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TECHNICAL SPECIFICATION

Doc No : DSF-SPC-MEC-015

Rev. 1

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HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

CENTRIFUGAL PUMPS IN GENERAL AND MEDIUM DUTY SERVICE

JUNE 2021

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REVISION HISTORICAL SHEET

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REFERENCES DOCUMENTS

EU Directives:

- **2006/42/EC** Machinery Directive
- **2014/68/EU** Pressure Equipment Directive (PED)
- **2004/108/EC** Electromagnetic Compatibility (EMC)
- **Regulation (EU) No 305/2011** Construction Products Directive (CPD)
- **2014/34/EU** Explosive Atmospheres (ATEX)

Job Spec. No. DSF-SPC-ELE-021
[Electric Motors]

Job Spec. No. DSF-SPC-MEC-006
[External Painting]

Job Spec. No DSF-SPC-QAC-003
[Noise Control]

Job Spec. No DSF-SPC-QAC-005
[Shop Inspection of Equipment and materials for NGT project]

ELOT EN ISO 5199
[Technical Specifications for Centrifugal Pumps-Class II]

ELOT EN 1092
[Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated]


ELOT EN 1514
[Flanges and their joints - Dimensions of gaskets for PN-designated flanges]

ELOT EN 1515
[Flanges and their joints – Bolting]

ELOT EN 10226
[Pipe threads where pressure tight joints are made on the threads]

ELOT EN 13480
[Metallic industrial piping]

EN ISO 2858
End-suction centrifugal pumps (rating 16 bar) - Designation, nominal duty point and dimensions

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API 610

[Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Gas Industry Services]

ISO 76

[Rolling Bearings - Static Load Ratings]

ISO 281

[Rolling Bearings - Dynamic Load Ratings and Rating Life]

ISO 21940-11:2016

Mechanical vibration — Rotor balancing — Part 11: Procedures and tolerances for rotors with rigid behaviour

ISO 20816-1

[Mechanical vibration — Measurement and evaluation of machine vibration — Part 1: General guidelines]

All standards or codes mentioned in this specification are valid in their latest version or by the relative superseded edition.



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1 SCOPE

ELOT EN ISO 5199 "Technical specifications for centrifugal pumps-Class II" is an integral part of this standard. The numbering section and paragraph is the same as in ELOT EN ISO 5199. The type of change e.g. addition, exception, modification or substitution is noted for each item.

Compliance with this specification does not relieve the Manufacturer or the Vendor of the responsibility for supplying equipment of proper design and construction and fully suitable for all specified operating conditions.

Exceptions to this and other applicable standards and specifications shall be clearly stated in the Vendor's/ Manufacturer's proposals. Vendor shall either submit a list of exceptions or a statement to the effect that its proposal is in full accordance with these standards and specifications. In this latter case it shall be assumed by the Purchaser that the proposal includes the cost of the requirements of any of the applicable EU Directives, standards and specifications.

The Vendor/Manufacturer is responsible for ensuring that materials supplied by its sub-vendors comply with the requirements of EU Directives, these standards and specifications.

2 SPECIFICATIONS

SCOPE AND FIELD OF APPLICATION

1.1 Mod. This specification covers the minimum requirements for centrifugal pumps intended primarily for chemical plants, offsite services and general utilities applications operating within following rated conditions:

- Fluid temperature between -29° to +177°C
- Discharge pressure up to 21 bar
- Pump speed up to 3600 rpm
- Nature of pumpage non-flammable



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This specification does not intend to exclude horizontally split case design, providing the rotor can be removed without disturbing main pipe connections. Its intent is also to permit the use of vendor's basic standard designs proven successful in similar service.

1.2 Subs. Any preference for pumps additional to their conformity to EN ISO 2858 will be stated in the material requisition/data sheet.

This specification shall apply to vertical or vertical in-line pumps as well where relevant. The Vendor/Manufacturer shall state all deviations in its quotation.

1.5 Subs. EU Directives, national laws and regulations and hierarchically the specific requirements stated in the purchase order and material requisition shall take precedence over this specification. The Vendor/Manufacturer shall in any case notify the purchaser of any possible conflict for resolution.

