include the area encompassed 30 degrees either side of the line passing through the plane of the bend. Acceptance criteria shall be as per ASME Sec. VIII Appendix 6.
- A check shall be performed on each bend by passing a gauging pig consisting of two discs having a diameter equal to 95% of the inside diameter of the pipe, connected rigidly together at a distance equal to 500 mm. Details of the gauging pig, including its dimensions shall be approved by Company.
- When Specified in requisition for quotation, all bends shall be subjected to hydrostatic testing at a pressure capable of generating a hoop stress in pipe equal to 95% of Specified Minimum Yield Strength of pipe. Test pressure shall be maintained for a min. of 15 sec.

**5.2** Company's Inspector reserves the right to perform stage wise inspection and witness tests on all bends as indicated in Clause 5.1 at Manufacturer's works, prior to shipment.

Manufacturer shall give reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection, to the Company's Inspector. Inspection and tests performed or witnessed by Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests. Under


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no circumstances any action of the Company's Inspector shall relieve the Manufacturer of his responsibility for the material and quality of the bends.

As a minimum the following stages will be subject to witness/hold/review by the Purchaser's Inspector:

- Bend Manufacturing Procedure Qualification.
- Heat Treatment.
- Destructive Testing of Test Bends.
- Inspection of Radiographs and Other NDT Results.
- Material Certification Checks.
- Full Dimensional Checks.
- Pre-release Inspection.

Where inspection or testing is to be performed by certified testing laboratories, the Manufacturer shall submit their proposed testing laboratory for approval.

The final inspection, before issue of a release note for the Induction Bends, shall include material certificates, test certificates, surface treatment, dimensional conformity, heat treatment, tagging and packing conformity.

## 6.0 TEST CERTIFICATES

Manufacturer shall submit the following Certificates:

- Test certificates of chemical analysis, mechanical tests, heat treatment, NDT, dimensional inspection and hydrotest carried out on pipe used for fabrication of bend.

  These test certificates are not required when pipe is supplied as free issue by the Company.

- Certificates of non-destructive test/examination carried out on bends.

- Records of heat treatment, if carried out for bends.

- Certified reports of dimensional tolerance of bends.

- Certificates of all other tests as required in this specification.

The Certificates shall be valid only when signed by Company's Inspector. Only those bends which have been certified by Company's Inspector shall be dispatched from Manufacturer's works.

## 7.0 MARKING, PACKING & SHIPMENT

Packing, shipping and handling of all materials to be in accordance with the instructions in the RFQ and as per following:

- All bends shall be marked as per MSS SP-75.

- All loose and foreign material i.e. rust, grease, etc. shall be removed from inside and outside of the bends prior to packing.


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- A coat of antirust paint shall be applied on the bends for protection during transit and storage. Type of paint shall be as agreed upon with the Company.
- Both ends of all bends shall be suitably protected to avoid any damage during transit by means of metallic or high impact plastic bevel protectors.
- Bends shall be packed / crated or bundled for transportation or shipping to the agreed destination.

Package of bends shall be marked with following:

- Purchaser's Name.
- Order Number.
- Package Number.
- Size (Inches), Wall Thickness (mm)
- Bend Radius (mm).
- Manufacturer's Name and Place of Manufacture.
- Destination of dispatch.
- Any Additionally marking / shipping marks specified in Purchase order/MR.

In addition, each bend shall be paint stencilled with the same information in 25 mm (1 Inch) or larger letters on the inside surface within 150 mm (6 Inch) of each end.

## 8.0 DOCUMENTATION

Documentation to be submitted by Manufacturer to Company is summarized below. Number of Copies (Hard copies / soft copies etc.) shall be as indicated in CONTRACT document.

8.1 All documents shall be in English language.

8.2 At the time of bidding, bidder shall submit the following documents:

- Reference list of previous supplies of bends of similar specifications.
- Brief description of manufacturing including heat treatment and quality control facilities of the Manufacturer's Works.
- Brief description of manufacturing and quality control facilities of the Manufacturer's works.

8.3 Within two weeks of placement of order, the Manufacturer shall submit bend manufacturing procedure including manufacturing, inspection, testing procedures, quality control manual and quality plans.

The Bend Manufacturing Procedure shall detail the following, as a minimum:

- Sequence of operation


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- Induction forming process including bending temperature, temperature control, bending rate, cooling rate and cooling procedure;
- Temperature measurement and calibration
- Post bend heat treatment procedure including temperature and time.
- Dimensional control procedure
- Pipe material used for bend manufacture
- NDT procedures
- Quality Control and Quality Plans

Upon successful completion of the bend manufacturing procedure qualification as per Clause 9.0 of this specification, Manufacturer shall submit the qualified procedure to Company for approval. Regular production of bends shall commence only after the bend manufacturing procedure has been qualified and approved by Company.

Once the approval has been given by Company any change in material and method of manufacture and quality control shall be notified to Company whose approval in writing of all such changes shall be obtained before the bends are manufactured.

8.4 Within two weeks from the approval date, Manufacturer shall submit to Company the approved drawings, documents and specifications as listed in Clause 8.3 above.

8.5 Prior to shipment, the Manufacturer shall submit test certificates as listed in Clause 6.0 of this specification.

## 9.0 BEND MANUFACTURING PROCEDURE QUALIFICATION

9.1 Prior to start of production bending, Manufacturer shall demonstrate the suitability of the proposed manufacturing procedures for producing pipe bends including the post-bending heat cycle, that meet the requirements of this specification, by mechanically testing additional bend(s) (test bends). The bending procedure shall be qualified in the presence of Company Representative.

9.2 Test bends shall be made by using the pipe specified in Clause 2.0 of this specification. One test bend is required per 'heat lot' where a heat lot is deemed to include all bends of the same diameter, wall thickness, mill heat number and bend forming parameters such as, bending temperature, bending rate, cooling medium volume & heat treatment temperature (excluding bend angle). In case, line pipes are free issued from multiple heat lots, heat lot having maximum numbers of pipes shall be considered for fabrication of test bend. The test bend shall be bent to an angle of 90°.

### 9.3 Inspection and Testing of Bends

9.3.1 All finished test bends shall meet the requirement of dimensional tolerances, inspection and non-destructive testing requirements specified in Clause 4.0 and 5.0 of this specification.

9.3.2 In addition, all finished test bends shall be subjected to following mechanical testing to confirm that the bends manufactured meet all mechanical property requirements of


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Company line pipe specifications referred in Section 2.0 of this specification. Test procedure and acceptance criteria shall be in accordance with the Company line pipe specification referred in Section 2.0 of this specification. The test specimen shall be taken from the bent portion of the bend only.

**a. Tensile Test**

One tensile test shall be conducted on the base material of finished test bend, to establish yield strength, ultimate tensile strength and elongation. The specimen shall be taken longitudinal or transverse to the axis as specified in the relevant pipe specification. In case of bends of 450 mm (18") NB and larger, the specimen shall be taken at inside radius and one at outside radius of the bend.

**b. All Weld Tensile Test**

In case of bends fabricated from SAW pipes, an all weld tensile test shall be conducted to establish yield strength, ultimate tensile strength and elongation of weld material on bend.

c. **Guided Bend Test/Reverse Bend Test**

For bends manufactured from SAW pipes one face and one root guided bend test shall be performed. For bends manufactured from HFW pipes, reverse bend test shall be carried out. Test method and acceptance criteria shall be same as given in applicable pipe specification referred under clause 2.0 of this specification.

**d. Hardness Test**

Hardness testing shall be performed "through thickness" on a test ring removed from the middle of the bend. Four specimens shall be prepared one from each quadrant. In case of bends fabricated from SAW/HFW pipes, one specimen shall the have longitudinal weld seam in the middle. Hardness shall be checked for base metal, weld metal and HAZ. In addition, hardness test shall be performed at spots where dents, bulges or wrinkles have been formed on the bends.

**e. Fracture Toughness Test**

Charpy-V-notch test temperature shall be the same as specified in the relevant pipe specifications referred in Clause 2.0. Three base material specimens shall be taken longitudinal or transverse to the axis as specified in the relevant pipe specification. In case of bends fabricated from SAW and HFW pipes, three transverse weld material specimens shall be taken with weld in the middle. In case of bends of 450 mm (18") NB and larger, the base material specimens shall be taken at the outside radius of the bend. If multiple thicknesses are involved, testing shall be done on bend with maximum thickness.

**f. Hydrostatic test**

Bends shall be hydrostatically tested to test pressure that shall result in hoop stress Corresponding to 95% of SMYS of pipe material. Test pressure shall be calculated for minimum allowable thickness. Test pressure shall be held for a minimum period of fifteen (15) seconds.

Should test bends fail to comply with the above requirements, the bend manufacturing procedure shall be disqualified. The Manufacturer shall revise the manufacturing procedure and re-qualify the same at his own cost and time.


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Upon completion of the successful procedure qualification, manufacturer shall provide a written bending procedure for each test bend. The submitted procedure shall indicate in addition to the details as per Clause 8.3, tolerances on various controlling parameters.


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ENERGISING QUALITY

# VCS QUALITY SERVICES PVT. LTD.

## STANDARD SPECIFICATION
## FOR
## PIG TRAPS

### VPC – SS – PP - 2011

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| 03 | 28.01.2020 | MB | MC | AD | SK |
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| REVISION RECORD | | | | | | |
|---|---|---|---|---|---|---|
| **Rev.** | **Revision Date** | **Prepared by** | **Checked by** | **Approved by** | **Authorized by** | **Revision Description** |
| 00 | 23.06.2017 | | | | | ISSUED AS STANDARD SPECIFICATION |
| | | AS | SM | AD | SK | |
| 01 | 11.04.2018 | | | | | RE-ISSUED AS STANDARD SPECIFICATION |
| | | AS | MC | AD | SK | |
| 02 | 25.09.2019 | | | | | RE-ISSUED AS STANDARD SPECIFICATION |
| | | BS | MC | AD | SK | |
| 03 | 28.01.2020 | | | | | Document formatting, numbering updated from SS-PL-024 to VPC-PP-SS-2011 other detail update as marked |
| | | MB | MC | AD | SK | |


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## ABBREVIATIONS:

| | |
|---|---|
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| API | American Petroleum Institute |
| BHN | Brinell hardness number |
| HAZ | Heat Affected Zone |
| MSS-SP | Manufacturers Standardization Society - Standard Practice |
| RTJ | Ring Type Joint |
| SSPC | Steel Structures Painting Council |


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## 1.0 SCOPE

This specification covers the minimum requirements for design, manufacture, testing and supply of Pig launching and receiving traps to be installed in onshore pipeline systems transporting non-sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

## 2.0 REFERENCE DOCUMENTS

Fabrication, testing and supply of Pig traps shall comply with the applicable sections of the latest edition of the following codes and standards.

