INTERNATIONAL STANDARD

ISO 14847

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Rotary positive displacement pumps — Technical requirements

Pompes volumétriques à mouvement rotatif — Prescriptions techniques

Reference number
ISO 14847:1999(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 14847 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee ISO/TC 115, *Pumps*, Subcommittee SC 1, *Dimensions and technical specifications of pumps*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read “...this European Standard...” to mean “...this International Standard...”.

Annexes A and ZZ of this International Standard are for information only.

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Contents

Foreword

The text of EN ISO 14847:1998 has been prepared by Technical Committee CEN/TC 197 "Pumps", the secretariat of which is held by AFNOR**,** in collaboration with Technical Committee ISO/TC 115 "Pumps”.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 1999, and conflicting national standards shall be withdrawn at the latest by September 1999**.**

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard specifies all the technical requirements for rotary positive displacement pumps and rotary positive displacement pump units with the exception of safety and testing. Safety and testing of positive displacement pumps and pump units are specified in the following European Standards:

EN 809 Pumps and pump units for liquids - General safety requirements

prEN 12162 Liquid pumps - Procedure for hydrostatic testing

EN ..... Positive displacement pumps and pump units - Code for acceptance tests [WI 0197018]

EN 12639 Liquid pumps and pump units - Noise test code - Grade 2 and 3 of accuracy

1 Scope

This standard specifies the technical requirements, other than safety and testing, for rotary positive displacement pumps and rotary positive displacement pump units.

This standard does not apply to rotary positive displacement pumps for fluid power applications.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 287-1	Approval testing of welders - Part 1: Steels
EN 287-2	Approval testing of welders - Part 2: Aluminium
EN 288-1	Approval of procedures for welding metallic materials - Part 1: General rules
EN 288-2	Approval of procedures for welding metallic materials - Part 2: Arc welding
EN 288-3	Approval of procedures for welding metallic materials - Part 3: Arc welding steels
EN 809	Pumps and rotary positive displacement pump units for liquids - General safety requirements
EN 20898-1	Mechanical properties of fasteners - Part 1: Bolts, screws and studs (ISO 898-1: 1988)
EN 20898-2	Mechanical properties of fasteners - Part 2: Nuts with specified proof load values - Course thread (ISO 898-2: 1992)
prEN 1956	Non-destructive testing - Penetrant testing and magnetic particle testing - Viewing conditions
prEN 12162	Liquid pumps - Procedure for hydrostatic testing
prEN 12723	Liquid pumps - General terms for pumps and rotary positive displacement pump units, definitions, quantities, symbols and units

prEN ISO 4126-1	Safety devices for protection against exessive pressure - Part 1: Safety relief valves (ISO/DIS 4126-1: 1995)
prEN ISO 9934-1	Non-destructive testing - Magnetic particle inspection - General principles (ISO/DIS 9934-1: 1996)
ISO 7-1	Pipe threads where pressure-tight joints are made on the threads - Part 1: Designation, dimensions and tolerances
ISO 14	Straight-side splines for cylindrical shafts with internal centering - Dimensions, tolerances and verification
ISO 228-1	Pipe threads where pressure-tight joints are not made on the threads - Part 1: Designation, dimensions and tolerances
ISO/R 773	Rectangular or square parallel keys and their corresponding keyways (Dimensions in millimetres)
ISO/R 774	Taper keys with or without gib head and their corresponding keyways (Dimensions in millimetres)
ISO/R 775	Cylindrical and 1/10 conical shaft ends
ISO/775: ADD 1	Checking of the depth of keyways in conical shaft ends - Addendum 1
ISO 1027	Radiographic image quality indicators for non-destructive testing - Principles and identification
ISO 2491	Thin parallel keys and their corresponding keyways (Dimensions in millimetres)
ISO 2492	Thin taper keys with or without gib head and their corresponding keyways (Dimensions in millimetres)
ISO 3117	Tangential keys and keyways
ISO 3453	Non-destructive testing - Liquid penetrant inspection - Means of verification
ISO 3912	Woodruff keys and keyways.
ISO 4156	Straight cylindrical involute splines - Metric modules, side fit - Generalities, dimensions and inspection
ISO 7005-1	Metallic flanges - Part 1: Steel flanges
ISO 7005-2	Metallic flanges - Part 2: Cast iron flanges