1.6 New Vendor qualification. Equipment offered by Vendor/Manufacturer shall satisfy the following minimum service and manufacturing experience requirements:

Pumps shall be identical or validly similar in power rating, speed, discharge pressure, mechanical design, materials and rotor dynamics with at least two units produced at the proposed manufacturing plant. These units must have had at least one year's satisfactory operation.

REFERENCES

Mod. Replace reference to **ISO 1940**, Balance quality of rigid bodies with **ISO 1940-1**, Mechanical vibration - Balance quality requirements of rigid rotors.

Replace reference to **ISO 2372**, Mechanical vibration of machines with operating speeds from 10 to 200 rev/s with **ISO 10816-1**, Mechanical vibration - Evaluation of machine vibration by measurements on non-rotating parts.

Add. The following European Directives also apply:

- 2006/42/EC Machinery Directive,
- 2014/68/EU Pressure Equipment Directive (PED),
- 2004/108/EC Electromagnetic Compatibility (EMC),
- Regulation (EU) No 305/2011 Construction Products Directive (CPD)
- 2014/34/EU Explosive Atmospheres (ATEX)

Equipment, components and the complete unit shall bear the CE mark as required by the applicable EU Directives and the relevant certificates or declarations of conformity shall be submitted to the purchaser.



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The latest revisions of following Specifications form part of this specification and take precedence over those listed in ELOT EN ISO 5199, as applicable:

Job Spec. No.DSF-SPC-ELE-021	Electric Motors
Job Spec. No.DSF-SPC-MEC-006	External Painting
Job Spec. No.DSF-SPC-QAC-003	Noise Control
Job Spec. No.DSF-SPC-QAC-005	Shop Inspection of equipment and materials for NGT project

4 DESIGN

4.1 GENERAL

4.1.1 Mod. CHARACTERISTIC CURVE

4.1.1.1 The head-capacity curve shall rise continuously from the rated capacity point to shut-off.

Shut-off head shall be between 110 and 120% of rated head, inclusive of the tolerances listed at paragraph 6.3.2, except axial and mixed-flow type pumps which require special consideration.

4.1.1.2 Pumps with constant speed driver shall be capable of a 5% increase in head by installation of a new impeller. Pumps with turbine or engine drivers may use maximum diameter impellers but shall be suitable for continuous operation at 105 % of rated speed and brief operation to 120% of rated speed.

4.1.1.3 Rated flow shall not exceed 115% of the flow at maximum efficiency for the rated impeller diameter.

4.1.1.4 Performance corrections for viscosity, when applicable, shall be computed in accordance with the Hydraulic Institute Standards.

4.1.1.5 Pumps for parallel operation shall exhibit deviations in head limited to 3% at any corresponding point of the performance curve.

4.1.1.6 Unless otherwise agreed, pump suction specific speed shall be limited to 11,000 (US definition), except for pumps with an anticipated



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operating range down to 30% or below of their capacity at peak efficiency, where the suction specific speed shall not exceed 10,000. Pumps with suction specific speed higher than those specified require purchaser review and approval.

4.1.1.7 Pumps and each component part thereof, which because of the weight, size or shape cannot be handled by hands, shall be provided with lifting lugs or equivalent features.

4.1.2 Mod. NET POSITIVE SUCTION HEAD (NPSH)

4.1.2.1 The NPSHA shall exceed the NPSHR by at least 0,3 m, over the entire anticipated operating range. When impractical or economically attractive, lower NPSH margin could be considered, provided satisfactory NPSH shop test curves of same pump models previously manufactured can be exhibited for review.

4.1.2.2 NPSH shall be referred to:

- pump centerline for horizontal pumps
- centerline of suction nozzle for vertical in-line pumps
- top of foundation for other vertical pumps

4.1.4 New The noise level for the pump set shall be guaranteed not to exceed that specified in the material requisition/data sheet approved by the Owner.

4.1.5 New VERTICAL PUMPS

4.1.5.1 Vendor shall supply, shop mount, align and be responsible for all vertical drive components.

All vertical drive components shall be fitted to the pump in the shop, aligned, dowelled and match-marked prior to being shipped.

