SPECIFICATION
FOR
CENTRIFUGAL PUMPS - API

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SPECIFICATION FOR CENTRIFUGAL PUMPS - API

Client	HINDUSTAN PETROLEUM CORPORATION LTD.
MMCI Project No.	254624

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1 General

1.1 This Specification covers the minimum technical requirements for API 610 Tenth Edition centrifugal pumps supplied against all requisitions to which this Specification is attached. The pumps covered by this Specification shall be designed, manufactured and tested in accordance with API Standard 610, Tenth Edition, "Centrifugal Pumps for General Refinery Service" October 2004 as modified in this Specification.

1.2 Compliance with this specification does not relieve the vendor from meeting the requirements of the ultimate user or his nominated representative when stipulated in the material requisition.

1.3 It is incumbent on the vendor to comply with all legislation applicable to the project in which this specification is applied.

2 Reference

In addition to the specifications referred to in the material requisition the following specifications together with codes, standards, specifications, drawings and documents referred to therein shall apply:

2.1 Codes Regulations and Standards

API 610 10th Edition	Centrifugal Pumps for Petroleum, Chemical and Gas Industries
API 682 3rd Edition	Pumps – Shaft Sealing Systems for Centrifugal and Rotary Pumps
ISO 9906: 2000	Acceptance Tests for Centrifugal, Mixed flow and or Hydraulic Institute Axial pumps.
ANSI/HI 1.6-2000	Centrifugal Pump Tests

3 Selection of 'Bought-Out' Items and the Use of Vendor's Suppliers

3.1 Details of, and the proposed vendor of all items which are not part of vendor's own manufacture, and any intent to use suppliers of vendor to partly or wholly manufacture any part of the equipment or its ancillaries shall be disclosed to the purchaser in the vendor's bid.

This requirement does not apply to standard fasteners and bulk items such as pipe and pipe fittings.

3.2 Alternatively, the purchaser may, at any time prior to award, nominate suppliers of vendor from whom certain items shall be obtained. The vendor shall advise prior to issue of purchase order the consequences of any such nomination. The vendor as a minimum shall advise manufacturer of seal, motor and coupling.

3.3 After the placement of the order, the vendor shall not substitute any of the agreed suppliers of vendor without the purchaser's prior approval.

4 Vendor's Experience Qualification

All pumps and ancillaries shall be selected from the vendor's established product range. Prototypes shall not be offered by the vendor. Pumps shall be purchased only from vendor's who can demonstrate successful operation of at least two similar units for a minimum of three

years in a comparable service, in a similar climate region which must be performing satisfactorily.

5 Precedence

In the event of conflict, actual or implied, among documents relating to an enquiry or order, the following order of precedence shall govern:-

- Material requisition for quotation or purchase order and variations thereto
- Data sheets and drawings
- This specification
- Relevant Design Standard.
- Other specifications and standards referenced to in this specification
- Other national and international standards

6 Design

6.1 General

All centrifugal pumps, drivers and all ancillaries shall conform to the requirements of API Standard 610, Tenth Edition, and as amended by the comments in Section 6.2.

6.2 Amendments/Supplements to API std. 610, 10th Edition

Following are the additions, decisions and modifications to the corresponding paragraph numbers of API 610, Tenth Edition:

Any bullet paragraph not addressed in this Specification will either be covered in the pump datasheet or deemed to be not required if referred to in the API as ‘when specified’.

Amendments/Supplements to API std. 610, 10th Edition

PARAGRAPH No.

6.3 Definition of Terms (Addition)

3.60 New - ‘Addition’

adds the requirement following this term to the referenced API Standard requirement. An addition does not change the API Standards requirement.

3.61 New - ‘Modification’

changes the API Standard requirement to that which follows the term. All parts of the API Standard requirement that are not addressed remain applicable.

3.62 New - ‘Decision’

Provides direction for choices, which are specified by the API Standard paragraph. Parts of bulleted paragraphs, which do not require decisions, are fully applicable.

4.3.1 Addition

The VENDOR shall comply with applicable Federal, State or Local codes, regulations, ordinances, and rules. Unless defined otherwise these shall be those applying to the country or state where the equipment is to be installed or purchased.

