

DEP SPECIFICATION

CENTRIFUGAL PUMPS

(AMENDMENTS/SUPPLEMENTS TO ISO 13709)

DEP 31.29.02.30-Gen.

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DESIGN AND ENGINEERING PRACTICE

DEM1



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TABLE OF CONTENTS

PART I	INTRODUCTION	5
1.1	SCOPE	5
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	5
1.3	DEFINITIONS	6
1.4	CROSS-REFERENCES	6
1.5	SUMMARY OF MAIN CHANGES.....	6
1.6	COMMENTS ON THIS DEP	7
1.7	DUAL UNITS.....	7
1.8	NON NORMATIVE TEXT (COMMENTARY).....	7
PART II	GENERAL	8
PART III	AMENDMENTS/SUPPLEMENTS TO ISO 13709:2009	9
3	Terms and definitions	9
3.43	Pressure casing	9
3.65	Continuous operation.....	9
3.66	Hazardous service	9
3.67	Abrasive service.....	9
3.68	Vital, essential and non-essential services	9
3.69	Certified test or certified inspection.....	10
3.70	Major weld.....	10
4	General.....	10
4.2	Classification and designation	10
6	Basic design	11
6.1	General	11
6.3	Pressure casings	12
6.4	Nozzle and pressure casing connections	13
6.6	Rotors	13
6.7	Wear rings and running clearances	14
6.8	Mechanical shaft seals	14
6.9	Dynamics	14
6.10	Bearings and bearing housings	15
6.11	Lubrication	15
6.12	Materials	15
7	Accessories.....	17
7.1	Drivers.....	17
7.2	Couplings and guards	19
7.3	Baseplates	20
7.4	Instrumentation	20
7.5	Piping and appurtenances	21
8	Inspection, testing and preparation for shipment.....	22
8.1	General	22
8.2	Inspection.....	23
8.3	Testing	24
8.4	Preparation for shipment	26
9	Specific pump types	26
9.1	Single stage overhung pumps	26
9.2	Between-bearings pumps (types BB1, BB2, BB3 and BB5)	27
9.3	Vertically suspended pumps (types VS1 through VS7).....	28
10	Vendor's data	30
10.2	Proposals	30
Annex G	(informative) Materials class selection guidance.....	31

Annex L (informative) Vendor drawing and data requirements 32
L.2 Description 32

Annex N (informative) Pump datasheets and electronic data exchange 33
N.3 Electronic data sheets 33

PART IV REFERENCES 34

APPENDICES

APPENDIX 1 MATERIALS SELECTION 37

PART I INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for centrifugal pumps.

This DEP is based on ISO 13709:2009. Part III of this DEP amends, supplements and deletes various clauses of ISO 13709. Part III follows the clause numbering of ISO 13709:2009 for easy reference.

All clauses of ISO 13709 not modified by this DEP remain valid as written.

NOTE: API 610, 11th edition, is identical to ISO 13709:2009.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual (DEM) 1 – Application of Technical Standards.

This is a revision of the DEP of the same number dated February 2015; see (1.5) regarding the changes.

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 shall 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 could 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 with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP 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, the objective being to obtain agreement to follow this DEP 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

NOTE: In ISO 13709, the term **Vendor** is used. In this DEP, the term Vendor shall be understood to mean the Manufacturer/Supplier.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

NOTE: In ISO 13709, the term **Purchaser** is used. In this DEP, the term Purchaser shall be understood to mean the Principal.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

1.3.2 ABBREVIATIONS

Term	Definition
MAWP	Maximum Allowable Working Pressure
NPSHA	Net Positive Suction Head Available
NPSH3	Net Positive Suction Head Required
PQR	Procedure Qualification Record
WPS	Welding Procedure Specification(s)

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (Part IV).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated February 2015.

The changes followed a requirements quality review and were not a full technical update. The following are the main, non-editorial changes.

Section/Clause	Change
All	Restructured and clarified requirements, enforced use of shall/should/may for normative statements.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://swwww.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

PART II GENERAL

(Part III) of this DEP is written as amendments and supplements to ISO 13709:2009. Wherever reference is made to ISO 13709, it shall be understood to mean ISO 13709:2009 as amended/supplemented by this DEP.

For ease of reference, the clause numbering of ISO 13709:2009 has been used throughout (Part III) of this DEP.

Clauses in ISO 13709:2009, which are not mentioned in this DEP, shall remain valid as written.