4.1.5.2 Pumps, except in line, shall be provided with their own thrust bearing designed to carry the maximum pump thrust in either direction, under any operating conditions.

4.1.5.3 Vendor shall determine the total dynamic head required of submerged pumps to provide the specified discharge pressure at discharge flange based on minimum liquid level.

4.1.5.4 Vendor shall state the following when appropriate:

- NPSHR reference point



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- Minimum submergence
- Minimum clearance from sump bottom

4.1.5.5 Pump column sections DN 80 diameter and larger shall be of flanged construction.

4.1.5.6 Vertical pumps shall be furnished with a soleplate to permit removal of the pump without disturbing the foundation bolts.

4.1.5.7 Line shaft bearing spacing of vertical type pumps shall not exceed 1.5 m.

4.2 PRIME MOVERS

4.2.1 New Prime movers, other than electric motors shall be sized per fig.1 of ELOT EN ISO 5199.

4.2.2 New Electric motor nameplate rating shall be based to the following percentage of pump rated power:

Motor Nameplate Rating	Percent of Rated Power
18.5 kW and less	125
22 kW - 55 kW	115
75 kW and above	110

4.2.3 New Pumps controlled by level control, pumps operating in parallel service or fire water pumps shall have driver rating at least equal to the pump maximum brake absorbed power.

4.2.4 New Motor manufacturer must be approved by Owner. The intent of this requirement is to confine motors to a single motor supplier to the greatest extent possible at a single plant site.

4.2.5 New Antifriction bearings shall be selected to provide a minimum rating life as required by para 4.12.2.

The antifriction bearings shall be equipped with metal cages.

4.2.6 New Drivers shall be aligned and mounted on the pump baseplate by the pump manufacturer unless otherwise specified.

4.3 CRITICAL SPEED, BALANCE AND VIBRATION

4.3.2 Mod. BALANCE AND VIBRATION



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The unfiltered vibration limits for pumps equipped with antifriction bearings as listed in the table of ELOT EN ISO 5199 are applicable from the minimum continuous stable flow to 110 percent of rated flow.

4.4 PRESSURE-CONTAINING PARTS

4.4.1 Add. PRESSURE-TEMPERATURE RATING

Pump casing design pressure at maximum pumping temperature must be at least equal to the maximum possible discharge pressure when operating with the specified liquid, given maximum suction pressure and including the possible head increases per para 4.1.1.2 and 6.3.2.2.

4.4.4 MECHANICAL FEATURES

4.4.4.1 Mod. DISMANTLING

Horizontal pumps and vertical in-line type pumps shall be designed to permit removal of the impeller, shaft, seal and bearing assembly without disturbing the inlet and outlet flange connections.

4.5 BRANCHES (NOZZLES) AND MISCELLANEOUS CONNECTIONS

4.5.3 Mod. VENT. PRESSURE-GAUGE AND DRAIN

Threaded vent (if not self-venting) and drain connections terminating with flanged valves shall be provided on all pumps.

For toxic and hazardous fluids, the connections shall be seal welded.

The connection of pressure gauges shall not be drilled.

4.5.5 Mod. AUXILIARY PIPE CONNECTIONS

Minimum pipe size shall be DN 15 for pumps with discharge nozzle up to DN 80. For larger sizes the minimum pipe size, except for mechanical seal or packing gland, shall be DN 20.

Threaded connections shall be tapered pipe threads per ELOT EN 10226.

4.5.7 New AUXILIARY PIPING

4.5.7.1 Auxiliary piping systems, including all the associated accessories, shall be supplied by vendor fully installed on horizontal pumps and on vertical pumps where practical.



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4.5.7.2 Piping containing process fluids shall be designed and fabricated in accordance with ELOT EN 13480, or equivalent standard.

4.5.7.3 All system components such as fittings, flanges, valves etc. that contain toxic or hazardous fluids shall be made of steel.

4.5.7.4 Pressure and temperature rating of piping containing pumped fluid shall be equivalent to pump design data.

4.5.7.5 When pump case is of alloy material, all components of the flushing system shall be equal or better than the casing material.

