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NATIONAL IRANIAN OIL REFINING & DISTRIBUTION COMPANY
NATIONAL IRANIAN OIL ENGINEERING
& CONSTRUCTION COMPANY

NIOEC SP

NIOEC SPECIFICATION FOR METERING PUMPS

FIRST EDITION

JULY, 2005

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IN THE NAME OF GOD

FOREWORD

By their very nature, technical Specifications are continuously subject to modifications and revisions. To strengthen their merit and usefulness, continuous improvements, addendum, deletion of disparate information and consequently provision of updated revisions are to be made in order to ascertain that such Specifications meet the current requirements, inclusive of Iranian Petroleum Standards (IPS) and the recognized and acceptable national and international Standards, as well as the optimal codes and practices based on the accumulated in-house know-how and plant knowledge and experiences.

However, in reality, due to several reasons, not to mention the complexity of the matter, the ultimate goal of continuous direct embedment of the required changes on the relevant Specifications may be far reaching. Therefore, in the interim periods between the officially issued revisions, the required changes will appear in other documents related to the engineering and design work of the ongoing projects.

In response to the initiative of the Design and Engineering Directorate, and considering that the task of the execution of several important and mega projects for the realization of the new oil refineries, pipelines and oil terminals as well as improvements of the existing facilities, has been assigned to NIOEC, it was decided to update the NIOEC Specifications and to issue new official revisions.

The Design and Engineering Directorate was itself entrusted to carry out this important task, and as such by forming several special technical committees, working in close co-operation and cohesion and sharing their expertise and knowledge, the updated and revised NIOEC Specifications were successfully prepared and complied.

These Specifications are intended to be used for Oil Refineries, Distribution Depots, Oil Terminals, Pipelines and Pump Stations within NIOEC's projects, and have been proven to be of high value for such purposes. It must however be appreciated that these Specifications represent the minimum requirements and should in no way be interpreted as a restriction on the use of better procedures, engineering and design practices or materials.

We encourage and highly appreciate the users and other clear sighted and experts to send their comments on the Specifications to the Design and Engineering Director of NIOEC for evaluation and approval.

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NOTES:

- 1) THIS SHEET IS A RECORD OF ALL REVISIONS TO THIS SPECIFICATION.
- 2) WHEN APPROVED EACH REVISION SHALL BE CONSIDERED AS A PART OF THE ORIGINAL DOCUMENT.
- 3) NUMBER OF PAGES EXCLUDES THIS SHEET AND THE COVER SHEET.

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INTRODUCTION

To satisfy the requirements of this NIOEC Specification, API 675 with the modifications as specified herein after shall be strictly followed.

The following annotations, as specified hereunder, have been used at the bottom right hand side of each clause or paragraph to indicate the type of change made to the equivalent clause or paragraph of API.

Substitution: The clause in API shall be deleted and replaced by the new clause in this Standard.

Addition: The new clause with the new number shall be added to the relevant section of API.

Modification: Part of the clause or paragraph in API shall be modified and/or the new description

1. SCOPE

- 1.1. NIOEC Specifications cover the general requirements for detailed engineering, procurements, testing inspection & construction of refinery/ oil plant, distribution depots, pump stations and pipelines.
- 1.2. This Specification covers the general requirements of metering pumps, shall conform to the American Petroleum Institute Standard 675, 3rd edition, November 2012(Errata 2014)as supplemented and modified herein.
- 1.3. This Specification supplements the Specification sheets for each individual pump on which the operating conditions and special requirements are listed in detail. Whenever the data included on the individual speciation sheet conflicts with the provision of this Specification, the former shall govern.
- 1.4. Compliance with the provisions of this Specification does not relieve the Contractor and/or Vendor/Contractor of the responsibility of furnishing pumps and accessories of proper design mechanically suited to meet operating guarantees at the specified service conditions.
- 1.5. Unless specific exception accompanied by a description of the proposed substitute is recorded under the heading "Exception" in the manufacturer's proposal, it shall be mutually understood that the proposal is based on equipment which complies strictly with the requirements of these Specifications.
- 1.6. Resolution on cases not explicitly stipulated in this specification, or on cases where conflicts may arise among the requirements of the referenced / relevant IPS and international standards shall be made through written consent and approval of NIOEC.
- 1.7. Deviations from this specification will only be permitted in obtaining written approval from NIOEC.