5.1.10 Addition

The Net Positive Suction Head Required (NPSHR) shall be based on water [at a temperature of less than 65 °C (150 °F)] at the rated flow and rated speed; no reduction or correction factors shall be applied for other liquids.

The Net Positive Suction Head Available (NPSHA) shall exceed the Net Positive Suction Head Required (NPSHR) by at least 1 m (3 ft) throughout the range from minimum continuous stable flow up to and including the rated capacity, and by 0.3 m (1 ft) at 120 % of rated flow. If the suction pressure at the pump is less than atmospheric, this margin shall be at least 2 m (6 ft).

For liquids containing dissolved gases, to avoid cavitation damage due to vapour-induced flow path restrictions, NPSHA shall be 1.5 x NPSHR, with a minimum margin of 5 m (15 ft) between NPSHA and NPSHR.

5.1.11 Addition

The calculation of NPSH shall be based on m3/h not m3/s as defined in Annex A. The suction specific speed (Nss), calculated at the Best Efficiency Point (BEP) for the maximum impeller diameter of the casing, shall not exceed 12,000 (rpm, m3/hr, m) or 10,320 (rpm, USGPM, ft). Pumps offered with suction specific speed > 12,000 (rpm, m3/hr, m) may be accepted subject to Purchaser's written approval.

5.1.13 Decision/Addition

Replace the first sentence of this clause by:

For single operation, Pumps shall have stable head/capacity curves which continuously rise by at least 5 % from rated capacity to shut off.

The use of an orifice to achieve continuous rise to shutoff is not acceptable.

5.1.19 Modification

Cooling water plans shall not be supplied, unless it is required by the seal flush plan or if the pumping temperature exceeds 200°C (400°F). Above 200°C (400°F) cooling water plans shall only be applied if recommended by the vendor.

5.3.6 Modification

Dual pressure ratings for any pump configuration are not acceptable.

5.4.3.1 Addition

All auxiliary connections to pressure casing shall be welded and provided with flanged customer connection at the edge of base plate. Suction and Flange auxiliary connection to have the same rating as the discharge flange. Seal gland connection may be threaded.

5.4.3.8 Decision

The use of studded connections is specifically excluded.

5.5.2 Addition

Individual nozzles, pump casings and base plates for all pumps shall be capable of withstanding twice the forces and moments stated in Table 4 of API 610 simultaneously under all operating conditions. The provisions of Appendix F of API 610 shall not apply.

5.6.3 Decision

The use of collets to retain impellers on shafts is not acceptable.

5.8.1 Modification

Unless otherwise specified, seals and sealing systems shall be furnished in accordance with API 682 3rd edition.

To ensure selection of the optimum mechanical seal and seal auxiliary facilities for the duty specified, the pump manufacturer shall be responsible for the engineering coordination, installation, and performance of its auxiliary facilities such as circulation, injection, quenching and cooling, as required for the seal selected by the seal manufacturer.

5.9.2.1 Modification

Paragraph 5.9.2.1 will apply when specified on the datasheet.

When a torsional analysis is performed the Vendor shall furnish a detailed report. This report will contain sufficient information to allow the Purchaser to undertake independent assessment of the torsional characteristics of the supplied equipment.

5.9.2.6 Decision

When the torsional analysis has been undertaken this paragraph shall apply.

5.12.2.5 Decision/Addition

Casting repair procedures shall be submitted by the Vendor for approval before any repair work is carried out.

6.1.3 Addition

Over and above the requirements specified in Table-11, the motor nameplate rating for pumps under parallel operation or for pump with auto-start operation shall not be less than the max. BKW indicated on pump data sheet (Power at End of the curve for the rated impeller) or shall have the specified margin as per this clause whichever is greater. The pump motors shall also be suitable for start-up under open discharge valve condition.

The motor nameplate rating for applications where the specific gravity of pumped fluid is less than 1.0 shall either be 100% of the BKW of pump at minimum continuous stable flow with clean cold water of specific gravity 1.0 or shall have the specified margin as per this clause, whichever is greater.

Motors shall comply with motor specification attached with requisition. The electric motor shall be suitable for the electrical area classification specified on the data sheet.

6.2.14 Decision

Paragraphs a) and c) shall apply.