ISO 7005-3	Metallic flanges - Part 3: Copper alloy and composite flanges
ISO 10375	Non-destructive testing - Ultrasonic inspection - Characterization of search unit and sound field

3 Definitions

For the purposes of this standard the definitions given in prEN 12723 apply together with the following:

3.1 rotary positive displacement pump: A machine in which liquid is trapped in confined volumes and transported from an inlet port to an outlet port by a rotational movement of the pumping element or elements.

NOTE: According to EN 809, pumps are defined as being terminated by their inlet and outlet branches as well as, in general, by their shaft ends without couplings.

3.2 rotary positive displacement pump unit: An assembly of a rotary positive displacement pump and its driver, with necessary transmission and structural supporting elements terminating at the connections for the inlet and outlet branches and at the energy supply to the driver.

4 Information and requirements to be confirmed, agreed and documented

4.1 Purchaser information

The purchaser shall provide the supplier with the information necessary for the proper selection of a pump or pump unit. To facilitate this the data sheet included as annex A can be used. The selection shall consider all received and relevant information on performance requirements, environment and intended operating conditions. Any missing information necessary for pump selection shall be requested by the supplier.

The purchaser's information shall include specification of options and items for special agreement according to this Standard and, where applicable, requests for deviations from this Standard. Clauses of this Standard referring to options and special agreements are listed in 4.2 and 4.3.

4.2 Optional requirements

If the purchaser wishes to include any of the optional requirements given in this standard such requirements shall be specified and documented at the time of enquiry and confirmed at the time of order. See clauses:

6.5.2 constant level oilers;
6.7.1 flanged or screwed connections;
6.7.1 studded flange facings;
6.7.1 alternative flange specifications;
6.7.1 alternative pipe thread specifications;
6.9.2 alternative connection specifications for auxiliary ports.

4.3 Items to be agreed

Items to be agreed between purchaser and supplier shall be fully documented at the time of placing the order. See clauses:

7.4	Baseplates;
7.4.1	drain rim baseplates;
7.4.1	special alignment facilities for baseplates;
7.6.2.2	systems for heating/cooling;
13.6	Installation / operating instructions

5 Fitness for purpose

The design and selection of the pump and pump components shall be compatible with the liquid, environment and operating conditions supplied by the purchaser in accordance with clause 4.

6 Pump design

6.1 Environmental conditions

Pumps and rotary positive displacement pump units shall be designed to operate under the following normal conditions:

- minimum air temperature 2 °C;
- maximum air temperature 40 °C;
- maximum relative humidity 80 %.

If unusual environmental or operating conditions, such as those listed below, have been specified by the purchaser at the time of enquiry, the pump shall be designed to meet these requirements:

- ambient temperatures or humidity deviating from the above values;
- exposure to direct sunlight;
- atmospheric pollution including airborne solids;
- biological attack;
- wetting by directed water;
- cleaning by hot water, steam or chemicals;
- external shock or vibration;
- lack of ventilation;
- flooding;
- extended periods of shut-down.

6.2 Basic design criteria

Pumps shall be designed to operate continuously as well as intermittently with any combination of parameters supplied by the purchaser in accordance with clause 4.

Consideration shall be given during design to the handling of components and assemblies when erecting, assembling and maintaining the pump/pump unit. Facilities shall be provided, where necessary, for jacking bolts, extraction screws, locating dowels and spigots and lifting eyes.

Designs shall comply with the safety requirements of EN 809.

6.3 Design of structural and pressure containing parts

The design of the pump and pump unit components shall be suitable for the operating conditions and for the environment specified.

6.4 Sealing systems

All shafts extending outside of enclosed machinery shall be fitted with a suitable seal. The seal shall be selected and installed according to the seal manufacturer's recommendations for the operating conditions.

6.5 Bearing lubrication

6.5.1 If grease lubricated bearings need re-lubrication during their service life of the pump, suitable means for re-lubrication shall be provided.