2. REFERENCES

The following standards, codes and specifications, to the extent specified herein after, shall constitute a part of this NIOEC specification. Latest edition of the undated referenced documents and the cited edition of the dated references shall apply. The applicability of changes made to the dated references, after the cited date shall be mutually agreed upon between NIOEC and the vendor/contractor.

API (AMERICAN PETROLEUM INSTITUTE)

API 675

"Positive Displacement pumps-Controlled Volume" 3rd edition -
2012 (Errata 2014)

ASME (THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

Boiler and Pressure Vessel Code, Section VIII, Div 1

NIOEC-SP (NIOEC SPECIFICATION)

NIOEC-SP-00-10	"NIOEC Specification for Unit"
NIOEC-SP-40-03	"NIOEC Specification for Spare Parts Requirement"
NIOEC-SP-40-04	"NIOEC Specification for Lubricating, Sealing and Controlling Oil"
NIOEC-SP-46-00	"NIOEC Specification for Pumps, Drivers and Auxiliary Equipment"
NIOEC-SP-46-07	"NIOEC Specification for Lubrication, Shaft Sealing, Control Oil System for Special Purpose Application"
NIOEC-SP-47-10	"NIOEC Specification for Noise Control and Vibration"
NIOEC-SP-60-02	"NIOEC Specification for Low Voltage Induction Motors"

NIOEC-SIP (NIOEC SHOP INSPECTION PROCEDURE)

NIOEC-SIP-46-04	"NIOEC Shop Inspection Procedure for Rotary Machines"
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3. UNITS

International system of units (SI) shall be used in accordance with NIOEC-SP-00-10, unless otherwise specified

4. MODIFICATION TO API 675

The paragraph numbering follows API Standard 675 and each paragraph denotes an Addition, Substitution or Alteration. Those optional section not covered in the text are included in the pump data sheets.

4.2 (Substitution)

NIOEC-SP-00-10 shall be followed.

6.1.1 (Modification)

Add the following sentences at the end of this clause:

The Vendor may offer alternative designs. The proven alternative design experiences should be within the range of at least 5 years continuously successful operation on the familiar pumped fluid and operation condition. Prototype design is not acceptable.

6.1.5 (Modification)

Add the following sentences at the end of this clause:

The requirements of NIOEC-SP-47-10 shall also be met.

6.1.10 (Modification)

Add the following sentences at the end of this clause:

Liquid ends shall be bolted or screwed to drive housing to facilitate replacement with the mounting designed to achieve and maintain alignment during operation and maintenance.

6.1.13 (Modification)

Remove “if specified” from this clause.

6.1.21 (Modification)

Remove “if specified” from this clause.

6.1.22 (Addition)

For abrasive fluid services, provisions shall be made to prevent particle sedimentation within the pump head spaces. For this services mechanically operated pump valves are preferred.

6.3.1 (Modification)

Add the following sentences at the end of this clause:

Inlet and outlet connection shall be flanged unless otherwise specified on the data sheet.

6.5.3 (Modification)

Double ball check valves, shall be provided on both suction and discharge.

6.6.2 (Modification)

Add the following sentences at the end of this clause:

Unless otherwise specified, double diaphragms shall be used for toxic and flammable, abrasive and corrosive fluids.

6.7.3 (Addition)

For packed pumps, provision shall be made to permit packing adjustment and visual observation of packing performance.

6.7.4 (Addition)

Plungers shall be replaceable without disturbing stroke adjustment or removing crosshead.