6.2.14c) Addition

Coupling guards shall be non-sparking.

6.3.2 Modification

Drain valves <= 2.0 inch(nb) which due to space limitations necessitate a non-standard or oversize baseplate can overhang the baseplate edge, but must be shipped loose. However, the pipe flange must not extend beyond the baseplate.

6.3.3 Decision

This paragraph shall apply.

6.3.6 Decision

Baseplate stiffness test is not required.

6.3.14 Addition

Adjustment alignment screws shall be provided for all components (except the pump) having a mass of over 75 kg (165 lb) for vertical and both horizontal planes.

6.4.2.2 & 6.4.2.3 Decision/Addition

Provision for bearing vibration and temperature detection monitoring equipment shall be made for all pumps and drivers with hydrodynamic bearings. Where driver rating is greater than 500 kW, vendor shall provide vibration and temperature sensing elements wired to skid edge junction box for pump and driver.

6.5.2.9 New

Socket welding of any seal piping is prohibited. All seal harnesses shall be 316L stainless steel and butt welded.

7.3.3.3 Addition

Pump performance testing shall be undertaken in compliance with ISO 9906: 2000 or Hydraulic Institute section ANSI/HI 1.6-2000, a minimum of seven points, which will be:
Closed valve (wherever practical, otherwise at minimum thermal flow)

- Minimum stable flow
- Between minimum flow and rated flow or best efficiency point , whichever is the lower
- Rated flow (RF)
- Best efficiency point (BEP)

- Between RF/BEP whichever is the larger, and maximum operating point
- Maximum operating point

One additional point may be required if rated point lies close to BEP resulting in more than 30% of the curve having no measured point.

If a spare rotor or complete inner assembly for multistage pumps is supplied with the pump, it shall be subject to the same running/performance tests in the pump casing as the main rotor. API 610 tolerances listed on Table 14 shall apply.

7.3.3.4b) Addition

Bearing temperature shall be measured at all seven points of the performance test, except closed valve.

7.3.4.4 Addition

Noise level shall not exceed 85 dB(A) @ 1m.

7.4.3.2 Modification

Refer to project painting specification.

8.2.2.3 Decision

Shrink fit impellers shall not be supplied.

8.3.10.5 Decision

This paragraph shall apply.

7 Inspection and Certification

7.1 Inspection Class

7.1.1 For the purpose of inspection and certification, pumps are categorised into four classes (I, II, III & IV).

7.1.2 The inspection class for the pump shall be determined in accordance with the maximum discharge pressure and the temperature relationship as shown in the Fig.1 and as modified by the paragraph 7.1.3.

Maximum discharge pressure shall be defined as: the maximum suction pressure plus the maximum differential pressure the pump is able to develop when fitted with the furnished impeller at the specified speed, specific gravity and pumping temperature.

The temperature used in the table shall be defined by consideration of the maximum / minimum design temperature and selection of that temperature which corresponds with the more severe inspection class.
Once the inspection class has been identified, the extent of inspection and NDE shall be given as in Section 7.2. The certification level shall be given in Section 7.5.

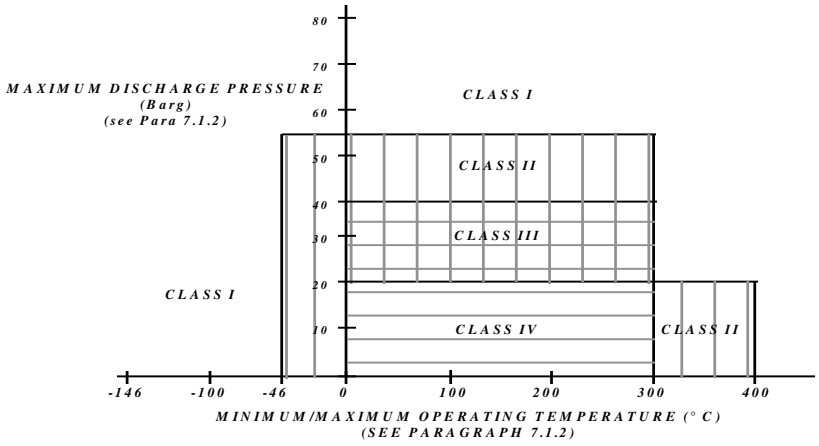

Figure 1

7.1.3 The inspection classes in the above figure apply only to pumps with casings fabricated from the following materials listed in table H1 of API 610 10th edition.