6.5.2 Oil lubricated bearings which are not lubricated by the process liquid shall be fitted with an oil reservoir with a visual oil level indicator. Adding or draining oil shall be accomplished without disassembly other than plugs or breathers.

NOTE: Constant level oilers may be used providing the working oil level is clearly marked on the bearing housing.

6.6 Shafts

6.6.1 Shafts with rectangular or square parallel keys shall comply with ISO/R 773 or ISO 2491.

6.6.2 Shafts with tapered keys shall comply with ISO/R 774 or ISO 2492.

6.6.3 Shafts with parallel or tapered ends for couplings shall comply with ISO/R775 and ISO 775 Addendum 1 for inspection of keyway depths.

6.6.4 Shafts with tangential keys shall comply with ISO 3117.

6.6.5 Shafts with Woodruff keys shall comply with ISO 3912.

6.6.6 Splined shafts shall comply with ISO 14 or ISO 4156.

6.7 Process inlet and outlet pipe connections

6.7.1 Inlet and outlet connections shall be flanged or threaded and positioned as specified on a dimensional drawing or in the supplier's literature.

NOTE 1: Connection flanges may be studded provided it is not necessary to remove the associated pipework during routine maintenance.

The type, size and rating of connections shall be as specified in ISO 7005 and fully detailed on the supplier's specification including any special surface finishes.

NOTE 2: Other connection specifications may be supplied if agreed between the purchaser and the supplier.

Thread forms for threaded pipe connections shall conform to ISO 7-1 or ISO 228-1.

NOTE 3: Alternative pipe thread forms may be supplied if agreed between the purchaser and the supplier.

6.7.2 Inlet and outlet connections shall have a design pressure higher than, or equal to, the maximum allowable operating pressure for that connection.

6.7.3 Unless intended for venting to atmosphere during operation tapped auxiliary openings not connected to pipework shall be fitted with plugs of material at least equivalent to the component.

6.7.4 *Forces and moments on process connections*

Metallic process connections shall be capable of supporting the forces and moments, acting simultaneously, indicated in table 1.

Table 1: Forces and moments on metallic process connections

Pipe dia. (mm)	Forces		Moments	
	$F_{(x, y \text{ or } z)}$ max. (N)	$F_{(total)}$ max. (N)	$M_{(x, y \text{ or } z)}$ max. (Nm)	$M_{(total)}$ max. (Nm)
25	190	270	85	125
40	255	360	115	170
50	295	420	145	210
80	425	600	215	315
100	505	720	260	385
125	610	870	325	480
150	720	1 020	385	565
200	930	1 320	500	735
250	1 140	1 620	625	920
300	1 355	1 920	740	1 090
350	1 565	2 220	865	1 270
400	1 775	2 520	980	1 445
450	1 980	2 815	1 095	1 615
500	2 200	3 125	1 220	1 795
600	2 625	3 725	1 460	2 145

NOTE: $F_{(total)} = \sqrt{F_x^2 + F_y^2 + F_z^2}$ and $M_{(total)} = \sqrt{M_x^2 + M_y^2 + M_z^2}$

At no time shall the values of F_x, F_y and F_z or M_x, M_y and M_z all be maximum values.

Screwed connections shall not be subject to moments which tend to tighten or loosen the pipe in the pump casing.

6.8 Draining and venting

Methods shall be provided for draining and venting the pump and shall be shown in the instruction manual.

6.9 Auxiliary pipe connections

6.9.1 All auxiliary connections shall be clearly identified in the instruction manual.

6.9.2 All auxiliary port connections shall conform to ISO 7005, ISO 7-1 or ISO 228-1.

NOTE: Other connection specifications may be supplied if agreed between the purchaser and the supplier.

6.10 Threaded fasteners

Threaded fasteners for pressure containing parts shall conform to EN 20898-1 and EN 20898-2.

Where mating parts such as studs and nuts of materials with galling tendencies are used, they shall be lubricated with a suitable anti-seizure compound before assembly.

7 Auxiliary equipment

7.1 General

Equipment for the operation of the pump or pump unit shall be clearly indicated by the supplier including any auxiliary equipment that has to be provided by the purchaser. Interface points, connections, etc., shall be indicated.