**AMERICAN PETROLEUM INSTITUTE (API)**

| | | |
|---|---|---|
| 5L | : | Specification For Line Pipe. |
| 1104 | : | Specification for Welding Pipelines and Related Facilities. |

**AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)**

| | | |
|---|---|---|
| B31.4 | : | Pipeline Transportation system for liquid Hydrocarbon & other liquids. |
| B 31.8 | : | Gas Transmission and Distribution Piping Systems. |
| B16.9 | : | Factory made Wrought Butt Weld Fittings. |
| B 16.25 | : | Butt Welding Ends. |
| BPVC Section VIII | : | Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels, Division 1. |
| BPVC Section IX | : | Welding and Brazing Qualifications. |
| BPVC Section V | : | Non-Destructive Examination. |
| B16.5 | : | Pipe Flanges and Flanged Fittings.. |
| B16.11 | : | Forged Steel Fittings, Socket-Welding and Threaded. |
| B16.20 | : | Metallic Gaskets for Pipe Flanges: Ring Joint, Spiral Wound and Jacketed. |
| B 16.47 | : | Large Diameter Steel Flanges. |

**MANUFACTURERS STANDARDIZATION SOCIETY (MSS)**

| | | |
|---|---|---|
| SP-75 | : | Specification for High Test Wrought Butt Welding Fittings. |
| SP-53 | : | Quality Standard for Steel Castings and Forgings |


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| | | |
|---|---|---|
| | | for Valves, Flanges and Fittings and Other Piping Components - Magnetic Particle Examination Method. |
| SP-44 | : | Steel Pipeline Flanges. |
| SP-97 | : | Integrally Reinforced Forged Branch outlet Fittings-Socket Welding, Threaded & Butt Welding Ends. |

**AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**

| | | |
|---|---|---|
| A370 | : | Standard Test Methods and Definitions for Mechanical Testing of Steel Products. |
| D709 | : | Laminated Thermosetting Material. |
| A-490 | : | Weather resistant High Strength Bolts, Nuts & Washers. |

**STEEL STRUCTURES PAINTING COUNCIL (SSPC)**

| | | |
|---|---|---|
| VIS-I | : | Visual Standard. |
| PC-10 | : | Sand Blast, Prime and Paint. |

**OIL INDUSTRY SAFETY DIRECTORATE (OISD)**

| | | |
|---|---|---|
| Std. 141 | : | Design and Construction Requirements for Cross Country Hydrocarbon Pipelines. |
| Std. 226 | : | Natural gas Transmission Pipelines and city gas distribution network. |
| Std 214 | : | Cross Country LPG Pipeline |

In case of conflict between various requirements of this specification and reference standards mentioned above, more stringent requirement shall apply unless otherwise agreed by Purchaser.

## 3.0 MATERIALS

3.1 Material of main components of Pig traps shall be as indicated in the Data Sheet. Material of Components not indicated in data sheets shall be as per Manufacturer's Standard (suitable for the service conditions indicated in Data Sheet) and shall be subject to approval by Company. In addition, the material shall also meet the requirements specified hereinafter.

3.2 All carbon steel used for fabrication of various components of Pig Traps shall be fully killed steel.

3.3 The carbon equivalent (CE) based on product analysis for each heat of steel calculated by the formula shall not exceed 0.45%.

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


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3.4 For Pig traps specified to be used for gas service or LPG Service, hardness test shall be carried out as per ASTM A370 for each heat of steel used in the manufacture of pressure containing parts of trap. A full thickness cross section shall be taken for this purpose. The maximum hardness of base metal, weld metal & HAZ of all the pressure containing parts shall not exceed 248 HV10. Hardness shall be recorded.

3.5 For Pig Trap Specified to be used for Gas Service or LPG Service. Charpy V-notch test shall be conducted on each heat of steel used in manufacturing of the pressure containing parts in accordance with ASTM A370. The specimens shall be taken in the direction of principal grain flow and notch perpendicular to original sample of plate or forging.

Charpy Impact test shall be carried out at -29°C temperature as stated in data sheet. If not stated in data sheet, the minimum average absorbed impact energy value of the set of three (3) full size specimen tested at 0°C shall be 27J. The minimum impact energy value of any one specimen of three specimen analyzed as above shall not be less than 22J.

In case of low temperature Carbon steel (LTCS) material specified in data sheet or offered manufacturers, the Charpy-V notch test requirement of applicable material standard shall be compiled with.

3.6 Non-metallic seal materials, if provided, shall be resistant to amine based corrosion inhibitors and explosive decompression.

3.7 The Manufacturer shall select materials as indicated in the data sheet along with the operating (Temperature/Pressure) parameters and in accordance with ASME B 31.4 / B 31.8, as applicable and ANSI B 16.25 for butt welding ends. Internal bore of weld joints shall not impede the pigging process or represent potential pig damage. The Manufacturer shall perform post weld heat treatment (PWHT) as/if required by the corresponding approved weld procedures. The Manufacturer shall prove by calculations to ASME VIII Division I that the material supplied satisfies the pressure/temperature rating as specified in data sheet.

## 4.0 DESIGN AND MANUFACTURE

### 4.1 GENERAL

a. The Pig traps shall be installed above ground and shall be suitable for handling all kinds of batching, gauging and cleaning pigs as well as intelligent pigs used for online Inspection of pipelines. Dimensions not shown specifically in the Data Sheet shall be as per manufacturer's standard and shall be subject to approval by Company.

b. Pig traps furnished under this specification shall be in compliance with the requirements of ASME B31.4/ B31.8, as applicable and OISD 141 / OISD 226/ OISD 214. In addition, design parameters indicated in the data sheets, shall be taken into account for design of scraper traps.

c. Pig traps shall be provided with quick opening end closure. Screwed type or plug-in types of end closures are not permitted. Quick end closure shall be designed, as per ASME Sec. VIII, Div. 1 with allowable stress level limits/design factor applicable for


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traps, for the design conditions indicated in the Data Sheet. Quality of welding shall be such that weld efficiency factor of 1.0 is achieved.

d. Quick opening closure manufactured by a third party shall comply with the requirements of this document and a name plate shall be affixed containing all pertinent manufacturers' information. Any removable segments of the quick opening closure shall have similar markings.

The quick opening end closure shall be of clamp ring/band-lock type or equivalent design and shall consists of a safety pressure release system allowing the opening only when there is no pressure in the trap. End closure shall be hand operated by a single lever operation and operable by one operator. End closures of size NB 600 (24") and above shall be fitted with worm gear operator for the opening of the closure. Hinge of the closure shall be so designed that the weight of the end closure is fully supported without sagging. Screwed type or plug-in type of end closures are not permitted.

e. Design factor and corrosion allowance as indicated in data sheet shall be considered in design of wall thickness for all related materials and quick opening end closures.

f. Minimum dimensions (diameter, wall thickness, length, location etc.) of the Pig trap body, neck and other appurtenances, shall be as indicated in the data sheets. Manufacturer shall verify suitability of indicated information and dimensions according to his requirements. Any alternate shall be clearly presented in the Manufacturers bid package. Subsequent revisions shall require Purchaser approvals.

g. Piping fittings used in fabrication of Pig trap shall be as per following:

| | |
|---|---|
| Size up to and including DN 40 (1½") | : Forged, Seamless as per ASME B 16.11. |
| Size DN 50 (2") to DN 400 (16") | : Forged, Seamless fittings as per ASME B 16.9. |
| Size DN 450 (18") and above | : Forged, Welded fittings as per MSS-SP-75. |
| All Integrally Reinforced Branch Outlet Fittings | : Forged, seamless as per MSS-SP-97. |

All Pig Trap branch connections/ end connection shall be in accordance with the data sheet information. Flanged ends, when specified, shall conform to ASME B 16.5 for size up to DN 600 (24") excluding 22" and MSS-SP-44 /ASME B 16.47, Series A for size DN 550 mm (22") and for DN 650 (26") & above. Flanges shall have raised face as unless otherwise indicated in data sheets.

Flange face shall be either raised face or ring joint type (RTJ) as indicated in Data Sheet. Flange face finish shall be serrated or smooth as indicated in Data Sheet. In case of RTJ flanges, the groove hardness shall be minimum 140 BHN.


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Butt weld ends, if specified, shall have ends prepared as per ASME B 16.25. However, end preparation for butt-welding ends having unequal thicknesses with respect to connecting pipe shall be as per ASME B31.4/ ASME B31.8, as applicable. Generally branch connections shall be orientated as follows:

- Drains - bottom of pig trap.
- Vents, pressure gauges, pig signaler - top of pig trap.
- Kicker line, balance line, bypass line - side (or possibly top quadrant) of pig trap. Not bottom of pig trap.
- The diameter of all branch connections shall be 2 inches minimum.
- Pig signaler connection when required to be welded as per data sheet.
- Pressure indicator connections shall be installed on the major barrel near the end closure and on the minor barrel near the pig trap valve.

h. Connection for pig signaller shall be provided in accordance with the data sheet. Manufacturer to provide details of the proposed pig signaller for Purchaser approvals. Installed assembly to be part of the hydro test factory testing. Functionality testing to be completed prior to shipping.

i. All Pig traps shall be provided with fabricated steel supports, minimum two numbers at suitable spacing shall be provided with traps for mounting on concrete foundation with an inset plate. The Pig trap supports under the barrel and the neck at the major foundations shall be welded to the trap in accordance with the requirements of this specification prior to final testing. The trap assemblies are to be installed unrestrained in a longitudinal direction, and be able to compensate for expansion of the unrestrained part of the pipeline through these supports.These supports will not be subjected to pipeline anchorage forces and shall be free sliding supports. The Manufacturer to provide details of slide plate design for Purchaser approval. Support base plate shall not have any holes. No foundation bolts shall be supplied. The material of support shall be compatible with trap material for welding purposes. All welds shall be examined by magnetic particle method.

Permanent supports shall be used to fully support and restrain the pig traps throughout their length and these shall be designed to carry the weight of the pig trap system filled with water.

## 4.2 PIG HANDLING

Manufacturer is responsible for designing and supplying a self-contained Pipeline Inspection Gauge (PIG) handling system complete with, baskets/trays, PIG insertion/ retraction devices, supports and rail tracks etc. with the Pig trap assembly. The handling requirements are for the nominal pipeline sizes as specified in data sheets.

The material used in the design of the pig handling system shall be ASTM A36 or equivalent structural steel.

All moving parts of the pig handling system, such as filter basket shall be manufactured from non-sparking materials.


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Each Pig Launcher / Receiver shall be provided with suitable Pig Handling System for either inserting the pig into the launcher, or retracting the pig from the receiver.

The pig handling facility, as required in the data sheet, shall consist of the following, as a minimum:

- Perforated filtering basket mounted on wheels / rails or PTFE slides.
- Fabricated trolley support cradle frame for the perforated basket.
- Beam / manual winch to push / pull the basket for insertion and retrieval of pigs.

The pig receiving traps shall be equipped with a half internal removable filtering basket consisting of a punched plate with at least five rows of drain holes. The filtering basket shall slide on guides/rails or wheels and in all cases the material of the parts being in contact with each other shall be of anti-spark type. The filtering basket shall be provided with suitable stops. Lock bracket shall be provided to such that the basket does not slide within the trap. Rear end of the basket shall be provided with suitable lug to enable retrieval of the basket by hooks. The handling system (for inserting and retracting the scraper and instrumented pigs from the trap) shall be complete with handling devices. In case any rails are required for sliding of the handling system, the same shall be provided by the scraper trap manufacturer.

## 4.3 MANUFACTURE

### 4.3.1 GENERAL

Pig traps shall be fabricated in accordance with drawings approved by Purchaser. The pipeline connection with the pig trap assembly will be a welded end.

The trap reducers, to be welded between neck and body of pig traps, shall have transition from one diameter to other by constant slope (not ‘bell’ shaped as per ASME B16.9).The Manufacturer may fabricate the reducers from steel plate.

Concentric or eccentric reducer used in the manufacture of traps shall be seamless type for sizes upto and including NPS 16 and welded type for sizes NPS 18 and above. Reducers shall conform to ASME B 16.9/ MSS-SP-75 as indicated in the data sheet. End thicknesses of reducer shall match with the adjoining body/ neck thickness.

Connections for vents and drains shall be provided on each trap. Sizes for vents and drains shall be as indicated in Data Sheet. The traps shall be provided with a suitable slope and the drain location shall be such that complete drainage of the trap is possible.

All branch connections shall be made by weldolet/ nippolet/ sockolet or by extrusion as indicated in Scraper Trap Data Sheet. All weldolets shall conform to MSS-SP-97 and all nippolets shall be as per Manufacturer's Standard. The extruded openings shall be adequately heat-treated and stress relieved.