PART III AMENDMENTS/SUPPLEMENTS TO ISO 13709:2009**3 Terms and definitions****3.43 Pressure casing**

Replace with the following:

Composite of all stationary pressure-containing parts of the pump, including all nozzles, seal chambers and auxiliary process liquid piping permanently attached to the pump casing or seal chamber, but excluding the gland plates and the stationary and rotating members of mechanical seals.

Add new clauses:

3.65 Continuous operation

Uninterrupted operation for a period of at least 24,000 h at the specified operating conditions.

This does not include intermittent operations such as:

- *pumps started and stopped automatically at intervals by process-operated controls;*
- *pumps started up and stopped manually for batch transfer.*

3.66 Hazardous service

1. Service comprising the following categories, which shall be specified on the data/requisition sheets:

a. **Hazard Category 1**

- i. Liquids classified as "very toxic - acute", in DEP 01.00.01.30-Gen.
- ii. Liquids containing ethylene oxide.

b. **Hazard Category 2**

- i. Liquids classified as "very toxic - chronic", in DEP 01.00.01.30-Gen.
- ii. Hydrocarbon liquids at an operating temperature above their auto-ignition temperature.

c. **Hazard Category 3**

- i. Hydrocarbon liquids with a seal chamber vapour pressure higher than 500 kPa (abs) (73 psia);
- ii. Light hydrocarbon services (ISO 21049:2004, Clause 3.38);
- iii. Liquids classified as "very toxic - environment", in DEP 01.00.01.30-Gen.

3.67 Abrasive service

Service in which there is an expected wear rate of 0.1 mm (0.004 in) or more per year, or where hard particles larger than 100 µm (0.004 in) exist in quantities exceeding 100 mg/kg (100 ppm).

3.68 Vital, essential and non-essential services

These terms are defined as in Table I-1:

Table I-1 Definition of vital, essential and non-essential services

	SAFETY EQUIPMENT	OTHER EQUIPMENT		
	SERVICE CATEGORY			
	VITAL	ESSENTIAL		NON-ESSENTIAL
		Non-spared equipment	Spared equipment	
Definition	A service in which failure of equipment causes an unsafe condition of the plant or installation resulting in jeopardy to life and/or major damage (fire, explosion, etc.).	A service in which failure of equipment renders a plant or process unit inoperable or reduces performance to a level unacceptable to the Principal.	A service in which failure of equipment renders a plant or process unit inoperable or reduces performance to a level unacceptable to the Principal.	All other services.
Examples	• Firewater pumps with diesel and motor drives; • Emergency Shutdown (ESD) systems; • Emergency Instrument Air (EIA) compressor.	• Hydrocracker (HCU) feed pump; • HCU recycle compressor; • Cat Cracker (FCCU) main air compressor; • Forced Draft (FD) and Induced Draft (ID) fans.	• Boiler Feedwater (BFW) pumps; • Fractionator's bottom pumps; • Fresh gas compressors (HCU).	• Drinking water pumps; • Sewage pumps.

3.69 Certified test or certified inspection

Inspection or test which Vendor conducts and certifies, without Purchaser involvement.

3.70 Major weld

Weld repair of a casting is defined as "major" if a repair weld has a depth of more than 50% of the wall thickness or has a length of more than 150 mm (6 in) in one or more directions, or if the total surface area of all repairs on the casting exceeds 10% of the total casting surface area. A weld repair necessitated by a leaking pressure test is also classed as "major".

4 General**4.2 Classification and designation****4.2.2 Pump designations and descriptions****4.2.2.4 Pump type OH4**

Add the following to this clause:

1. Pump type OH4 shall not be used.

4.2.2.5 Pump type OH5

Add the following to this clause:

1. OH5 pumps shall also comply with BS 4082-1, with a casing test pressure rating of Code R.

4.2.2.10 Pump type BB4

Add the following to this clause:

1. Pump type BB4 shall not be used.

6 Basic design

6.1 General

6.1.1

Add the following to this clause:

1. For Pumps in Vital or Non-Spared Essential services, the pump Manufacturer/Supplier shall confirm that the quoted equipment, pump, gear, and driver design is proven (i.e., that the Manufacturer/Supplier has experience of 24,000 operating hours with the same equipment in at least 3 similar installations).

6.1.8

Replace 2nd paragraph with:

1. The Net Positive Suction Head Available (NPSHA) shall exceed the Net Positive Suction Head Required (NPSH3) 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 the lesser of 120% of rated flow and maximum system capacity.
2. If the suction pressure at the pump is less than atmospheric, then the NPSHA shall exceed the NPSH3 by at least 2 m (6 ft) with the following exception:
 - a. NPSH margins for high energy pumps are excluded from this guideline, and shall be subject to Principal guidance and approval.
3. The use of inducers shall be subject to approval by the Principal.