Equipment provided by the supplier shall be clearly identified. If assembled with the pump or pump unit, applicable general design requirements apply equally to the entire assembly.

7.2 Drivers

The power of the driving system at rated speed shall be at least 5 % above the pump input shaft requirements at the duty conditions as supplied by the purchaser in accordance with clause 4. The selection of the driving system size shall include allowances, for example, for starting at low temperature, for simultaneous operation with maximum viscosity and maximum differential pressure and, if necessary, for relief valve overpressure operation. The pump supplier shall properly select the driving system when included in the scope of supply.

7.3 Couplings

7.3.1 *General*

When the pump is driven by an independently mounted driver, then a flexible coupling shall be used to connect the shafts.

7.3.2 *Rating*

The type of coupling and its rating shall be selected in accordance with the coupling manufacturer's recommendations using the power calculated from the rated conditions as supplied by the purchaser in accordance with 4.1.

7.3.3 *Selection of coupling*

Selection of couplings shall be in accordance with the environmental conditions - see clause 6.1.

7.3.4 *Parallel shaft couplings*

When an interference fit is used for mounting couplings on parallel shafts the supplier shall include instructions for removal and replacement of the coupling.

Transitional fit couplings shall be securely locked to the shaft.

7.3.5 *Tapered shaft couplings*

Taper bored hubs shall comply with ISO/R 775. The supplier when fitting the coupling shall ensure that best contact is achieved at the large end of the taper. The coupling shall be clamped in position by a positively locked locking device.

7.3.6 *Keys*

If keys are fitted, they shall conform to ISO/R773, ISO/R774 or ISO 3912

7.4 Baseplates

7.4.1 The baseplate or base-frame shall be made sufficiently rigid to avoid permanent distortion during transport, if necessary by temporary means and shall maintain alignment during operation.If drain rims or special facilities for alignment are required they should be agreed between the purchaser and the supplier

7.4.2 The baseplate shall incorporate anchorage points.

7.5 Guarding

Guards shall be provided in accordance with EN 809.

7.6 Heating and cooling

7.6.1 *Design of heating/cooling passages*

All heating and cooling passages shall be designed to operate under the conditions specified by the purchaser in accordance with clause 4.

7.6.2 *Connections for heating/cooling*

7.6.2.1 Where heating and/or cooling is required to be incorporated in the pump, finished auxiliary connections to the heating and cooling chambers shall be provided by the supplier.

7.6.2.2 The specification of other equipment to be supplied; pipework/isolating/drain/control valves, instrumentation, condition monitoring equipment; shall be subject to agreement.

7.7 Pressure-relief devices

NOTE: Systems using positive displacement pumps should be fitted with pressure relief devices.

7.7.1 If a relief valve is incorporated in the pump it shall comply with the requirements of prEN ISO 4126-1. The relief valve shall be capable of passing the maximum flow produced by the pump as installed.

7.7.2 The maximum relief valve over-pressure shall not exceed 25 % of a set gauge pressure higher than 20 bar and shall not exceed 5 bar at lower set pressures.

8 Noise

Requirements for noise emission shall be in accordance with EN 809.

9 Installation and maintenance

9.1 The pump/pump unit should be designed and constructed to allow installation, routine maintenance, inspection and the replacement of wearing parts such as seals, shaft sleeves, and gaskets to be performed with the minimum of dismantling.

9.2 Documentation supplied with the pump/pump unit shall be in accordance with prEN 809.

9.3 For installation, commissioning and maintenance the design shall permit the use of standard tools, unless technically unsuitable for functional or other relevant reasons. If special tools are required, this has to be clearly stated by the supplier.

9.4 Jacking screws, lifting lugs or eye-bolt holes and dowels shall be provided where necessary to facilitate disassembly and assembly. When jacking screws are provided the stationary face shall be relieved locally if any possible surface damage by the jacking screws could jeopardize tightness or function.

10 Materials, welding and repairs

10.1 Selection of materials

The materials shall be selected relative to their physical properties and chemical compositions to meet the requirements of clauses 4.1 and 6.1.