Stub-in or pipe-to-pipe connection shall not be used for making branch connections.

All inside weld beads shall be ground smooth.

The tolerance on internal diameter and out of roundness at the ends for the welding end of the


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neck (at the end where connecting pipeline will be welded) shall be as per applicable connected pipe specification as indicated in the Data Sheet.

Circumferential weld on the body and on neck is not permitted, the welding necessary to join the individual metal sections (body, neck, reducer etc).

4.3.2 WELDING

All welding shall be carried out by welders and welding procedure qualified in accordance with ASME Section IX. The procedure qualification shall also include hardness & impact test when required as per clause 3.4 & 3.5 this specification and shall meet the requirements as specified therein.

No repairs by welding shall be carried out on base metal. Manufacturer shall obtain Purchaser approval prior to carrying out any repair of welds. Repair welding shall be carried out by welders and welding procedures duly qualified as per ASME Sec IX and records for each repair shall be maintained.

The repair welding procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 and 3.5 of this specification and shall meet the requirements as specified therein. Radiography and heat treatment shall be repeated after the weld repair.

All pressure containing welds, except for size DN 40 and below, made for fabrication of Pig traps shall be butt welds. Socket welds shall be permitted for size DN 40 and below only.

All weld ends shall be checked for surface defects using dye penetrate prior to welding.

4.3.3 STRESS RELIEVING

When required as per provisions of the design codes, complete pig trap assembly shall be stress relieved after fabrication. Stress relieving shall also be carried out when branch openings are made by extrusion process.

4.3.4 FABRICATION

The pig handling facilities frame will be of fully welded construction and shall be manually operated. All steel parts of the pig handling system shall be hot dip galvanized.

## 5.0 INSPECTION AND TESTS

The Manufacturer shall ensure all equipment used for testing and inspection purposes is calibrated and certified accordingly. The Manufacturer shall record all inspection and testing activity on the appropriate inspection certificate. The following inspection and testing shall be carried out prior to painting, marking and shipment of pig traps.

The manufacturer shall perform all inspection and tests as per the requirements of this specification and the relevant codes, standards and specifications, prior to shipment at his works. Such inspections and tests shall be, but not limited to, the following:


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## 5.1 TESTING OF MATERIALS

Chemical composition and mechanical tests including yield strength, ultimate tensile strength, impact test, elongation and hardness shall be carried out for each heat of steel used as per the applicable standard as referred to in this specification.

Chemical composition and mechanical properties shall be checked as per relevant material standards and this specification, for each heat of steel used.

## 5.2 VISUAL INSPECTION AND DIMENSIONAL CHECK

All pig traps shall be visually inspected for visible surface defects. The internal and external surfaces of the scraper traps shall be free from any strikes, gouges and other detrimental defects. Bevels at butt weld ends shall show a smooth contour. All dimensions shall be checked for conformance with Company approved drawings.

## 5.3 NON-DESTRUCTIVE EXAMINATION

a. All butt welds shall be 100% radiographically inspected. Procedure and acceptance criteria shall be as per API 1104.
b. All forgings shall be wet magnetic particle examined on 100% of the forged surfaces. Method and acceptance shall comply with MSS-SP-53.
c. Any other weld that, in Purchaser's opinion, cannot be radiographed, shall be inspected by ultrasonic or magnetic particle methods. Procedure & acceptance criteria shall be as per ASME Section VIII Appendix 12 and Appendix VI respectively. Root pass of closure weld shall also be examined by magnetic particle inspection method.
d. All finished wrought weld ends shall be 100% ultrasonically inspected for lamination type defects for a distance of 50mm from the end. Any laminations larger than 6.35 mm shall not be acceptable.

**5.4** Company's Inspector reserves the right to perform stage wise inspection and witness tests, including hydrostatic test, as indicated in specification at Manufacturer's Works prior to shipment. Manufacturer shall give reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection, to the Company's Inspector.

Inspection and tests performed/witnessed by Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspections and tests and of specific integrity of the pig traps.

## 5.5 HYDROSTATIC TESTING

A hydrostatic test shall be carried out on each pig trap complete in all respects, including welding of quick opening end closure and pig signaller (if applicable). The test pressure as indicated in data sheets shall be held for a period of 1 hour and the assembly visually inspected for leaks. Any pressure changes must correspond with temperature changes otherwise the test will not be acceptable. Test records to be maintained accordingly by Manufacturer.

## 5.6 FUNCTIONAL TEST

A minimum of two closing and opening cycles shall be performed and correct operation of both


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quick opening closure and safety system shall be ascertained.

## 6.0 PAINTING

### 6.1 SURFACE PREPARATION

After all inspection and tests required have been carried out; all external surfaces shall be thoroughly cleaned to remove grease, dust and rust. Surface preparation shall be carried out by shot blasting to SP-10 in accordance with "Steel Structures Painting Council Visual Standard-SSPC-VIS-1"..

### 6.2 PAINTING

Machined parts shall be coated with anti-rust removable paint and non machined parts shall be applied with two coats of protective paint. Manufacturer shall indicate the type of paint used in the drawings submitted for approval. The Manufacturer to provide paint procedure for approval prior to manufacture.

## 7.0 MARKING

Marking shall be done on a stainless steel plate and affixed to the trap body by means of corrosion resistant fasteners. Marking shall include the following:

- Manufacturer's Name
- Trap/Neck diameter, thickness
- Material
- ASME Class Rating
- Tag Number
- Design Pressure & Design Temperature
- Year of manufacture
- Empty & hydrotest weight of the trap assembly.

## 8.0 TEST CERTIFICATES

Manufacturer shall furnish the following certificates:

a. Test certificates relevant to the chemical and mechanical properties of the materials used for manufacture of trap as per relevant standards and this specification.

b. Hydrostatic test certificates.

c. Test Reports on radiography, ultrasonic inspection and magnetic particle examination.

d. Test Reports on heat treatment carried out, if any.

e. Welding procedures and welders qualification reports.

The certificates shall be considered valid only when signed by Company's Inspector. Only those traps which have been inspected and certified by the Company's Inspector shall be dispatched from Manufacturer's works.


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## 9.0 PACKING & SHIPPING

Before shipment, traps shall be properly packed against damage during transportation. All traps shall be provided with suitable protectors for flange faces. All butt weld ends shall be suitably protected to avoid any damage during transit by means of metallic or high impact plastic bevel protectors. All machined surfaces subject to corrosion during transit shall be well protected by coat of grease or other suitable material

All pig traps shall be cleaned from inside of all foreign materials, grease, rust etc prior to packing. Prior to shipment, parts and equipment which have bare metallic surfaces shall be protected with a rust preventative which will provide protection at temperatures up to 50$^{o}$C. Sealing surfaces and moving parts to have a graphite grease coating applied.

## 10.0 SPARES

Manufacturer shall furnish list of recommended spares and accessories required during start-up and commissioning (with special attention to consumable items such as gaskets, seals, etc. for end closure) and supply of such spares shall be included in the price quoted by Manufacturer.

Manufacturer shall furnish list of recommended spares and accessories and special tools required for two years of normal operation and maintenance of the traps and price for such spares shall be quoted separately.

## 11.0 CERTIFICATION

All Certification of finished product shall be EN 10204 type 3.2.

## 12.0 DOCUMENTATION

Documentation to be submitted by Manufacturer to Company is summarized below. Number of Copies (Hard copies / soft copies etc.) shall be as indicated in CONTRACT document

12.1 At the time of bidding, Manufacturer shall submit the following documents:

a. General arrangement drawing of scraper trap, quick opening end closure and pig signallers with overall dimensions and list of spares as per clause no. 10.0.
b. Reference list of similar supplies for the past five years including project, client, year of supply, client, location, size, rating, service and contact person.

12.2 After placement of order, the Manufacturer shall submit the following drawings, documents and specifications for company's information & review:

a. Trap assembly and sectional drawings showing all parts and accessories with materials and dimensions.
b. Support Assembly drawing. Hydrotest load on both the supports of the Scraper Trap.
c. Arrangement & details of foundation bolts for pig handling and lifting system, where applicable.


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12.3 Prior to shipment, the Manufacturer shall submit the following:

a. Test certificates as listed in clause 8.0 of this specification.

b. Manual for installation, erection instructions, maintenance and operations instructions including a list of recommended spares for the scraper traps.

12.4 Final drawings/ documents as indicated in clause no. 12.2 above shall be submitted in soft format also.

12.5 All documents shall be in English Language only.


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ENERGISING QUALITY

# VCS Quality Services Pvt. Ltd.

## STANDARD SPECIFICATION
## FOR
## FLANGES AND WELDED FITTINGS
## {SIZE DN 450MM (18”) AND ABOVE}

## VPC – SS – PP -2023

| | | | | | |
|---|---|---|---|---|---|
| 01 | 27.01.2022 | SR | MC | HK | GW |
| **Rev. No** | **Date** | **Prepared By** | **Checked By** | **Approved By** | **Authorized By** |

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| REVISION RECORD | | | | | | |
|---|---|---|---|---|---|---|
| **Rev.** | **Revision Date** | **Prepared by** | **Checked by** | **Approved by** | **Authorized by** | **Revision Description** |
| 00 | 28.01.2020 | | | | | |
| | | MB | MC | AD | SK | |
| 01 | 27.01.2022 | | | | | VCS QMS Integration |
| | | SR | MC | HK | GW | |
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## ABBREVIATIONS:

| | |
|---|---|
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| API | American Petroleum Institute |
| BHN | Brinell hardness number |
| HAZ | Heat Affected Zone |
| MSS-SP | Manufacturers Standardization Society - Standard Practice |
| RTJ | Ring Type Joint |
| SSPC | Steel Structures Painting Council |
| CE | Carbon Equivalent |
| LTCS | Low Temperature Carbon Steel |
| LPG | Liquefied Petroleum Gas |


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## 1.0 SCOPE

This Technical specification specifies the minimum requirements for the design, manufacture and supply of carbon steel flanges such as welding neck flanges, blind flanges, spectacle blinds, spacers and blind etc and welded fittings such as tees, elbows, reducers, caps, outlets etc of size DN 450 mm (18") and above to be installed in onshore pipeline systems handling non-sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

## 2.0 REFERENCE DOCUMENTS

Reference has been made in this specification to the latest edition (edition in force at the time of issue of enquiry unless specified otherwise) of the following Codes, Standards and Specification.

**AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)**

| | | |
|---|---|---|
| B31.3 | : | Process Piping. |
| B31.4 Slurries | : | Pipeline Transportation system for liquids and . |
| B 31.8 | : | Gas Transmission and Distribution Piping Systems. |
| B16.5 | : | Pipe Flanges and Flanged Fitting. |
| B16.9 | : | Factory made Wrought Butt Weld Fittings. |
| B 16.25 | : | Butt Welding Ends. |
| B 16.47 | : | Large Diameter Steel Flanges. |
| B 16.48 | : | Steel Line Blanks. |
| Section VIII | : | Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels. |
| Section IX | : | Welding and Brazing Qualifications. |

**AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**

| | | |
|---|---|---|
| A370 | : | Standard Test Methods and Definitions for Mechanical Testing of Steel Products. |

**MANUFACTURERS STANDARDIZATION SOCIETY (MSS)**

| | | |
|---|---|---|
| SP-25 | : | Standard Marking System for Valves, Fittings, Flanges and Unions. |
| SP-75 | : | Specification for High Test Wrought Butt Welding Fittings. |
| SP-97 | : | Forged Carbon Steel Branch Outlet Fittings- Socket Welding, Threaded and Butt Welding Ends. |

In case of conflict between various requirements of this specification and the requirements of above referred Codes and Standards, more stringent requirement shall apply unless otherwise agreed by Purchaser.


