

DEP SPECIFICATION

CENTRIFUGAL SUBMERGED MOTOR PUMPS AND ELECTRO SUBMERSIBLE HYDRAULIC TURBINES

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for centrifugal submerged motor pumps (column-mounted or pot-mounted) in refrigerated product or pressurised storage service.

This DEP also specifies requirements and gives recommendations for electro submersible hydraulic turbines, also referred to as liquid expanders.

Note: If a term in this DEP is not applicable to the design, manufacturing, testing, or operation of submerged generator liquid expanders, then any related clause is not applicable.

This DEP is intended to be used in conjunction with API 610/ISO 13709 data/requisition sheets for centrifugal pumps.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process should be implemented. This is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this document which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this document as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Best efficiency point is the flow at which a pump achieves its highest efficiency.

Continuous service for this pump/expander type is an uninterrupted operation period of at least 16,000 h under the conditions specified for the guarantee point, unless otherwise specified. Manufacturer/Supplier shall state if longer continuous service is available with different bearing options, i.e., ceramic or hydrostatic sleeve type.

Column-mounted is the installation of a complete pump assembly in a storage tank column.

Guarantee point is the normal operating point as specified on the data/requisition sheet and the point at which the Manufacturer certifies that performance of the pump is within the tolerances specified (ref. API Std 610, section 7.3.1.1). At least the following data shall be shown on the data/requisition sheets for this point: flow, total differential head, rated suction pressure, density and viscosity of the pumped liquid, NPSHA and speed.

Intermittent service is operation, including intentional stops and starts, under the conditions specified for the guarantee point.

Design pressure is the greatest pressure at the specified pumping temperature for which the pump casing and the vessel (for pot-mounted pumps) are designed.

NOTE: This includes all intended operating conditions and possible upset conditions.

Maximum discharge pressure is the maximum suction pressure plus the maximum differential head that the pump would be able to develop when operating at the specified conditions of speed, maximum density and lowest pumping temperature with the maximum impeller size installed.

Maximum rated discharge pressure is the maximum suction pressure plus the maximum differential head that the pump would be able to develop when operating at the specified conditions of speed, maximum density, and lowest pumping temperature with the furnished impeller size installed.

Maximum suction pressure is the highest suction pressure to which the pump may be subjected during operation.

Minimum flow is the higher of the two (2) minimum flows defined below. Minimum flow does **not** refer to the minimum required process flow.

Minimum continuous thermal flow is the lowest flow at which the pump can operate without its operation being impaired by the temperature rise of the pumped liquid.

Minimum continuous stable flow is the lowest flow at which the pump can operate without exceeding the vibration limits imposed by this DEP.

Net positive suction head (NPSH) is the total suction head determined at the suction flange (bell mouth) or at the centreline of the first impeller or inducer of the pump, minus the vapour pressure of the liquid at the highest temperature specified. Both suction head and vapour pressure are expressed in metres liquid absolute.

Net positive suction head available (NPSHA) shall be determined by the Principal for the pumping system. NPSHA is the total suction head determined at a reference location (see below) minus the vapour pressure of the liquid at the highest temperature specified and at rated flow. Both suction head and vapour pressure are expressed in metres liquid absolute.

For pot-mounted pumps, the NPSHA is referenced to the suction flange of the pot.

For column-mounted pumps, the NPSHA is referenced to the centre line of the inducer or the impeller of the pump.

Net positive suction head required (NPSHR) is the minimum NPSH required at rated flow and at highest specified liquid temperature to prevent a head drop of more than 3% to the overall head value measured due to cavitation within the pump. This is due to the properties of cold boiling liquids which result in instantaneous loss of performance. The NPSHR is determined by the Manufacturer and shall be based on the pump handling the actual product specified on the data/requisition sheet and expressed in metres of actual liquid.

Pressure casing comprises all stationary pressure-containing parts of the complete pump unit, including all nozzles or other parts attached thereto subject to a differential pressure greater than 1 bar (ga).