4.5.7.6 The minimum nominal wall thickness for carbon steel piping shall be Schedule 80 for nominal pipe size up to DN 40 and Schedule 40 for DN 50 and larger sizes.

Minimum wall thickness for stainless steel piping shall be Schedule 40 for nominal pipe size up to DN 40, and Schedule 10 for DN 50 and larger size.

4.5.7.7 Seamless steel tubing with Parker Ferulok™ or equal compression type fittings, might be used for sizes 3/4 inch or smaller.

Minimum tubing wall thickness for DN 15 and DN 20 sizes shall be 1.65 mm and 2.4 mm respectively.

Tubing ferrules shall be 18-8 stainless steel.

4.5.7.8 Piping shall preferably be fabricated by welding.

Welded fittings may be either socket weld or butt weld type as suitable for the service.

Use of threaded connections for toxic or hazardous fluids shall be held to a minimum and shall be seal welded, except for connections to mechanical seal gland plate and for instrument connection.

4.5.7.9 Piping shall be arranged to provide the flexibility and the accessibility necessary for proper operation, maintenance and cleaning. Piping shall be securely supported to minimize vibration and to prevent breakage during shipment and operation.

4.5.7.10 All connections DN 50 and larger shall be flanged. Threaded connections may be used up to DN 40 pipe size, unless prohibited by clause 4.5.7.8.



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4.5.7.11 Auxiliary connections that do not require to be piped shall be plugged with solid plugs.

The plugs shall be made of same material of pump casing, except for carbon steel plugs which shall be used with cast iron casing.

4.5.7.12 When cooling water is required, pump vendor shall supply the cooling water piping manifolded to single inlet and outlet connections.

4.5.7.13 Piping systems for cooling water or seal flush shall be complete with all fittings, such as valves, sight flow indicators, strainers, gauges, orifices, vent and drain facilities, etc. required for operation and maintenance.

4.5.7.14 All piping systems containing toxic or hazardous fluids shall be hydrostatically tested to at least 150 percent of the casing design pressure.

4.5.7.15 After fabrication, all supplied piping system shall be flushed, cleaned to an operable condition, and preserved, as applicable.

4.5.7.16 The proposed auxiliary piping layout shall be subject to purchaser review and approval.

4.7 Subs. BRANCH (NOZZLE) FLANGES

Unless otherwise specified, flanges shall conform to ELOT EN 1092, ELOT 1514 and ELOT EN 1515 as applicable.

4.7.2 In case the design of the pump does not cope with this requirement, Vendor shall supply a suitable adapter made of same or better grade material, sized to the next larger acceptable pipe size.

4.7.3 Flanges shall be full or spot faced on the back and shall be designed for through bolting.

4.8 IMPELLERS

4.8.4 New Impeller blade under filing, overfilling or V-cutting is not allowed on corrosive or erosive service.

4.9 Subs. WEAR RINGS OR EQUIVALENT COMPONENTS



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4.9.1 Renewable wear rings are required on pumps with closed type impellers. Casing wear rings are required as a minimum.

4.9.2 Mating wear surfaces of hardenable materials shall have a difference in hardness of at least 50 Brinell, unless both wear surfaces have a hardness of at least 400 Brinell.

4.9.3 Renewable wear rings shall be held in place by a press fit with locking pins, threaded dowels or other equivalent method. Tack welding method requires purchaser's approval.

4.11 SHAFT AND SHAFT SLEEVES

4.11.3 Mod. SHAFT DEFLECTION

The 50 μ m shaft deflection limit shall apply to all one and two-stage horizontal pumps and to vertical in-line pumps.

4.11.8 Mod. Arrangement of shaft sleeve, if fitted

Unless otherwise agreed, shaft sleeves shall be provided on all pump applications.

For pumps equipped with conventional packing, shaft sleeves shall be made of stainless steel, hardfaced in the packing area.

4.12 BEARINGS

4.12.2 Clar. ROLLING BEARING LIFE

The basic rating life of 17,500 hours shall be intended based on a rating life (L_{10}) per ISO 76 and ISO 281.