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## 3.0 MATERIALS

The Material of flanges & fittings shall be as indicated in purchase requisition. In addition, the material shall also meet the requirements specified hereinafter.

**3.1** The Carbon Steel used for the manufacture of flanges and fittings shall be fully killed.

**3.2** The carbon equivalent (CE) shall not exceeding 0.45, based on check analysis calculated in accordance with following.

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

**3.3** For flanges and fittings specified to be used for gas service or LPG service, Charpy V-notch test shall be conducted on each heat of steel. Unless specified otherwise, the Charpy V-notch test shall be conducted at $0^0$C in accordance with the impact test provisions of ASTM A 370 for flanges and MSS-SP-75 for all fittings.

The average absorbed impact energy values of three full-sized specimens shall be 27 joules. The minimum impact energy value of any one specimen of the three specimens analyzed as above shall not be less than 22 Joules.
When Low Temperature Carbon Steel (LTCS) materials are specified for flanges and fittings in Purchase Requisition, the Charpy V-notch test requirements of applicable material standard shall be complied with.

**3.4** For flanges and fittings specified to be used for Gas service or LPG service, Hardness test shall be carried out as per ASTM A 370 for each heat of steel used. A full thickness cross section shall be taken for this purpose and the maximum hardness of base metal, Weld metal and heat affected zone shall not exceed 248 $HV_{10}$. Hardness testing shall cover at least 10% per item, per size, per heat, per manufacturing method.

**3.5** In case of RTJ (Ring Type Joint) flanges, the groove hardness shall be minimum 140 BHN. Ring Joint flanges shall have octagonal section of Ring joint

## 4.0 DESIGN AND MANUFACTURE

**4.1** Flanges such as weld neck flanges and blind flanges shall conform to the requirements of ASME B 16.5 up to sizes DN 600mm (24") excluding DN 550mm (22"), and MSS-SP-44 for sizes DN 550mm (22") and ASME B 16.47 (series A) for sizes DN 650 mm (26") and above.

**4.2** Type, face and finish of flanges shall be as specified in Purchase Requisition. The interpretation of range of face finish shall be as follows:

| | | |
|---|---|---|
| Serrated Finish/125 AARH | : | Serration with 125 to 250μ in AARH. |
| 63 AARH | : | 32 to 63μ in AARH. |

**4.3** Spectacle blind and spacer & blind shall conform to the requirements of ASME B 16.48 up to sizes DN 600 mm (24"). For sizes DN 650 mm (26") and above, spectacle blind and spacer & blind shall conform to Manufacturer's standard.

**4.4** Flanges manufactured from bar stock are not acceptable.

**4.5** Fittings such as tees, elbows, reducers, etc. shall be either welded or seamless type. All fittings (except weldolets) shall comply with the requirements of MSS- SP-75. Fittings such as weldolets etc. shall be manufactured in accordance with MSS-SP-97.

**4.6** For reducing butt weld fittings having different wall thickness at each end, the


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greater thickness shall be used for fabrication of fittings. The ends shall match to suit respective thickness.

**4.7** Tees shall be manufactured by forging or extrusion method. Stub-in or pipe to pipe connection shall not be used in the manufacture of tees. The longitudinal weld seam shall be kept at 90 degree from the extrusion. Fittings shall not have circumferential weld joint.

**4.8** All butt weld ends shall be beveled as per ASME B 16.5/MSS-SP-44/ASME B 16.47 as applicable for flanges and MSS-SP-75/MSS-SP-97 as applicable for fittings.

**4.9** All welds shall be made by welders and welding procedures qualified in accordance with provision of ASME Sec. IX. The procedures qualification shall include Charpy V-notch test for weld/heat affected zone and hardness test in accordance with clause 3.3 and 3.4 of this specification respectively.

**4.10** Inside weld projection for welded fittings shall not exceed 1.6 mm. The reinforcement of inside weld seam shall be removed for a distance of 100 mm from each end of welded fittings.

**4.11** The tolerance on internal diameter and out of roundness at the ends for welded fittings shall be as per connected pipe specification/as indicated in Material Requisition.

**4.12** Repair by welding on flanges and parent metal of fittings is not permitted. Repair of weld seam by welding shall be carried out by welders and welding procedures duly qualified as per ASME Section IX and records for each repair shall be maintained. Repair welding procedure qualification shall include all tests, which are applicable for regular production welding procedure qualification.

## 5.0 INSPECTION AND TESTS

The Manufacturer shall perform all inspections and tests in accordance with the requirements of this specification and the relevant codes, at his works, prior to shipment. Such inspection and testing shall include, but not be limited to, the following:

### 5.1 TESTING OF MATERIALS

Chemical composition and mechanical tests including yield strength, ultimate tensile strength, impact test, elongation and hardness shall be carried out for each heat of steel used as per the applicable standard as referred to in this specification.

### 5.2 VISUAL INSPECTION AND DIMENSIONAL CHECK

All flanges and fittings shall be visually inspected. The internal and external surface of the flanges and fittings shall be free from any strikes, gauges and other detrimental defects.

Dimensional checks shall be carried out on finished products as per ASME B 16.5/MSS-SP-44/ASME B 16.47(Series A) as applicable for flanges, ASME B 16.48 for spacers and blinds and ASME B 16.9/MSS-SP-75/MSS-SP-97 as applicable for fittings and as per this specification.

### 5.3 NON-DESTRUCTIVE EXAMINATION

The non-destructive inspection shall be carried out as given below:

a. All butt and repair welds for welded fittings shall be examined 100% by radiography. Acceptance criteria shall be as be ASME B 31.4 or ASME B 31.8 as applicable and API 1104.


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b. All finished wrought weld ends subject to welding in field, shall be 100% tested for lamination type defects by ultrasonic test. Any lamination larger than 6.35 mm shall not be acceptable.

c. When elbows of sizes ≥ DN 450 mm (18”) are manufactured, the first elbow of each radius, diameter and wall thickness shall be ultrasonically checked for sufficient wall thickness in areas where a minimum wall thickness is to be expected. This shall be followed by random inspection of one out of every three elbows of the same radius, diameter and wall thickness.

d. Welds, which cannot be inspected by radiographic methods, shall be checked by ultrasonic or magnetic particle methods. Acceptance criteria shall be as per ASME Section VIII Appendix 12 and appendix 6 respectively.

e. Magnetic particle or liquid penetrate examination shall be performed on cold formed butt welding tees with extruded outlets (that are subjected to an extreme fiber elongation of greater than 5% as per the supplementary requirement SR 3 of MSS-SP-75.

**5.4** The Purchaser reserves the right to perform stage wise inspection and witness tests as indicated above, at the Manufacturer's works, prior to shipment. The Manufacturer shall give reasonable notice of date and time for such inspection and shall provide reasonable access and facilities required for inspection, to the Purchaser’s Inspector. The Purchaser reserves the right to require additional testing, at any time, to confirm or further investigate a suspected fault. All costs incurred shall be for the Manufacturer’s account. In no case shall any action of the Purchaser, or his Inspector, relieve the Manufacturer of his responsibility for material, design, quality, or Performance of the materials concerned. Inspection and tests performed/witnessed by the Purchaser's Inspector shall in no way relieve the Manufacturer of his obligation to perform the required inspection and tests.

## 6.0 PAINTING

Once all inspection and test have been carried out all external surface shall be thoroughly cleaned to remove grease, dust & rust. Standard mill coating shall be applied on external surface to protect against corrosion during transmit and storage. The coating shall be removable type in field.

## 7.0 MARKING

All Flanges & fittings shall be stamped with the requirements of applicable dimensional manufacturing standard. The marking shall also include following:

- PO Number.
- Item Code.

## 8.0 TEST CERTIFICATES

Manufacture who intends bidding for fittings must possess the records of a successful proof test, in accordance with the provision of ASME 16.9/MSS-SP-75,as applicable.
Manufacturer shall furnish the following certificates:

- Test certificates relevant to the chemical analysis and mechanical properties, including hardness of the materials used for manufacture of flanges and fittings in accordance with the requirement of relevant standards and this specification.
- Test reports on radiography, ultrasonic and magnetic particle examination.
- Test reports of heat treatment carried out as per the specification.
- Welding procedures and welders qualification reports.


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- Certificates for each fitting stating that it is capable of withstanding without leakage a test pressure, which results in a hoop stress equivalent to 100% of the specified minimum yield strength for the pipe with which the fitting is to be attached without impairment of serviceability.

## 9.0 PACKING & SHIPPING

Ends of all fittings and weld neck flanges shall be suitable protected to avoid any damage during transit. Metallic or high impact plastic bevel protected shall be provided for flanges and fittings. Flanges face shall be suitably protected to avoid any damage during transit.

## 10.0 DOCUMENTATION

The Manufacturer shall supply documentation in accordance with the Vendor Data Requirements List (VDRL) as attached with Purchase Order.


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Energising Quality

# VCS Quality Services Pvt. Ltd.

# STANDARD SPECIFICATION
# FOR
# PRESSURE SAFETY RELIEF VALVE

## VCS-SS-IN-5504_02

| Rev. No | Date | Prepared By | Checked By | Approved By | Authorized By |
|---|---|---|---|---|---|
| 02 | 11.05.2022 | AK | AS | SV | KNC |
| 01 | 18.01.2020 | DG | VB | KNC | AD |
| 00 | 23.05.2018 | ND | UM | KP | AD |

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## REVISION RECORD

| Rev. | Revision Date | Prepared by | Checked by | Approved by | Authorized by | Revision Description |
|---|---|---|---|---|---|---|
| 00 | 23.05.2018 | Neha Dev | Udit Manichanda | K.Prasanth | Anupam Das | |
| 01 | 18.01.2020 | | | | | Format change and document numbering is revised. |
| | | Debayan Ghoshal | Vinod Babu | Kedarnath Chakraborty | Anupam Das | |
| 02 | 11.05.2022 | | | | | VCS QMS Integration |
| | | Amita Kumari | Anmol Saxena | Sarita Verma | Kedarnath Chakraborty | |
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## ABBREVIATION

| | |
|---|---|
| AARH | Arithmetic Average Roughness Height |
| ANSI | American National Standards Institute |
| API | American Petroleum Institute |
| ASME | American Society of Mechanical Engineers |
| FAT | Factory Acceptance Test |
| IBR | Factory Acceptance Test |
| ISO | International Organization for Standardization |
| MOP | Maximum Operating Pressure |
| NACE | National Association of Corrosion Engineers |
| NPS | Nominal Pipe Size |
| NPT | Nominal Pipe Thread |
| PSV | Pressure Safety Relief Valve |
| SAT | Site Acceptance Test |
| Sec | Section |


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# 1 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of Pressure Safety Relief Valves along with its accessories.