7.2 Extent of Inspection and NDE

7.2.1 Having determined the inspection class, the material inspection requirements are given in Table 1 and in the accompanying notes. Type of inspection shall be determined by inspection class and fabrication process.

Fabrication Process	Duty	Inspection Class			
		I	II	III	IV
Cast	Casing	MPI / DPI + RT (Note 2)	MPI / DPI (Note 2)	MPI / DPI Machined surfaces only	Visual inspection
Wrought	Casing (Seam welds only)	MPI / DPI + RT/UT	MPI / DPI	Visual inspection	Visual inspection
Nozzle attachment weld	Pressure retaining	MPI / DPI + RT / UT	MPI/DPI	Visual inspection	Visual inspection
Butt weld	Pressure retaining	MPI / DPI + RT/UT	MPI / DPI	Visual inspection	Visual inspection
Fillet weld	Pressurised component	MPI / DPI	MPI / DPI	Visual inspection	Visual inspection
All	Internals	Visual inspection	Visual inspection	Visual inspection	Visual inspection

TABLE 1

Notes (for Table 1)

1. 'Wrought' includes all forgings, plates and tubulars.

2. MPI/DPI of casings to include all exterior and accessible interior surfaces, including machined surfaces.

3. Radiography of cast casings refers to critical areas, defined as areas of highest stress, abrupt changes in section, weld ends and at risers gates or feeders. Manufacturers are to submit, for Purchaser's approval, details of the critical areas proposed to receive RT.

4. NDE of welds defined in Table 1 above to be 100% of all welds.

5. Pressure retaining; refers to process fluids (including seal plans 52/53)

7.3 Inspection Procedure and Sequence

7.3.1 Surfaces of all castings shall be suitably cleaned by chipping or blasting prior to inspection.

7.3.2 All castings shall be visually examined and proven free from sand, scale, cracks, tears, voids and other harmful defects. Visual acceptance levels shall be as specified in MSS-SP55.

7.3.3 NDE procedures and acceptance criteria (RT, UT, DPI, MPI) shall be in accordance with API 610 10th Edition section 7.2.2.

7.3.4 MPI shall be used for ferrous materials utilising the wet method. Dry powder shall not be used. Permanent magnets shall not be used.

7.3.5 MPI/DPI for acceptance shall be performed in the final machined condition.

7.3.6 All NDE shall be performed in the final heat treated condition (not necessarily after stress relieving) unless agreed otherwise by the Purchaser.

7.4 Welding & Repair

7.4.1 Welding procedures shall be submitted to the purchaser for approval.

7.4.2 The repair of any defect found on castings by plugging penning, use of plaster or cement compound, or impregnation by plastic materials or similar compounds is prohibited. Repairs to the pressure boundary shall be by welding only.

7.4.3 After major weld repair all cast casings shall be heat treated or stress relieved as required by the casting specification, however the purchaser reserves the right to specify solution heat treatment for repairs to austenitic stainless steel where considered applicable for process or environmental reasons.

All weld repairs shall be re-examined by appropriate method as defined in Section 7.2.

7.5 Material Certification

Material Certification shall be provided in accordance with Fig. 2 in accordance with BS EN 10204.

PART	Inspection Class			
	I	II	III	IV
Casing Auxiliary Piping (process & seal system inc. all pressure retaining fittings, valves, etc.) Impeller Shaft		3.1		
Diffusers Mechanical seals Pressure bolting Sleeves Throttle bushes Wear rings			2.2	

Figure 2

8 General

8.1 General Requirements

Packaging and preservation shall be in accordance with the project requirements as listed in the material requisition.

8.2 Spares

Vendor shall advise the commissioning and two years operating spares, and complete the relevant forms as requested in the material requisition, and be not less than that of table 18 of API 610, Tenth Edition.

8.3 Special Tools

Any special tools required for erection, commissioning or maintenance shall be identified and supplied with the equipment.

9 Painting and Coating

Painting and coating shall be in accordance with the Project specific Painting specification.