4.12.4 LUBRICATION

4.12.4.1 New Unless otherwise agreed, pump bearings shall be oil lubricated.

4.12.4.2 New Considerations shall be given to lubrication of slow-roll idling turbine driven pumps.

4.12.5 BEARING HOUSING DESIGN

Bearing housings shall be equipped with *Tried*TM or equal constant-level sight-feed oilers (0.12-liter minimum size). The oilers shall consist in a transparent glass bottle with mechanically lockable adjustment, and with protecting metal guard.



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4.13 SHAFT SEALING

4.13.1 Clar. GENERAL

4.13.2 Mod. Unless otherwise specified, the pumps shall be furnished with balanced type mechanical seals.

4.13.2 Mod. STUFFING BOX

Stuffing boxes shall be provided with a lantern ring for the flush injection directly into the packing. Lantern rings shall feature threaded holes to facilitate their removal.

4.13.3 Mod. MECHANICAL SEALS

4.13.2 Mod. TYPE AND ARRANGEMENT

Mechanical seal arrangement and material selection shall be identified in accordance with API Std. 610 code.

Preferably, all mechanical seals for pumps covered by this specification shall be of the same type and standard design, featuring same materials for all components in the whole temperature range, in order to ensure maximum interchangeability and minimize spare parts inventory.

Exceptions to this requirement will be considered for special applications (corrosive, toxic or hazardous liquids, slurries, etc.) dictating use of dual seals, special features or materials.

Built-in or integral type mechanical seals are unacceptable.

4.13.3.4 Mod. CONSTRUCTION FEATURES

A spark-resistant throttle bushing, pressed into the seal gland against an outside shoulder shall be provided, unless an auxiliary sealing device is specified.

The gland connections shall be identified by stamping on the seal gland "F" for flush, "V" for vent, "Q" for quench and "D" for drain.

4.13.3.5 Mod. ASSEMBLY AND TEST

Mechanical seals shall be installed during all running tests, but shall not be used during the pump casing hydrostatic test.

4.13.4 Mod. AUXILIARY PIPING FOR STUFFING BOX AND MECHANICAL SEAL



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See also new para 4.5.7.

4.13.5 Mod. Mechanical design of auxiliary piping

See also new para 4.5.7.

4.14 Add. NAMEPLATES

4.14.1 Nameplates shall be in stainless steel material and secured with stainless steel screws or pins.

4.14.2 Mechanical seal nameplate shall also be provided and attached to the pump. Nameplate shall include complete seal identification.

4.16 Add. COUPLINGS

4.16.1 Unless otherwise specified, couplings shall be of the non lubricated type, with stainless steel flexible discs and steel hubs, supplied from manufacturers approved by purchaser.

Couplings shall be supplied and mounted by pump Vendor.

4.16.2 Where servicing of the mechanical seal requires removal of the coupling hub, the hub shall be mounted with a taper fit.

4.16.3 Coupling selection shall be based on motor direct starting and a minimum locked rotor torque of 250 percent of rated torque.

4.16.4 Couplings, coupling-to-shaft junctures and any other torque transmission components shall be suitable to sustain peak torque transient due to short circuits and motor re-acceleration following momentary power interruptions (typically 5 times the rated torque).


4.16.5 In hazardous area removable rigid all metal non-sparking guards shall be provided for all couplings.

Guards shall extend to within approximately 12 mm of stationary housings.

4.17 Clar. BASE PLATE

Unless otherwise agreed upon, baseplates for horizontal pumps shall be designed for filling with grout but stiff enough without being filled to withstand the forces and moments described in para 4.6.

Grouting holes shall be provided in each bulkhead section delimited by cross members, irrespective whether full or partial depth.

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The grouting openings shall be so located to be accessible for grouting with the pump and driver installed on the baseplate.

Two DN 15 minimum vent holes shall be provided for each bulkhead compartment.

4.17.3 Add. BASE PLATE DESIGN

4.17.3.1 Base plates for horizontal pumps shall be drain-rim or drain-pan design, provided with a DN 25 minimum drain tapped connection at the pump end.

4.17.3.2 The base plate shall extend under the pump and drive components.

4.17.3.3 Baseplates shall be fully machined, even if pump Vendor does not mount the driver; in this latter case, the baseplates shall be supplied with driver pads machined but not drilled.