# 2 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

| | |
|---|---|
| Owner/ Purchaser/ Company | Owner of the particular Project (Project Specific). |
| Consultant | The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management. |
| Bidder/ Manufacturer / Supplier / Vendor | The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor. |
| Works/ Shop | The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser. |
| Datasheet | Technical data provided by the Purchaser / Owner / Company. |
| Standard Specification | Specifications Developed as Standard by the Company. |
| Job Specification | Specifications Developed pertaining to particular project / Job in regard. |
| Material Requisition | Requisition as raised to Supplier for Quotation of the item |
| Purchase Requisition | Requisition as raised to Supplier for Procurement of the item |
| Purchase Order | Legal Order supplied to Supplier for procurement of the Engineered Item |
| Site | The work place where the equipment is installed and commissioned. |

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# 3 REFERENCE DOCUMENTS

## 3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

**American National Standard Institute (ANSI) / American Society of Mechanical Engineers (ASME)**

| | |
|---|---|
| B1.20.1 | Pipe Threads |
| B 16.5 | Steel Pipe Flanges and Flanged Fitting |
| B 16.20 | Ring Joint Gaskets and Grooves for Steel Pipe Flanges |
| B 16.34 | Valves- Flanged, Threaded and Welding End |

**American Society of Mechanical Engineers (ASME)**

| | |
|---|---|
| Sec-VIII | Boiler and Pressure Vessel Code Section VIII 'Pressure Vessels' |
| Sec-I | Boiler and Pressure Vessel Code Section-I 'Power Boilers' |

**American Petroleum Institute (API)**

| | |
|---|---|
| API-520 | Sizing, selection and installation of pressure relieving devices in refineries<br>Part I Sizing & Selection<br>Part II Installation |
| API-521 | Guide for Pressure Relieving and Depressurizing systems |
| API-526 | Flanged Steel Pressure Relief Valves |
| API-527 | Seat Tightness of Pressure Relief Valves |
| EN10204 | Inspection Documents for Metallic Products |
| IBR | Indian Boiler Regulations |

## 3.2 Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

a. Data sheets

b. Job Specifications

c. Standard Specifications

d. Codes and Standards

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Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

# 4 MATERIALS

Materials selected shall be in accordance with the Data Sheets and Standard Specifications. For corrosion service the material selected shall be in compliance with the requirements of NACE MR-0175 / IS0-15156 latest editions.

# 5 DESIGN

## 5.1 Valve Design

5.1.1 The definitions of various terminologies used in Purchaser's Data Sheets are as per clause 1.2 of API RP 520 PART 1.

The design of pressure relief valves in steam service under IBR design code shall be governed by regulation 294 and regulation 295 of IBR. However where design code is specifically indicated as ASME SECTION-I, the valve design shall meet the pressure safety relief valve requirements specified in ASME SECTION-I.

Adequate support of relief valves shall be provided, since they are subjected to high reaction forces when they are relieving.

The Valve body, end connections shall be of the same material as the piping material Specification. The body and internal material shall meet the design temperature. Material selection should be in accordance with API STANDARD 526.

Pressure loss between the equipment / vessel nozzles and the inlet of the Valve shall not exceed 3% of the Valve set pressure.

## 5.2 Type and Selection of Safety Relief Valve

Safety Valves shall be primarily used for Compressible fluids and Safety Relief Valves shall be used for incompressible fluids.

Unless otherwise specified, the Safety Relief Valves shall be non-balanced closed bonnet direct spring-loaded type, i.e. conventional. For special applications pilot operated Safety / Relief Valves or air-assisted Relief Valves may be employed. Safety Valve sizing shall be as per API 520 and the allowable accumulation shall be as per ASME CODE. The Valve sizes, inlet/outlet connections, orifice area shall be sized as per API 526. The range of standard sizes used and the set pressure limits shall be sized in accordance with standard API 526.

The orifice designations, materials, area, end connection sizes and rating shall be as per API RP 526 for flanged steel Safety Relief Valves. Seat tightness requirements and testing shall be as per API RP 527.

Set pressure and accumulation pressure shall be as per the applicable pressure vessel design code:

| | |
|---|---|
| ASME section VIII | Pressure Vessels |
| ASME section I | Power boilers / Steam generators |

Generally the Thermal Relief Valve shall be modified or semi-nozzle type. Thermal Relief Valves shall have an orifice area of 0.11 Sq. in. and minimum size shall be 101 unless otherwise specified.

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Where a number of Relief Valves are provided in parallel, the set pressures may be staggered to avoid valve chatter.

The criteria for the selection of a Relief Valve shall be as given below:

### 5.2.1 Conventional Safety Relief Valve

The Blow down shall not exceed 3% of the valve set pressure as per standard ASME SECTION I and shall not exceed 7% of the valve set pressure as per standard ASME SECTION VIII.

**a. Non-balanced spring-loaded relief valves**

A conventional Pressure Safety Relief Valve shall be a self-actuated spring loaded Pressure Safety Relief Valve which shall be designed to open at a pre-determined pressure and protect a vessel or system from excess pressure by removing or relieving fluid from that vessel or system.

i. A conventional Safety/Relief Valve shall be used in the following cases:

ii. Back pressure (super-imposed and built-up) is constant.

iii. Superimposed back pressure is less than 5% and built-up back pressure is less than 10% of the set pressure with overpressure at 10%.

iv. Superimposed back pressure is less than 10% and built-up back pressure is less than 20% of the set pressure with accumulation at 21%.

For cases where a constant back pressure is exerted, the spring of the Safety Relief Valve should be selected and set for the difference between the set pressure (being the maximum allowable working pressure) and the constant back pressure. Spring-loaded Relief Valves connected to a closed discharge system shall always have a closed Bonnet.

Blow down ring shall be provided to adjust the blow down line within 2.5% to 7% of the Valve set pressure.

**b. Non-balanced spring-loaded relief valves**

A balanced Pressure Safety Relief Valve shall be a spring loaded Pressure Safety /Relief Valve which incorporates a bellows or other means of balancing the Valve disc to minimize the effects of back pressure on the performance characteristics of the Valve.

A balanced type of Safety/Relief Valve shall be provided when the variable back pressure (gauge) is higher than allowed for a conventional Valve.

The maximum superimposed and built-up back pressure (gauge) shall not exceed 65 % (Preferably 50%) of the set pressure (gauge) for relief of vapors or flashing liquids.

Safety/Relief Valves of the balanced type shall have a vented bonnet which shall be vented to atmosphere in such a manner as to prevent the ingress of rain and dirt. Hazards to personnel should be avoided. However, any flow from the vent should be visible.

Whenever the balanced bellow spring type Valve is used, there is always a potential risk of bellow rupture or damage. In such applications, the Valve with supplementary piston shall be provided. The outlet Valve line size shall be large enough to accommodate the internal drain or in case of the balanced bellow spring type Valve, the vent shall be directly routed to the flare atmosphere.

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### 5.2.2 Pilot – Operated Relief Valve

Pilot Design shall be inherently fail safe. Self-actuated Pilot operated Valves shall be of pop / modulating action and it shall be supplied with main Valve and pilot Valve completely piped and tubed along with other accessories specified such as back-flow preventer. Pilot-operated Safety Relief Valves may be used in a clean gas or liquid service where proper operation of the pilot Valve is always assured, provided that, where required, permission has been obtained from local authorities. The pilot Valve shall be of the non-flowing type. With this type, the flow through the pilot lines and pilot valve ceases immediately when the main valve opens, thus minimizing the likelihood of foreign matter being drawn into the small bore sections of the Valve.

Situations in which pilot-operated Safety Relief Valves are particularly suitable are:

a. Where the pressure loss between the protected equipment and the inlet flange of the Relief Valve exceeds 3 % of the set Pressure of the Relief Valve;

b. Where high back-pressures (50 % to 70 % of set pressure) are possible;

c. If the margin between the maximum operating pressure (MOP) of the protected system and the Relief Valve set pressure is less than 10 % of the relief valve set pressure.

The O-ring and diaphragm material of pilot shall be suitable for the pressure and temperature conditions specified in the data sheet.

All Pressure Safety Relief Valves in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. End connections shall be blinded / plugged after this degreasing process to avoid images of oil particles.

Normally pilot operated Valves are provided with soft seals which give a better valve tightness.

### 5.2.3 Rupture Disc

Generally Rupture discs shall be used where:

a. Relief loads caused by unexpected sources cannot be handled fast enough by Safety Relief Valves.

b. On the inlet side of a Relief Valve to protect the valve if the process fluid is extremely corrosive, or polymerizes, or to ensure against valve leakage of hazardous and toxic fluids.

When the rupture disc is used in association with the Safety Relief valve to protect the valve internals, the line pressure of rupture disc/valve void shall be monitored using Pressure gauge.

Unless otherwise specified, the bursting tolerance of the disc shall be as follows:

a. For bursting pressure of 1 bar gauge and above, tolerance shall be ±5% of the specified bursting pressure or less.

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b. For bursting pressures below 1 bar gauge Vendor's stated bursting tolerance is acceptable.

Where Vacuum services are encountered, Vendor shall provide vacuum supports. Retainer ring shall also be provided to hold the vacuum support and the rupture disc in place.

## 5.3 Valve Sizing

5.3.1 Sizing shall be carried out using the formulae mentioned in the following standards whenever the sizing code mentioned in the Purchaser's Data Sheets refers to these;

| Sizing Code | Standard |
|---|---|
| API | API RP 520 Part I<br>API RP 521 |
| ASME | Boiler and Pressure vessel code Section VIII 'Pressure Vessels'.<br>Boilers and Pressure vessel code Section-I. - 'Power Boilers' |
| IBR | Indian Boiler Regulations, paragraph - 293 |

5.3.2 Discharge Co-efficient

Following discharge coefficient values shall be used for sizing of Pressure Relief Valves;

a. For all Valves in gas, vapor or steam service with design code as ASME Sec VIII or ASME Section I discharge co-efficient of 0.975 as per API 520 shall be used.

b. For all Valves in steam service covered under IBR design code, discharge coefficient shall either be selected as per Regulation 293 or as tested and certified by IBR as per Appendix 'L' of IBR.

c. For Valves in liquid service, the discharge coefficient of 0.62 shall be used as per API 520. However Vendor may use the ASME certified valve coefficients when Pressure Safety Relief Valve with liquid trim design are offered.

d. For the selected orifice letter designation and inlet and outlet size of the Pressure Safety Relief Valve, relieving area of the valve offered by Vendor shall meet those in API-526.

e. The discharge capacity of the selected Pressure Safety Relief Valves shall be calculated based on certified ASME capacity curves or by using ASME certified discharge coefficient and actual orifice area. Higher valve size shall be selected in case pressure safety relief valve discharge capacity so computed, is less than the required flow rate.

f. For Pressure Safety Relief Valve covered under ASME SEC-I design code, the Valve design shall conform to ASME SECTION I requirements with selected area higher of the area calculated as per ASME SECTION I requirements and that calculated as per regulation 293 of IBR.

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## 5.4 Valve Construction

### 5.4.1 Body

a. The Valve body material shall be in accordance with the piping material Specification and rating with a minimum of ANSI 150 Ibs. Minimum inlet connections for flanged valves are 1-inch.

b. Flanges shall be integrally cast type, slip-on or weld-on flanges shall not be allowed, except as approved by the Company.

c. Unless otherwise mentioned, end connection details shall be as below:

   i. Threaded end connections shall be to NPT as per ANSI/ASME B 1.20.1.

   ii. Flanged end connections shall be as per ANSI/ASME B 16.5.

d. Flanged face finish shall be as per clauses 6.4.4.1, 6.4.4.2 and 6.4.4.3 of ANSI/ASME B 16.5.The face finish as specified in the Data Sheets, shall be as follows;

| | |
|---|---|
| 125 AARH | 125 to 200 AARH |
| 63 AARH | 32 to 63 AARH |

e. For flanged Valves, inlet and outlet sizes and ratings and centre to flange face dimensions shall be in accordance with API-526. Dimensional tolerance shall be as mentioned therein.

f. Body drain with a plug shall be provided as a standard feature on every pressure relief valve.

g. For the pilot operated Pressure Relief Valves, where Vendor's standard model provides only semi nozzle design (i.e. the body is part of the inlet flow path), body material shall be of the same material as that of nozzle specified in Purchaser's Data Sheets, as a minimum.

### 5.4.2 Trim

a. The term 'trim' covers all the parts of the valves exposed to and in contact with the process fluid except for the body and bonnet assembly i.e. nozzle, disc, disc holder, stem etc.

b. Wherever stelliting of disc and nozzle has been specified, it stands for stelliting of the seat joint and the entire disc contour, unless otherwise mentioned.

c. For high temperature application, the materials for the internals shall be selected to avoid galling.

d. Pressure Relief Valves with design as per ASME Section I shall have two adjustable rings to adjust Valve over-pressure and blow down.