Inducers generally are only acceptable on high speed integrally geared (OH6) and vertical submerged motor cryogenic pumps.
4. For sulfinol, carbonate and amine services, NPSH margin ratio (i.e., NPSHA/NPSH3) shall be at least 1.3 for tip speeds up to 35 m/s, at least 1.5 for tip speeds between 35 and 60, and at least 2.0 for tip speeds above 60 m/s.
5. For liquids containing dissolved gases, to avoid cavitation damage due to vapour-induced flow path restrictions, NPSHA shall be 1.5 x NPSH3, with a minimum margin of 5 m (15 ft) between NPSHA and NPSH3.
6. For Pumps in Vital or Non-Spared Essential services, NPSHA shall exceed NPSH3 by at least 10% or 2 m (6 ft), whichever is greater, at the rated operating point.
 - a. NPSHA shall exceed NPSH3 by 1 m (3 ft) at 120% of the rated operating point.

6.1.9

Replace this clause with:

1. The value of S shall be 213 in SI units (11,000 in USC units) or less.

6.1.14

Replace this clause with the following new heading and clause:

6.1.14 Information to be submitted with the tender

1. For each pump service with a driver 75 kW (100 HP) and larger, the Vendor shall submit estimated sound pressure levels (including octave band spectrum) of the equipment, together with any other relevant information as requested in the data sheet, DEP 31.10.00.94-Gen.
2. The Vendor shall indicate what special silencing measures, if any, are proposed in order to meet the specified sound pressure levels.

6.1.15

Replace the last sentence with the following:

1. Modifying the impeller to meet performance by underfiling, or overfiling shall only be permitted as part of a controlled manufacturing process subject to approval by the Principal, and provided that the pump Manufacturer/Supplier submits a record of the filing undertaken.
2. The numbers of vanes in impellers shall be different to the numbers of vanes in diffusers.
3. On pumps with two or more stages, the impellers/diffuser configuration shall be staggered to avoid coincidence of pressure pulses.

6.1.28

Add the following to this clause:

1. For marine applications, the Vendor shall state the maximum inclination at which the pump can operate.

Add the following new clause:

6.1.35

1. Balance disk or combinations with a balance disk shall not be used.

6.3 Pressure casings**6.3.6**

Replace this clause with:

1. All parts referred to in the definition of pressure casing (3.43) SHALL [PS] have the same MAWP.

6.3.9

Add the following to a) and c) respectively:

- a. Or if specified, a pumping temperature of 100 °C (200 °F) or higher.
- c. Axially split casing pump, BB3, may be used up to rated discharge pressures of 10,000 kPa (1,450 psi) in hazardous service, and 14,000 kPa (2,000 psi) in non-hazardous service.

6.3.10

Add the following to this clause:

1. Gasket materials shall be as per ISO 13709:2009 Table H.1.

6.4 Nozzle and pressure casing connections

6.4.2 Suction and discharge nozzles

6.4.2.1

Replace this clause with:

1. All pumps shall have flanged suction and discharge nozzles of equal ASME pressure/temperature ratings.

6.4.3 Auxiliary connections

6.4.3.1

Add the following to this clause:

1. Socket welded connections shall not be used when:
 - a. the pump nozzles are Class 900 or above, or;
 - b. the pumping temperature is 0 °C (32 °F) or below, or;
 - c. the pump is for hazardous service, or;
 - d. ISO 15156 or NACE MR0103 is applicable.
2. Full penetration butt welded connections shall be used when:
 - a. the pump nozzles are Class 900 or above, or;
 - b. the pumping temperature is 0 °C (32 °F) or below, or;
 - c. the pump is for hazardous service, or;
 - d. ISO 15156 or NACE MR0103 is applicable.
3. Unions shall not be used.

6.4.3.10

Replace the first sentence with:

1. Piping shall be gusseted in two orthogonal planes to increase the rigidity of the piped connection, in accordance with the following stipulations.

6.6 Rotors

6.6.3

Replace the third sentence with:

1. Collets shall not be used in vertical pumps.

6.6.11

Add the following to this clause:

1. The use of target rings s shall be subject to approval by the Principal.

Add the following new clause:

6.6.15

1. Shafts and impellers shall not be plated for repair purposes.
2. Repairs to rotating elements shall be subject to approval by the Principal.
3. For Pumps in Vital or Non-Spared Essential services, each rotor shall be clearly marked with a unique identification number on the end opposite the coupling.