4.17.3.4 All mounting pads shall be fully machined flat and parallel to receive the equipment. Corresponding surfaces shall be in the same plane within 0.15 mm per meter.

4.17.3.5 Vertical leveling screws spaced for stability shall be provided on the outside perimeter of the baseplate, for unit weighing more than 200 kg.

4.17.3.6 Alignment positioning screws shall be provided for each drive equipment to facilitate horizontal (transverse and longitudinal) adjustment for all units having an installed driver of 30 kW and larger.

4.17.3.7 A separate mounting soleplate, matching pump mounting flange, shall be supplied, unless otherwise specified, for all vertical pumps.

4.17.3.8 Mounting plate surfaces that are to be grouted shall have 50-millimeters-radius outside corners.

4.17.3.9 Baseplates shall be provided with two diagonally oriented earthing bosses.

4.17.4 ASSEMBLY OF PUMP AND DRIVER ON BASEPLATE

4.17.4.1 Mod. Driver pads height shall allow the installation of 3 mm minimum in thickness of stainless steel shims for alignment purpose. All



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shims shall extend underneath the full surface of driver feet, straddling the hold-down bolts.

4.17.4.2 Add. The pump vendor shall supply the necessary driver hold-down bolts, washers, shims and dowel pins, also when the driver supply or mounting is by others. The bolts shall be hexagonal headed type, threaded in accordance with metric threads.

On shipment, bolts, washers, shims and dowel pins shall be securely fastened to pump baseplate to prevent loss.

5 MATERIALS

5.1 Mod. SELECTION OF MATERIALS

5.1.1 Materials shall be in accordance with those specified in the material requisition/data sheet, unless otherwise agreed.

5.1.2 Pressure-casing parts of pumps handling hazardous or toxic fluids shall be made of steel.

5.1.3 Materials shall be identified in the proposal with applicable National standard and grade.

5.1.4 Asbestos and its compounds or other carcinogenic mineral fibers shall not be used in any form.


5.2 Add. MATERIAL COMPOSITION AND QUALITY

5.2.1 18 Cr-8 Ni stainless steel parts which are weld fabricated or hard surfaced by welding and are exposed to the pumped fluid shall be of a stabilized or a low-carbon grade stainless steel.

5.3 REPAIRS

Weld procedures for all major repair weldings on pressure containing parts shall be submitted to purchaser for approval.

Brazed or welded repairs on cast iron parts will not be accepted.

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6 SHOP INSPECTION AND TESTS

6.1 Clar. **GENERAL**

6.1.1 The extent of inspection and testing participation, as well as the advance notice, are defined in the equipment data sheets, and Job Spec. No. 900/4 and Job Spec. No. 970/2.

6.1.2 The Vendor shall provide a quality control plan listing the Proposed program of inspection and testing, for purchaser review and agreement, on the items to be witnessed or observed and the hold points.

6.1.3 Unless otherwise agreed upon the scope of purchaser Inspection shall include as a minimum, suborders, materials, welding, heat treatments, repairs, non-destructive testing, dimensional check, approval of test data and certification, final inspection prior to shipment and, if required by Regulations, verification of Machinery Directive conformity certificate and "CE" mark.

6.1.4 Acceptance of shop test shall not constitute a waiver of requirements to meet field performance under the specified operating conditions, nor does inspection relieve the Vendor of its responsibilities in any way whatsoever.

6.3 **PUMP TEST AND INSPECTION**

6.3.1 **HYDROSTATIC TEST**

6.3.3.1 Mod. Hydrostatic test shall be maintained for a minimum of 30 minutes.

6.3.1.2 Mod. Hydrostatic test of the complete assembled pump is not allowed.

6.3.1.2 Mod. Cooling passages and jackets shall be tested to at least 8 bar.

6.3.2 Add. **PERFORMANCE TEST**

The pumps shall be operated for a sufficient time to reach oil sump temperature stabilization and in any case for a sufficient period to obtain at least five points of complete test data. These points shall include shutoff, minimum continuous stable flow, rated flow and 110 percent of rated flow or end of curve operation, as applicable.

6.3.2.2.b Test speed shall be within 3 percent of the rated speed, unless otherwise approved by purchaser. Test result shall be converted to the rated speed.