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e. Resilient seat, seals or O-rings wherever used shall be suitable for pressure and temperature conditions specified.

f. Gaskets wherever used shall be metallic type. Gaskets with asbestos filler or with asbestos bearing material shall not be used.

### 5.4.3 Nozzle Disc

a. The Valves shall be full Nozzle - full lift type. The nozzle shall be of forged construction. A full nozzle shall be used for conventional and balance bellows type, for Valve size 1" and larger. Semi-nozzle are acceptable for pilot operated PSV, in accordance with API RP-520.

b. Valves shall be of the full nozzle type of design with the exception as per clause 5.3.4 and Valves in Thermal Relief application.

c. Modified nozzle shall be provided for Thermal Relief Valve services for Valve sizes not greater than 3/4"x 1" unless otherwise specified.

d. The disc is a piston type held against process pressure by a spring, Disc, nozzle, guide and ring are Vendor's standard stainless steel as a minimum except where the line classification dictates a better material.

### 5.4.4 Bonnet & Spring

a. Lifting lever shall be provided whenever the fluid to be relieved is steam and air or water above 65°C.

b. Bonnet shall be of the closed type for all process applications in general. Open type bonnet shall be used only for steam and non-hazardous/non-toxic fluids. For all steam applications under design code IBR or ASME Section-I with open bonnet design, weather protection cover shall be provided.

c. Carbon steel springs shall be made corrosion resistant through plating/coating as per Manufacturer's standard design or as specified in the Purchaser's Data Sheets.

d. Spring material is carbon steel up to 230°C and tungsten steel for higher temperatures. The spring is adjustable for popping pressures within Code allowances above and below initial set pressure.

e. The spring shall be designed for specified set pressure and suitable for a minimum range of adjustment within +/-10% of set pressure specified for set pressure range below 17 bar and within +/-5% of set pressure above 17 bar.

f. The allowable tolerance in set pressures are as below:

   i. ±0.14 kg/cm2g for set pressure upto and including 5 kg/cm2g.

   ii. ±3% for set pressure above 5 kg/cm2g.

g. The springs of safety relief valves shall be protected with a suitable coating to prevent the occurrence of general corrosion and / or sulfide stress corrosion cracking.

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### 5.4.5 Cap

All Valves shall be provided with a cap over the adjusting bolt. Cap shall be of either bolted type or screwed type as specified in the Purchaser's Data Sheets with the cap material being the same as for the body. The cap and bonnet will be provided with lugs for wire seal after setting the Valve. Bolted cap will also be provided as per the requirements.

## 5.5 Name Plate

All Pressure Gauges shall be marked as per Manufacturer's standard and shall have a permanently attached stainless steel plate with the following, as a minimum detail:

a. Tag number as per Data Sheet;

b. Manufacturer's serial number and / or model number;

c. Manufacturer's name / trade mark;

d. Nominal Flange size in inches and rating in pounds for both inlet and outlet;

e. Orifice letter designation;

f. Valve set pressure;

g. Cold Bench test set pressure.

# 6 FABRICATION AND PAINTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Pressure Safety Relief Valve. Vendor shall submit the required Specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing herein. Painting of Pressure Safety Relief Valve shall be in accordance with Company painting Specifications.

# 7 INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Pressure Safety Relief Valve shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydro test, material test, hazardous area certification test, calibration test and any other before Factory Acceptance Testing (FAT).

## 7.1 Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Pressure Safety Relief Valve complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Pressure Relief Valve.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.


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The FAT shall be consisting of the following as a minimum:

a. Visual inspection

b. Dimensional check

c. Calibration

d. Cold bench set pressure test

e. Functional test

f. Non-Destructive examination of individual components of PRV.

g. Hydrostatic pressure Test

h. Seat tightness Test

i. Hardness test as per NACE MR01-75 (If Applicable)

j. Any other tests

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

## 7.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the company / owner's representative. SAT shall be performed on the Pressure Safety Relief Valve as per the approved test procedure. A comprehensive test procedure in compliance with the company specification shall be developed and issued to company / owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the Pressure Safety Relief Valve functions correctly and properly in accordance with the specified requirements.

# 8 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for the Pressure Safety Relief Valve shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard "Marking, Packing and Shipping Procedures" for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

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# 9 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

a. Itemized recommended spare parts list for start-up and pre-commissioning.
b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Pressure Safety Relief Valve, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

# 10 DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

## 10.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

a. Standard Specification, Data Sheets;

b. Sizing calculations;

c. Bill of Materials including Vendor list, details of third party items;

d. Catalogues and Manuals;

e. Quality Assurance Plan;

f. Any other documents.

## 10.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company’s approval:

a. Specifications, Data Sheets;

b. Sizing calculations;

c. Bill of materials including Vendor list, details for third party items;

d. Catalogues, Manuals and relevant drawings and documents;

e. Dimensional drawings;

f. Detailed sectional drawings showing all parts with reference numbers;

g. Calibration certificates;

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h. Material test certificates;

i. Installation procedures for PSV and its accessories

j. Procedures for FAT;

k. Quality Assurance Plan;

l. Any Other documents.

## 10.3 Guarantee & Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design .The cost of correction / replacement of any warranty items shall be borne by the Vendor, as per the purchase conditions of the Material / Purchase Requisition.

The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.

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ENERGISING QUALITY

# VCS PROJECT CONSULTANTS PVT. LTD.

# STANDARD SPECIFICATION
# FOR
# JIB CRANE

## VPC-SS-ME-3002

| Rev. No | Date | Prepared By | Checked By | Approved By | Authorized By |
|---|---|---|---|---|---|
| 01 | 01.11.2019 | SS | RNR | RNR | SK |
| 00 | 16.02.2019 | SS | RNR | RNR | SK |

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| REVISION RECORD | | | | | | |
|---|---|---|---|---|---|---|
| **Rev.** | **Revision Date** | **Prepared by** | **Checked by** | **Approved by** | **Authorized by** | **Revision Description** |
| 00 | 16.02.2019 | SS | RNR | RNR | SK | Issued for use as standard |
| | | Satish Singh | RN Rai | RN Rai | Suresh Kumar | |
| 01 | 01.11.2019 | SS | RNR | RNR | SK | Format change and document is generally revised. |
| | | Satish Singh | RN Rai | RN Rai | Suresh Kumar | |
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## 1.0 SCOPE

The scope of this specification is to specify the minimum requirements for the design, fabrication, testing, painting and supply of Jib Cranes which are intended for EPIC of GSMC.

## 2.0 DEFINITIONS & ABBREVIATIONS

### 2.1 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

| | | |
|---|---|---|
| OWNER/COMPANY | : | OWNER of the particular Project (Project Specific |
| CONSULTANT | : | The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management. |
| SUPPLIER/BIDDER/VENDOR | : | Manufacturer(s) who supplies the Jib Cranes/ Launcher and Receiver |
| PURCHASER | : | EPIC contractor carrying out the engineering, procurement and construction of the plant. |

### 2.2 ABBREVIATIONS

| | | |
|---|---|---|
| ITP | : | Inspection and Test Plan |
| PO | : | Purchase Order |
| BS | : | British Standards |
| ANSI | : | American National Standards Institutes |
| SPRS | : | Single Point Responsibility Supplier |
| SPIR | : | Spare Parts and Interchangeability Record |

## 3.0 CODES AND STANDARDS

Design and fabrication shall be in accordance with applicable sections of the latest edition following codes and standards:

| CODES | TITLE |
|---|---|
| BS 2573-1 | Rules for the design of cranes. Part 1: Specification for classification, stress calculation and design criteria for structure. |
| BS 2573-2 | Rules for the design of cranes. Part 2: Specification for classification, stress calculation and design of mechanism. |


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| | |
|---|---|
| ANSI B30.16 | American National Standards Institute (ANSI): Overhead Hoists, Under hung. |
| IS:3832 | Specification for Hand operated Chain Pulley Block. |
| IS:807 | Specification for Design, Erection & Testing of cranes & hoists (Structural Portion) of Cranes & Hoists. |
| IS 15419:2004 | Jib Cranes – Code of Practice |

## 4.0 COMPLIANCE TO SPECIFICATIONS

Supplier shall design the equipment in full compliance with all the specifications and codes applicable for this Project.

## 5.0 SCOPE OF WORK

5.1 SCOPE OF SUPPLY

| S.No. | CAPACITY (MT) | BOOM LENGTH (m) | LIFT (m) | QTY. | REMARKS |
|---|---|---|---|---|---|
| 1 | 5T * | # | # | 2 Nos. | Located & used for launcher / receiver equipment no. xxx and xxx. |

(*) Launcher / Receiver supplier/Bidder to check and confirm, and furnish the supporting documents.

(#) Launcher / Receiver supplier/Bidder to furnish.

5.1.1 Spare Parts

Bidder to include the spare parts for pre-commissioning, commissioning, first year operational spares and two years' operational spares. The list of spare parts is to be comprehensive and compiled into 1 (one) SPIR form that details Commissioning, 1 year and subsequent 2 year operational requirements.

### 5.1.1.1 Spares for Commissioning and Start Up

a. Bidder to supply consumables and spare parts necessary for pre-commissioning, commissioning, start-up and operation of the facility, including any special tools and handling equipment for each item of equipment.

### 5.1.1.2 Spares List for Subsequent 2 Years of Operation

A completed, (priced) SPIR form shall be completed by the respective equipment manufacturer, and to be submitted.


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5.2 SCOPE OF SERVICES:

5.2.1 Supervision of erection and commissioning of jib crane (Diem basis).

## 6.0 TECHNICAL REQUIREMENTS

- The jib crane shall be self-standing and shall be furnished with a column base and base plate for bolting to a concrete foundation.
- The stated lifting capacity shall be at full extension of the boom travel.
- The jib crane boom and column shall be designed to resist the most stringent combination of loads (i.e., live, crane, dead, impact, and seismic) in accordance with applicable codes and standards.
- The material of construction of various structural parts shall be steel plates and rolled steel sections of National/ International standards.
- The combined deflection of pillar and Jib on application of rated load at free end of Jib shall not exceed Jib radius / 250.
- The bearing at trunnion & guide rollers shall be designed for thrust load and turning moment. Suitable arrangement to lubricate the bearing and to prevent ingress of dirt and water shall be provided.
- The hoist shall be manually operated chain pulley block type hoist with travelling trolley on the Jib unless otherwise specified in data sheet. Chain pulley block shall be BIS stamped.
- The load chain will be of alloy steel material.
- The jib crane will be installed in an open air environment and shall be designed as per the attached Environmental Data.
- The jib crane shall be designed to operate with a continuous 3600 boom rotation. A boom rotation rope shall be attached to the end of the boom and extend to three (3) feet above crane base elevation.
- The bearings for rotation of the boom shall be externally lubricated.
- The materials for rubbing parts shall be of non-sparking type. The suggested materials for such components are as follows:
- Lifting mechanism:
  - Ratchet wheel, chain guides and gears : Solid construction in aluminum bronze or phosphor bronze.
  - Hand chain wheel : Solid construction / rims of aluminum bronze or phosphor bronze.
  - Load chain wheel : Solid construction in aluminum bronze.
- Trolley mechanism:
  - Hand chain wheel guides : Solid construction in aluminum bronze or


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| | | | |
|---|---|---|---|
| | | | phosphor bronze. |
| - | Hand chain wheel | : | Solid construction/rims of aluminum bronze or phosphor bronze. |
| - | Un-geared and geared wheels | : | Solid construction in aluminum bronze. |