10.2 Manufacture

10.2.1 *Castings*

Castings shall be free from significant imperfections, such as shrink holes, blow holes, cracks, scale, blisters and other similar injurious defects. The surface of castings shall be cleaned by sand-blasting, shot blasting, pickling or any other standard method. All mould flash and remains of gates and risers shall be chipped, filed or ground flush.

10.2.2 *Welded fabrications*

10.2.2.1 All welding of process pipework and pressure containing parts shall be performed by suitably qualified operators and procedures in accordance with EN 287-1, EN 287-2, EN 288-1, EN 288-2 and EN 288-3.

10.2.2.2 Cast iron shall not be welded.

10.2.2.3 Inlet and outlet nozzles attached to pressure containing parts by welding shall have full penetration welds.

10.2.2.4 Piping nozzles attached to carbon or alloy steel pressure containing parts shall have the same nominal composition as the part or shall be low carbon austenitic stainless steel.

10.2.2.5 Fabricated pressure containing parts, operating at 75 % or more of the allowable design stress, shall be stress relieved.

10.3 Repairs

Components shall not be repaired if any of these conditions exist:

- depth of defect exceeds 20 % of design wall thickness;
- length of defect exceeds 20 % of the component dimension in that direction;
- total surface area affected exceeds 10 % of component surface area;
- replacement material exceeds 10 % of the raw component weight;
- pressure containment component is forged.

Defects shall be excavated and inspected, by dye penetrant, in accordance with ISO 3453, or magnetic particle, in accordance with prEN 1956 and prEN 9934-1, to ensure all defective material is removed prior to repair.

Pressure containing castings shall not be repaired by peening or burning-in.

NOTE: Shallow surface defects, which do not impair the pressure containing capabilities, may be repaired by metal spraying.

10.3.1 Only components in readily weldable material shall be repaired by welding using suitably qualified operators and procedures. (see 10.2.2.1)

10.3.2 Repairs shall only be implemented when the repair will have the same, or exceed the, physical and chemical properties of the parent material and a permanent seal on pressure containing parts is ensured.

10.3.3 To prove the soundness of the repair, pressure containing parts shall be pressure tested in accordance with EN 12162. Other components shall be inspected by non-destructive methods to prove the soundness of the repair. Such methods include:

- dye penetrant in accordance with ISO 3453;
- magnetic particle in accordance with prEN 1956 and prEN ISO 9934-1;
- ultrasonics in accordance with ISO 10375;
- radiography in accordance with ISO 1027.

11 Surface protection

When the materials used are not corrosion resistant all external non-functional surfaces shall be protected with the supplier's standard coating system suitable for the environmental conditions set out in clause 6.1.

NOTE: When the information supplied by the purchaser in accordance with 4.1 indicates special environmental conditions, materials which are not corrosion resistant shall be suitably treated and painted or otherwise protected from the stated hazards.

12 Nameplates and marking

Nameplates and marking shall be in accordance with the requirements of EN 809.

13 Preparation for dispatch

13.1 Corrosion protection

The pump shall have adequate internal and external corrosion protection prior to dispatch. Necessary action to remove the protection, if necessary, shall be described in the start-up instructions and necessary warnings securely attached to the pump. Information to maintain the effectiveness of the corrosion protection at site shall be provided by the supplier.

13.2 Securing of rotating parts

In order to avoid damage to bearings caused by vibration during transport, rotating parts should be secured according to:

- mode of transport;
- distance of transport;
- mass of rotor;
- bearing design.

In such a case a warning label shall be securely attached to the pump.

13.3 Openings

To prevent the ingress of foreign matter during shipment, storage and installation, all openings shall be fitted with suitable covers prior to despatch.

13.4 Piping and auxiliaries

Precautions shall be taken to ensure that small piping and auxiliaries are protected from damage during transportation and storage.

13.5 Identification

All components supplied loose with the pump shall be clearly and durably identified.

13.6 Installation/operating instructions

The supplier's installation/operating instructions shall be packed and dispatched with the pump/pump unit together with any other documentation agreed with the purchaser.

Annex A (informative)

Data sheet

The data sheet presented in this annex can be used by the purchaser to communicate the pump requirements to prospective suppliers. All necessary information on the data sheet would be provided by the purchaser to describe the pump/pump unit operating environment.