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6.3.2.2.c Unless otherwise agreed, no contract motors shall be used for conducting the performance test. Calibrated and certified shop motors or torque meters shall be used for evaluating pump rated power.

6.3.2.2.d In case of multiple unit, except for pumps operating in parallel, only one pump, at purchaser's choice shall be given a "witnessed" test in the following cases:

- Vertical multistage pumps
- Pumps operating in parallel
- Pumps with normal specified capacity lower than pump minimum continuous flow (minimum flow shall be checked and recorded)
- Pumps with orifice plate fitted on discharge nozzle
- Prototype, or pumps operated beyond previous Vendor experience
- Pumps supplied by new Vendors

6.3.2.2.e Pump performance shall be within the following tolerances of the characteristics to be guaranteed.

Rated head	-2% to +5%
Head at "shut-off"	-10% to +10% (°)
BkW	+4%
Efficiency	-1/2 point of efficiency
NPSH required	+0%

6.3.2.3 Add. NPSH test is required on all pumps when the difference between NPSHA and NPSHR is 0,6 m. or lower, in which case both NPSH and performance test shall be witnessed.

Unless otherwise agreed, the NPSH test shall be performed by using a vacuum suppression tank.

6.3.2.4 Add. The pumps shall operate with no undue heating of bearings or other display of unfavorable operation.

6.3.2.6 New If it is necessary to dismantle the pump after the shop test for the sole purpose of machining the impeller(s) to meet the tolerance on differential head, no retest will be required, unless the reduction in diameter exceed 5 percent of the original diameter. The diameter of the shop test, and the final diameter of the impeller, shall be recorded on a certified shop test curve showing both impeller trim diameters



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6.3.2.7 New Any filing, grinding or other reworking of the impellers to meet the guaranteed performances shall be described in the test report and part list in sufficient detail to permit re-ordering of new impellers similarly reworked and/or supplied at the appropriate (without any blade filing) trimming diameter.

6.3.3 Add. INSPECTION

Unless otherwise specified, each pump receiving a witnessed performance test shall be dismantled for a witnessed internal inspection.

No surfaces or parts of pump shall be painted until the inspection is completed.

If disassembly is required for improving operation or for defect correction, the initial running test is not acceptable and must be repeated.

6.3.4 Add. FINAL INSPECTION

Performance and NPSH test curves shall be reviewed by purchaser prior to the pump being released for shipment.

7 PREPARATION FOR DISPATCH

Preparation for shipment shall be in accordance with the requirements stated in the purchase documents.

The painting of all exterior surfaces shall be suitable for the specified environment. The paint, preparation, and painting procedure shall be approved by purchaser and shall include both primer and finish coat.

8 New. SPECIAL TOOLS

Pumps shall be supplied with all special tools and fixtures for installation, commissioning and maintenance.

9 New GUARANTEE AND WARRANTY



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9.1 Pump Vendor shall be responsible for the commercial and engineering coordination, supply, delivery and satisfactory operation of the complete unit, including driver, transmission, and all the auxiliary equipment.

9.2 Pump Vendor shall be responsible for parts supplied by its sub-suppliers.

9.3 Unless exception is recorded by the Vendor in its proposal, it shall be understood that the Vendor agrees to the guarantees and warranties specified below:

9.3.1 MECHANICAL

Unless otherwise specified in the purchase order, all equipment and component parts shall be warranted by the Vendor against defective materials, design and workmanship for 1 year after being placed in service or 18 months after date of delivery whichever is the earliest.

9.3.2 PERFORMANCE

The equipment shall be guaranteed for satisfactory performance at all operating conditions specified in the data sheet.

9.3.3 MAKE GOOD

In any performance deficiency or defects occur during the guarantee and warranty period, the Vendor shall make all the necessary alterations, repairs or replacement at the conditions defined in the purchase documents.

ANNEX E Mod. The seal flushing designation shall be those specified in API Std 610.

ANNEX F Add. Enquiry, proposal, purchase order

ANNEX G Add. Documentation after purchase order

The information to be furnished by the vendor at proposal and as contract data is specified in the Material Requisition.