- The frame shall be built from steel plates and designed with bolted/welded construction.
- All gears shall be machine cut. Gearing shall be provided with means for ample grease lubrication.
- Chain pulley block shall be provided with an automatic mechanical ratchet and pawl type load brake, which will prevent self-lowering of the load, arrest and sustain load in all working positions.
- Only antifriction bearing shall be used. All the bearing shall be lubricated and arrangement of lubrication shall be clearly indicated in maintenance manual.
- A locking device shall be provided to secure the crane boom in place at any angle throughout the specified crane rotation. All locking devices shall be operable by one person and be designed for the loads described herein.
- The trolley shall be of the under hung, gear operated, heavy-duty type.
- The hoist shall be provided integral with the trolley and shall be gear operated, heavy-duty, and designed at the load conditions specified.
- The crane shall be designed to meet the lifting requirements as specified in the enclosed data sheet and will be operated manually unless otherwise specified in data sheet.
- Crane shall be designed and built to ensure that all equipment along with the accessories is mounted suitably for convenient and safe operation. Adequate access shall be provided for operation and maintenance.
- The Jib and pillar of the crane shall be designed to withstand impact loads and for maximum strength and minimum deflection.
- The bearing at trunnion & guide rollers shall be designed for thrust load and turning moment. Suitable arrangement to lubricate the bearing and to prevent ingress of dirt and water will be provided.
- The hook shall be of forged aluminum bronze. It shall be of swiveling type and mounted on thrust bearings. A safety latch shall be provided on top and bottom hooks to prevent coming out of slings.
- The load chain will be of alloy steel material. The grade of load and hand chain will be 80 and 30 respectively as per relevant IS code.
- Hoisting, lowering, CT motion of crane shall be done manually with the help of hand chains unless otherwise specified in data sheet. The Jib shall be slewable by 360 degrees


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## 7.0 PAINTING

Surface Preparation & Painting shall be as per attached painting specification with MR.

## 8.0 TESTING AND INSPECTION

For Inspection and Testing refer attached inspection plan with MR.

Requirement of Third Party Inspection shall be as per MR. TPI Requirement. Bidder to include the cost of Third Party Inspection.

All testing shall be carried out in accordance with SUPPLIER's standard written procedures reviewed / approved by the PURCHASER / COMPANY. The test procedures shall detail out as a minimum, the scope, duration and acceptance criteria of all tests, measurements to be taken etc. Test certificates shall be furnished for all shop tests performed.

The crane will be subjected to inspection during the process of fabrication and upon completion.

The complete crane and trolley/hoist assembly shall be tested to verify that it performs according to the specification. The crane load capacity shall be demonstrated by testing to a minimum of 125% of rated load.

## 9.0 NOISE LEVEL

It is the SUPPLIER's responsibility to ensure that the sound pressure level of the supplied equipment shall not exceed the allowable value of 85dBA at 1 meter from the equipment.

## 10.0 DOCUMENTATION

10.1 SUPPLIER DATA REQUIREMENTS- BID

The supplier shall provide the following Technical data / information with the bid:

a. Compliance statement by the bidder, confirming to all requirements of Technical Specification attached herewith.
b. Technical Description of the Jib Crane.
c. Preliminary General Arrangement Drawings (including maintenance and removal spaces).
d. Scope of work and services.
e. Filled in Data sheets attached.
f. Reference List for past suppliers of similar jib cranes.
g. Spare Parts List for each type of crane.
h. Special Tools List for each type of crane.

10.2 Supplier shall submit all drawings and documents as per the Purchaser's requirement for his review/approval in accordance with agreed submission schedule.


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10.3 Supplier shall provide installation, operation and maintenance manuals for the complete unit.

## 11.0 LIST OF ATTACHMENT

a. Data sheet for Jib Crane
b. Specification for surface Preparation & Painting, Environmental Data.
c. TPI Requirements.
d. SPIR form.


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# VOLUME II OF IV
# ( ELECTRICAL)

Energising Quality

# VCS Quality Services Pvt. Ltd

# STANDARD SPECIFICATION
# FOR
# OIL FILLED TRANSFORMER

# VCS – SS – EL – 4003

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| | | | | | |
| 02 | 25.02.2022 | SP | RD | AA | HK |
| 01 | 16.10.2019 | MG | VV | AD | SK |
| 00 | 05.07.2017 | MG | RD | AD | SK |
| Rev. No | Date | Prepared By | Checked By | Approved By | Authorized By |

| | | |
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**REVISION RECORD**

| Rev. | Revision Date | Prepared by | Checked by | Approved by | Authorized by | Revision Description |
|---|---|---|---|---|---|---|
| 00 | 05.07.2017 | MG | RD | AD | SK | Issued for use as Standard |
| 01 | 16.10.2019 | MG | VV | AD | SK | New revision system updated |
| 02 | 25.02.2022 | SP | RD | AA | HK | New revision system updated |
| | | | | | | |


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## ABBREVIATION

| | |
|---|---|
| BIS/IS | Bureau of Indian standards |
| IEC | International Electro-Technical Commission |
| BS | British Standards |
| IEEE | Institute of Electrical and Electronics Engineers |
| NEMA | National Electrical Manufacturers Association |
| OISD | Oil Industries Safety Directorate |
| CCE | Chief Controller of Explosive |
| DGMS | Director General Mines Safety |
| IE Rules | Indian Electricity Rules |
| CPRI | Central Power Research Institute |
| LV | Low Voltage |
| MV | Medium Voltage |
| HV | High Voltage |
| TPN | Three pole neutral |
| CT | Current Transformer |
| NGR | Neutral Grounding Resistor |
| ONAF | Oil Natural Air Force |
| OLTC | On Load Tap Changer |


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## 1.0 SCOPE

1.1 This specification together with the data sheets covers the minimum technical requirements for the design, manufacture, testing and supply of Distribution Transformer and associated accessories like current transformer, tap changer, bushings etc.

1.2 All deviations from the requirements of this specification shall be clearly brought out in the bid. In the absence of such a statement it shall be understood that all requirements of this specification are fulfilled without any exception.

The intent of this standard specification is to define the general requirements of oil filled power/distribution transformers.

## 2.0 REFERENCE DOCUMENTS

2.1 The transformer shall comply with the latest edition of the following and other relevant Indian Standards/Manual:

| | |
|---|---|
| IS: 335: | Insulating oil |
| IS: 1271: | Thermal evaluation and Classification of electrical insulation. |
| IS: 2020: | Power transformers |
| IS: 2099: | Bushing for Alternative voltages above 1000 v. |
| IS: 2705: | Current transformers. |
| IS: 3347: | Dimensions for porcelain Transformer Bushings |
| IS: 3637: | Gas operated relays. |
| IS: 3639: | Fitting & accessories for power transformers |
| IS: 4201: | Application guide for CTs. |
| IS: 6600: | Guide for loading of oil immersed transformer |
| IS: 8478: | Application guide for ON-load tap changers |
| IS: 8468: | On-load tap changers |
| IS: 10028: | Code of practice for selection, installation and maintenance of transformers. |
| IS: 13947: | LV switchgear and control gear - Part I General rules |
| | CIBP Manual on Transformer. |

2.2 In case of conflict between the above standards and this specification, the requirements of this specification shall prevail.

2.3 Transformer shall also conform to the provisions of the latest revisions of the Indian Electricity Rules and any other statutory regulations currently in force.

## 3.0 DEFINITIONS


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For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

| | |
|---|---|
| OWNER / COMPANY | OWNER of the particular Project (Project Specific). |
| CONSULTANT | The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management. |
| BIDDER / SUPPLIER / VENDOR | The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor. |

## 4.0 MATERIALS

4.1 Transformer shall be double wound core type with cold rolled non aging grain oriented low loss, high permeability silicon steel laminations perfectly insulated and clamped to minimize vibration and noise.

4.2 Windings shall be of copper

## 5.0 DESIGN

### 5.1 ENVIRONMENTAL CONDITION

Transformer shall be suitable for operating satisfactorily in humid and corrosive atmospheres found in fertilizer plants, refineries and petrochemical plants. Service conditions shall be as specified in the Data Sheets.

### 5.2 TERMINAL AND MARSHALLING BOX

Windings shall be brought out and terminated on outdoor bushings, cable boxes or bus duct chamber which will be located as specified on the Data Sheet.

5.2.1 When outdoor bushings are specified they shall be supplied complete with terminal connectors suitable for the specified conductor size.

5.2.2 Cable boxes shall be supplied with cable lugs and glands.

5.2.3 For MV/LV PVC Power/control cables double compression cable glands and crimped type tinned copper cable lugs shall be supplied. Gland plate shall be removable type. For single core cables, gland plate shall be of non-magnetic material. HV cable box shall be suitable for termination of specified size of XLPE insulated cable .The head room available between cable gland plate and terminals lugs shall not be 600mm for cables upto 11 KV cables & 900 mm for 22KV & 33KV cables.

5.2.4 Cable box and disconnecting chamber shall be air insulated.

5.2.5 Cable box shall be weatherproof to IP-55. For fixed portion of cable box, inspection cover with lifting handle shall be provided.

5.2.6 Primary cable box (where applicable) shall be able to withstand specified primary system fault level for 0.25 secs.

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5.2.7 Terminal chamber for bus duct termination shall have a gasketed cover plate bolted to it and shall be weatherproof to IP-55. A separate inspection cover with lifting handle shall be provided to facilitate connection and inspection. Phase sequence of the bus bars shall be as specified in the Data Sheets.

5.2.8 Marshalling box shall be weatherproof to IP-55. All protective devices and neutral CTs shall be wired by means of PVC insulated copper conductor armoured cables upto the marshalling box. Terminals shall be clamp type or equal. Removable gland plate with double compression type glands shall be provided. Lamp with switch & socket shall be provided in the marshalling box.

5.2.9 For transformers having provisions for terminating TPN bus duct, on the 433V side, neutral of the star connected secondary winding shall be brought out to a secondary terminal chamber. A CT shall be mounted (if specified) on the neutral terminal with CT secondary wired up to the marshalling box.

5.2.10 If specified in the Data Sheet, a separate neutral bushing shall be provided for neutral earthing of transformers, in such cases, the neutral CT shall be mounted before bifurcation of the neutral.

5.2.11 Supporting arrangement for neutral bushing connection to earth/NGR through GI strip/cable as applicable shall be provided

## 5.3 COOLING

5.3.1 Type of cooling shall be in accordance with Data Sheet.

5.3.2 Forced air cooling system, if required, shall have a separate control panel to be installed near the transformer unless otherwise specified. The specified accessories for cooler controls may also be accommodated in the marshalling box if sufficient space is available. Control panel shall be weatherproof to IP-55 construction and shall accommodate the incoming/outgoing switchgear/ starters for each cooling fan motor, auto/manual selector switch, internal wiring and cable glands necessary for purchasers external cable connections. Contacts shall be provided for remote indication/alarm for following operating conditions:

a. Auto/manual selection.
b. Winding over temp.
c. Fans ON (for each fan separately).
d. Fans tripped (for each fan separately).

5.3.3 Cooling fans shall be of rust-proof construction with wire guard and totally enclosed weatherproof induction motors complete with mounting/supporting structure. These shall be suitably sized to limit the temperature rise of the transformer to specified values with continuous maximum loading of ONAF rating and at maximum ambient temperatures. Minimum of one standby fan per 50% cooler bank shall be provided.

5.3.4 In Auto mode all fans including redundant fans shall be running. Temperature shall be within limits even if redundant fans fail. In manual mode each fan can be started independently.

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## 5.4 OIL

Transformer shall be supplied with first filling of oil and 10% extra oil in nonreturnable drums. Oil shall conform to IS-335.