Pot-mounted is the installation of a complete pump assembly or expander assembly, process auxiliaries and power connections in a pressure vessel.

Pressurised storage service is the handling of liquefied butane or lighter hydrocarbons stored in pressurised vessels at specified temperature.

Rated discharge pressure is the discharge pressure developed by the pump at the guarantee point with the furnished impeller size and at rated flow, speed, suction pressure and density.

Rated flow is the flow at the guarantee point.

Rated power is the power required by the pump at the guarantee point.

Refrigerated product service is the handling of butane or lighter hydrocarbons that are in the liquid phase under atmospheric pressure.

Rated suction pressure is the specified suction pressure of the pump at the guarantee point.

Note: With respect to submerged generator liquid expanders, the following are not applicable terms: column-mounted, maximum discharge pressure, maximum rated discharge pressure, maximum suction pressure, minimum continuous thermal flow, net positive suction head (NPSH/NPSHR/NPSHA), rated discharge pressure, rated suction pressure.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced clause number is shown in brackets. Other documents referenced by this DEP are listed in [5].

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number, dated April 2003. The following are the main, non-editorial changes:

Old clause	New clause	Change
1.1	1.1	Changed requirement to use this DEP for expanders from may to shall. Changed from DEP pump data sheet to API 610 pump data sheet. Added the addition of applicability to submerged generator liquid expanders (electro submersible hydraulic turbines) results in additional exceptions/deviations.
2.1	2.1	Added note with respect to submerged generator liquid expanders. Added comment that expanders shall be of upward flow design. Refined the requirements for head rise, operating range and guarantee point to be per API 610/ISO 13709. Changed preferred operating range to in accordance with API 610. Added requirement that pump and expander suppliers shall state their minimum continuous flow rate and the basis for this value, i.e. CFD, etc.
2.2	2.2	Deleted reference to DEP 31.10.00.31 Gen, Noise Control as it is not considered suitable for reference in requisitions of individual equipment.
2.3	2.3	For liquid expanders, added Generator DEP and Variable Speed Drive DEP. Deleted reference to DEP 80.00.10.10 and API RP 500 on area classification selection since supplier is not responsible for determining the appropriate area classification, buyer should specify.
2.5	2.5	Modified preferred operating range to be in agreement with API 610.

Old clause	New clause	Change
2.13	2.13	Added requirement for Manufacturer to comment on inlet strainers and mesh sizes. Added comment for Manufacturer to comment on need of ceramic bearings to prevent bearing arcing in for VFD motors or generator applications.
2.14	2.14	Added reference to speed measurement system and that supplier shall comment on new developments to improve reliability.
3.3	3.3	Deleted reference to DEP 30.10.02.31-Gen. Metallic Materials-prevention of brittle fracture since this is not appropriate reference for purchase specification.
4.4	4.4	Added requirements for generator testing.
4.6	4.6	Changed max flow point from 125% to 120% in accordance with API 610. Modified instrument range based on supplier experience. Added requirements for expander runaway test. Added requirement to measure axial position of shaft to ensure thrust equalizing system working properly.
4.7	4.7	Changed basis for NPSHR for multi-stage pumps to 3% drop in total differential head due to properties of cold boiling liquids which result in instantaneous loss of performance.
5.0	5.0	Deleted DEP 31.38.01.11 Gen on piping-general requirements since it was not called out in the DEP. Also deleted DEPs for pump data sheet, noise control, area classification and metallic materials-prevention of brittle fracture.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of "DEPs on the Web", available through the Global Technical Standards web portal <http://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.7 HIERARCHY OF DOCUMENTS

In the event of conflict between documents relating to the enquiry or order, the following hierarchy shall apply:

- 1st priority: the purchase order and variations thereto;
- 2nd priority: data/requisition sheet and variations thereto;
- 3rd priority: this DEP.