In the table entitled ‘Operating conditions for each pump’, each column is for a specific 'set' of information. It should be noted that the pump/pump unit would not be guaranteed for undocumented operating conditions.

The left-hand column lists the important liquid properties which will exist at the pump connections. NPIPA is a function of the inlet liquid properties and the system design and may be modified by the position of the pump inlet connection. The second column is used to identify the units which quantify the liquid properties.

The third column, 'Rated conditions', lists the operating conditions which the supplier will guarantee the pump can attain. For a fixed speed pump each box in the column should only contain a single value. A variable speed pump should have the minimum and maximum flows indicated. The performance of rotary positive displacement pumps can be greatly influenced by the liquid viscosity; the 'Rated' column may only show one temperature and one viscosity.

Most pumps do not operate at a single condition but operate over a range of conditions. The remainder of the columns allow specific alternative duty conditions to be specified. It is not necessary to complete all the columns. It is only necessary to fill columns which completely describe the extremes of pump operation. Fixed speed pumps should not have additional flows specified.

Positive displacement pump operating conditions data sheet

Item No.	Purchaser		
	Purchaser ref		
	Service		
	Site/location		
	Pump type		
No. of pumps running		No. of pumps standby	
Driver for running pumps		Driver for standby pumps	
Baseplate/ skid/ trailer		Baseplate/skid/trailer	
Liquid Density Corrosive Y/N (If Y give values on next page) Allowable leakage rate to atmosphere at rated operating conditions		Specific heat capacity Abrasive Y/N	pH
Solids Density Friable Y/N Particle size/ shape/ distribution		 Hardness Miller No. or similar	Hard/soft % by WT/VOL Settling velocity

OPERATING CONDITIONS FOR EACH PUMP

Type of operating conditions	Units	Rated conditions	Values of operating conditions for				
			Maximum outlet pressure	Minimum outlet pressure	Maximum inlet pressure	Minimum inlet pressure	Max differential pressure
inlet temp							
viscosity							
vapour press							
inlet pressure							
NPIPA (1)							
Flow (2)							
Outlet press							
Compressibility							
Duty							

Duty definitions	Continuous	Light	Intermittent	Cyclic	Irregular
	8/24 h/day	3/8 h/day	0/3 h/day	Describe	Describe

R V Back press	R V set press		R V overpressure

Description of cyclic or irregular	
	Motor starting (S-D/DOL/etc.)
Pump starting (on load/by-pass)	No. of pumps running on this inlet pipe
Inlet pipe bore x length (for acceln HD)	Outlet pipe bore x lengh
Residual inlet press pulsations %	Residual outlet press pulsation %

PRESSURE CONTAINMENT DESIGN CONDITIONS

Inlet design pressure / temperature	Outlet design pressure / temperature
Cooling system media / design press/ temp	Heating system media / design press / temp

APPLICABLE STANDARDS, CERTIFICATION AND TESTING REQUIREMENTS

SITE CONDITIONS

Indoor / outdoor / onshore / offshore / attended / unattended	Concrete / structural steel foundations
Atmospheric pollution	Maintenance interval
Special precautions	Max / min temperature
	Black bulb temperature
Cooling water	Humidity
Compressed air	Altitude
Steam	Water available for quench / flush Y / N
Electrical supplies	
Electrical area classification	
Electrical equipment physical protection	

COMMENTS

(1) At underside of baseplate (2) For compressible liquids outlet volume will be less than inlet volume	

Annex A (informative) A positive displacement pump operating conditions data sheet (Continued)