## 5.5 ACCESSORIES

5.5.1 Conservator shall be complete with oil filling plug and cap, oil drain valve, oil level gauge in addition to magnetic oil level gauge. A flexible oil resistance air bag shall be provided for conservator if specified in Data Sheet. Air bag shall be designed to withstand repeated expansion and contraction due to changes in oil level.

5.5.2 Explosion vent or pressure relief valve (PRV) shall be provided as specified in Data sheet. Explosion vent shall have sight gauge and equaliser pipe connection PRV shall be provided with alarm contact.

5.5.3 Direction of explosion vent shall be communicated at the time of Vendor document review.

5.5.4 Thermometer pocket with associated thermometer (0-120°C) shall be provided.

5.5.5 Separate buchhloz relay shall be provided for main tank and OLTC chamber. This shall be double float type for the main tank with separate normally open trip and. alarm contacts. For the OLTC chamber the relay shall be of single float type or oil surge relay with one trip contact. Isolating valve shall be provided on either side of the relay arid distance piece shall be supplied.

5.5.6 Oil temperature indicator shall be 150 mm dial type with two normally open contacts for tripping and alarm. It shall be provided with maximum reading pointer.

5.5.7 Winding temperature indicator shall have normally open contacts one each for tripping, alarm and starting/stopping of cooling fan motors. It shall be provided with maximum reading pointer.

5.5.8 Contact rating of all auxiliary devices shall be 2A, 110V/220V DC

5.5.9 Size of valves for drain, filter and sampling shall be as per the table below.

| Transformer rating KVA | | Size of drain mm | Size of filter mm | Size of sampling mm |
|---|---|---|---|---|
| Over | Up-to & including | | | |
| - | 1600 | 25 | 25 | 15 |
| 1600 | 10000 | 50 | 25 | 15 |
| 10000 | 25000 | 80 | 50 | 15 |
| 25000 | 50000 | 100 | 50 | 15 |
| 50000 above | | 100 | 50 | 15 |


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## 5.6 CORE AND WINDING

5.6.1 Transformer shall be double wound core type with cold rolled non-aging grain oriented low loss, high permeability silicon steel laminations perfectly-insulated and clamped to minimize vibration and noise. Care should be taken to insulate core fastening bolts to reduce losses and avoid hot spots. All parts of magnetic circuit shall be bonded to earth system.

5.6.2 Windings shall be of copper and shall be designed to withstand the applicable thermal and dynamic short circuit stresses.

## 5.7 TAPPINGS & WINDINGS

5.7.1 These shall be provided on high voltage side and connected to off circuit or on-load tap changing gear as specified on Data Sheet. Under conditions of external short circuit, the tap changing equipment shall be capable of carrying the same current as the windings.

5.7.2 OFF CIRCUIT TAP CHANGING GEAR:

a. Off circuit tap changing gear shall have an external operating handle mounted on the transformer side and shall meet the following requirements:
   I. Positive snap-action contact changing
   II. The mechanism shall be such that it is impossible for the contacts to be set in a position whereby the windings remain open-circuited or partly short circuited.
   III. Mechanical stops at the ends shall be provided to prevent overrunning.
   IV. The driving rod through cover or tank wall shall be properly sealed against liquid leakage under all service conditions.
b. The handle shall be metallic and the adequately sized in order to allow operation without the need of tools and be located in a directly accessible position.
c. The handle shall be provided with padlock facilities to lock the tap changer in the desired position.
d. Tap positions shall be clearly marked in line with the data given on the rating plate.

5.7.3 ON LOAD TAP CHANGER

a. High speed on load tap changing gear with number of steps as specified on the data sheet shall be provided and mounted on the transformer. The OLTC gear shall have diverter resistance and the current diverting contacts shall be housed in a separate oil chamber segregated from the main tank of the transformer. The contacts shall be accessible for inspection and their tips shall be replaceable.


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b. OLTC oil chamber shall have oil filling, drain and sampling facility. It shall be provided with oil level indicator, connection orifices, valves & silica gel breather shall be provided.
c. OLTC shall be provided with local and remote controls.

LOCAL CONTROL

i. Manual-Mechanical Control

The cranking device for operation of the OLTC gear shall be removable and located at a height not exceeding 1.500mm. above ground level for easy operation. The mechanism shall be complete with normal accessories including at least the following:

- A mechanical tap position indicator (Rated tap voltages shall be marked on the diagram plate).
- A mechanical operation counter.
- Mechanical stops to prevent over cranking of the mechanism beyond extreme tap positions.

ii. Electrical Control

Control circuit shall incorporate the following:

- Local/remote manual electrical operation.
- Device to ensure a positive and full completion of tap change once it is initiated even if there is loss of power.
- An interlock to cut-off electrical control automatically upon recourse being taken to manual mechanical control in emergency.
- Electrical interlock to cut-off a counter impulse for a reverse tap change, being initiated during a progressive tap change and until the mechanism comes to rest and resets circuits for a fresh operation.
- All auxiliaries and devices for electrical control of OLTC gear should be housed in a weather-proof cabinet mounted on the transformer and shall include:
  - Local tap position indicator
  - 5 digit operation counter
  - Cubicle lighting
  - Thermostatically controlled space heater.
  - Miniature circuit breaker with magnetic and thermal overload devices for controlling the incoming supply to the OLTC motor.
  - Padlocking arrangement for the hinged cabinet door.
  - Removable plate with cable glands.
  - Inside tag with control scheme indelibly marked.

iii. Remote Electrical Control

Remote control panel shall comprise of the following

- Individual/parallel control on Master follower sequence selector switch.
- Raise/lower control switch.
- Potentiometer type tap position indicator.
- Out of step relay.

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- Time delay relay.
- Indicating lamp for out of step.
- Out of step buzzer.
- Indicating lamp for tap changer supply available.
- Indicating lamp for tap change in progress.

5.7.4 RTCC panel shall be dust & vermin proof, floor mounting, free standing type. The enclosure shall be cold rolled sheet of 2.5 mm for front and back and 2.5mm thick for the rest. All doors and opening shall be provided with neoprene gaskets.

5.7.5 Automatic tap changing control shall be provided complete with voltage sensing relay if specified on Data Sheet.

5.7.6 OLTC wherever called for shall be suitable for bidirectional power flow.

5.7.7 OLTC shall also be rated for basic insulation level value as specified for the transformer in the Data Sheet.

5.8 NOISE

Audible Noise level shall not exceed the limits as indicated in the CIBP manual.

## 6.0 FABRICATION

6.1 Transformer tank shall be of welded sheet steel construction and provided with gasketed steel cover plates. Base shall be suitably reinforced to prevent any distortion during lifting. Base channels shall be provided with skids and pulling eyes to facilitate handling. Transformer tank shall be tested as per clause 12.0 of this specification.

6.2 All covers and seals shall be oil and air-tight and shall not be affected by mineral or synthetic oil action. Detachable radiators equipped with air vent, drain plug and lifting lugs shall be provided with shut-off valves to permit removal of any radiator unit without emptying the tank. Radiators shall be securely braced to prevent undue vibration. For transformers of ratings less than 500 KVA, fixed radiators welded to the tank May be provided.

6.3 All fasteners and bolts etc. shall be galvanized as per IS 802 or zinc passivated. All surfaces to be painted shall be thoroughly cleaned, descaled, made free from rust and transformer shall be epoxy painted. Paint shall be suitable to withstand specified atmospheric conditions.

6.4 Transformer shall be suitable for using emulsifiers as part, of fire protection system.

6.5 Different parts of transformers shall be connected by copper flexible for earth continuity purpose.

## 7.0 INSPECTION AND TESTING

7.1 Purchaser's representative shall be given free access in the works from time to time for stage wise inspection and progress reporting. Four weeks advance notice shall be given to witness the final routine test as per IS: 2026 and other tests as agreed upon. These

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tests shall be performed on the complete assembly at manufacturer's works. One transformer of each rating shall be subjected to heat run tests if specified in Data Sheet. Test certificates duly signed by Purchaser's representative shall be issued as part of final document.

7.2 Impulse test, if specified in the Data Sheet, shall be carried out on all the three limbs of the transformer.

7.3 Transformer tank shall be tested as below.

7.3.1 ROUTINE TESTS

Oil leakage Test - All tanks and oil filled compartments shall be tested for oil tightness by being completely filled with air/oil of a viscosity not greater than that of insulating oil to IS:335 at an ambient temperature and subjected to a pressure equal to the normal pressure plus 35 kN/m2 (5 lb/sq in.) measured at the base of the tank. This pressure shall be maintained for a period of not less than 12 hours for oil and 1 hour for air, during which time no leakage shall occur.

7.3.2 TYPE TESTS

a. Vacuum Test – Wherever specified in the Data Sheet, one transformer tank of each size shall be subjected to the specified vacuum as given below The tanks designed for vacuum of 760mm of mercury shall be tested at a maximum internal pressure of 3.33 kN/m2 (25mm of Hg) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the value specified in table-2 without affecting the performance of the transformer.

**Table-1**

| Highest System Voltage | MVA Rating | Vacuum Gauge pressure kN/m2 | mm of Hg |
|---|---|---|---|
| Upto 72 kv | Upto 1.6 | 34.7 | 250 |
| | above 1.6 & upto 20 | 68.0 | 500 |
| | Above 20 | 100.64 | 760 |
| Above 72kv | For all MVA ratings | 100.64 | 760 |

**Table-2**

| Horizontal length of flat plate (in mm) | Permanent deflection (in mm) |
|---|---|
| Upto and including 750 | 5 |
| 750 to 1250 | 6.5 |
| 1251 to 1750 | 8 |
| 1751 to 2000 | 9.5 |


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| | |
|---|---|
| 2001 to 2250 | 11 |
| 2251 to 2500 | 12.5 |
| 2501 to 3000 | 16 |
| Above 3000 | 19 |

b. Pressure Test - When specified one transformer tank of each size shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35 $kN/m^2$ (5 lb/sq in.) whichever is lower measured at the base of the tank and will be maintained for one hour. The permanent deflection of flat plates after the excess pressure has been released shall not exceed the figure specified in Table-2.

## 8.0 MARKING, PACKING AND SHIPMENT

8.1 All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in air bobbled polythene sheets before being placed in crates/cases to prevent damage to finish. Crates/cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', `Owner's particulars', 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchase order.

8.2 The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature, unless otherwise agreed.


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Energising Quality

# VCS Quality Services Pvt Ltd

# STANDARD SPECIFICATION
# FOR
# MEDIUM VOLTAGE INDUCTION MOTOR

## VCS – SS – EL - 4006

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| 02 | 25.02.2022 | SP | RD | AA | HK |
| 01 | 16.10.2019 | MG | VV | AD | SK |
| 00 | 05.07.2017 | MG | RD | AD | SK |
| Rev. No | Date | Prepared By | Checked By | Approved By | Authorized By |

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**REVISION RECORD**

| Rev. | Revision Date | Prepared by | Checked by | Approved by | Authorized by | Revision Description |
|---|---|---|---|---|---|---|
| 00 | 05.07.2017 | MG | RD | AD | SK | Issued for use as Standard |
| 01 | 16.10.2019 | MG | VV | AD | SK | New revision system updated |
| 02 | 25.02.2022 | SP | RD | AA | HK | New revision system updated |
| | | | | | | |


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## ABBREVIATION

| | |
|---|---|
| BIS/IS | Bureau of Indian standards |
| IEC | International Electro-Technical Commission |
| BS | British Standards |
| IEEE | Institute of Electrical and Electronics Engineers |
| NEMA | National Electrical Manufacturers Association |
| OISD | Oil Industries Safety Directorate |
| CCE | Chief Controller of Explosive |
| DGMS | Director General Mines Safety |
| IE Rules | Indian Electricity Rules |
| CPRI | Central Power Research Institute |


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