PERSONNEL HAZARDS

- ☐ Intoxicating by inhalation
- ☐ Intoxicating in contact with skin
- ☐ Intoxicating if swallowed
- ☐ Harmful by inhalation
- ☐ Harmful in contact with skin
- ☐ Harmful if swallowed
- ☐ Toxic by inhalation
- ☐ Toxic in contact with skin
- ☐ Toxic if swallowed
- ☐ Very toxic by inhalation
- ☐ Very toxic in contact with skin
- ☐ Very toxic if swallowed
- ☐ Contact with water liberates toxic gas
- ☐ Contact with acids liberates toxic gas
- ☐ Contact with acids liberates very toxic gas
- ☐ Harmful/toxic by inhalation when smoking
- ☐ Danger of harmful reaction with clothing
- ☐ Danger of cumulative effects
- ☐ Causes burns
- ☐ Causes severe burns
- ☐ Irritating to eyes
- ☐ Irritating to respiratory system
- ☐ Irritating to skin
- ☐ Danger of very serious irreversible effects
- ☐ Possible risk of irreversible effects
- ☐ Risk of serious damage to eyes
- ☐ May cause sensitization by inhalation
- ☐ May cause sensitization by skin contact
- ☐ May cause cancer
- ☐ May cause heritable genetic damage
- ☐ May cause birth defects
- ☐ Danger of serious damage to health by prolonged exposure

GENERAL HAZARDS

- ☐ Explosive when dry
- ☐ Risk of explosion by shock, friction, fire or other sources of ignition
- ☐ Extreme risk of explosion by shock, friction, fire or other sources of ignition
- ☐ Forms very sensitive explosive compounds
- ☐ Heating may cause an explosion
- ☐ Explosive with or without contact with air
- ☐ May cause fire
- ☐ Contact with combustible material may cause fire
- ☐ Explosive when mixed with combustible material
- ☐ Flammable
- ☐ Highly flammable
- ☐ Extremely flammable
- ☐ Low ignition temperature °C
- ☐ Reacts violently with water
- ☐ Contact with water liberates highly flammable gases
- ☐ Spontaneously flammable in air
- ☐ May cause flammable / explosive vapour-air mixture
- ☐ May form explosive peroxides
- ☐ Can become highly flammable in use
- ☐ Risk of explosion if heated when confined
- ☐ Risk from static electricity

PUMP / PERFORMANCE HAZARDS

- ☐ Corrodes cast iron
- ☐ May crystallise on contact with air
- ☐ May crystallise on cold surfaces, < °C
- ☐ May crystallise at low velocity, < m/s
- ☐ May solidify on contact with air
- ☐ May deposit wax on cold surfaces, < °C
- ☐ May deposit wax at low velocity, < m/s
- ☐ May deposit solids at low velocity, < m/s
- ☐ Contains dissolved gas % by wt / vol
- ☐ Contains entrained gas % by wt / vol
- ☐ Gas evolves at absolute pressure below bar
- ☐ Good solvent for petroleum based lubricants
- ☐ Excellent solvent for petroleum based lubricants
- ☐ Mixture emulsifies at high velocity, > m/s
- ☐ Liquid is pseudoplastic
- ☐ Liquid is dilatant
- ☐ Liquid is thixotropic
- ☐ Liquid is rheopectic
- ☐ Liquid is Bingham plastic
- ☐ Liquid may not be contaminated with hydrocarbon based lubricants
- ☐ Liquid may not be contaminated with water
- ☐ Lubricants must be food quality
- ☐ Pump will be cleaned with steam °C
- ☐ Pump will be cleaned with chemicals /solvents
- ☐ Non-Newtonian products require shear rate data with viscosity

PURCHASER MATERIAL RECOMMENDATIONS

Metallic materials in contact with liquid:
corrosion rate (mm/year)

a) _____
b) _____
c) _____
d) _____
e) _____

Non- metallic materials in contact with liquid:

f) _____
g) _____
h) _____
i) _____
j) _____
k) _____
l) _____

Materials not allowed in contact with liquid:

m) _____
n) _____
o) _____
p) _____
q) _____
r) _____
s) _____
t) _____
u) _____
v) _____
w) _____
x) _____
y) _____
z) _____

Annex ZZ
(informative)

Corresponding International and European Standards for which equivalents are not given in the text

At the time of publication of this International Standard, the following ISO documents were equivalent to the normative European Standards referenced in the text. Members of the ISO and IEC maintain registers of currently valid International Standards.

prEN12162	ISO 12162:1995, *Thermoplastics materials for pipes and fittings for pressure applications — Classification and designation — Overall service (design) coefficient.*

ICS 23.080

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