6.1.21 (Modification)

Remove “if specified” from this clause.

6.12.2 (Modification)

Add the following sentences at the end of this clause:

All lubricant oils shall be based on NIOEC-SP-40-04.

6.12.3 (Addition)

All gearing, cams, connecting rods, cranks, etc. required to obtain the reciprocating plunger action from the motor, shall be housed in oil tight drive units. Exposed crankshafts are not acceptable. The oil tight drive unit shall be suitable for dusty atmosphere application in a totally enclosed crank case.

6.13.1 (Modification)

Add the following sentences at the end of this clause:

Continuous stroke adjustment with the unit in operation must be provided unless otherwise specified on datasheet.

6.13.2 (Modification)

The capacity should follow as closely as possible a straight line relationship with stroke length.

Repetitive accuracy (reproducibility) shall be at least 98% between the range of 10 to 100 % of the specified design capacity.

6.14.2.1(Substitution)

The liquid end shall be made from suitable corrosion resistant alloys, unless otherwise specified on the individual pump datasheet.

6.14.2.23 (Addition)

Material for valves shall match those specified for the case material.

6.14.6.5 (Modification)

Remove “if specified” from this clause.

6.15.3 (Modification)

Add the following sentences at the end of this clause:

SI units are to be shown on nameplates.

7.1.1.1 (Modification)

Add the following sentences at the end of this clause:

Metering pumps shall be driven by electric motors. Drivers shall be suitable for continuous operation at the relief valve setting.

7.1.2.1 (Substitution)

Motors shall be in accordance with NIOEC Specification NIOEC-SP-60-02.

3.1.8 (Addition)

Minimum motor horse power for any pump application shall be 0.4 kW.

3.1.97.1.2.8 (Addition)

Motors shall be equipped with suitable seals to prevent moisture from entering through the shaft opening.

7.1.2.6 (Substitution)

Chain and belt drives are not acceptable. Drivers for all Metering pumps shall be furnished and mounted by the pump Vendor.

7.2.11.c (Modification)

Remove “if specified” from this clause.

7.4.2.1 (Modification)

Remove “if specified” from this clause.

7.5.1 & 7.5.2 & 7.6.2 (Modification)

The API 614 shall be substituted to NIOEC SP-46-07.

7.8.1 (Modification)

Remove “if specified” from this clause.

7.5.3 (Addition)

The maximum vibration amplitude (peak to peak) as measured on the rotor shaft shall not exceed, 38 µm and 25 µm for 1500 and 3000 RPM units.

8.1.5 (Modification)

All tests and inspections shall be performed in accordance with the relevant NIOEC inspection and test procedures including Shop Inspection Procedure (NIOEC-SIP-46-04).

8.3.4.2 (Substitution)

Flow repeatability and linearity tests shall be run by using 100, 75, 50, 25, 10 percent of rated capacity points in descending and ascending order if specified on the data sheets.

8.4.1 (Modification)

Add the following sentences at the end of this clause:

Pumps shall be shipped in airtight polyethylene covers suitably boxed for export shipment.

8.4.6 (Substitution)

Two sets of packing and one set of operating and maintenance manuals shall be included in shipment.

9.2.3(a) (Modification)

Add the following sentences in the end of this clause:

Proposal shall also include the following:

General Catalogue or brochure describing the pump offered.

Max Capacity of each pump unit.

Speed and BHP of motor.

Speed of pump in strokes per minute.

Plunger diameter and stroke length.

Max working pressure of pump.

9.3.4.2 (Modification)

Add the following sentences at the end of this clause:

The minimum requirements of NIOEC SP-40-03 shall be met.

Positive Displacement Pumps— Controlled Volume for Petroleum, Chemical, and Gas Industry Services

API STANDARD 675
THIRD EDITION, NOVEMBER 2012

ERRATA, JUNE 2014



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Licensee:

Positive Displacement Pumps— Controlled Volume for Petroleum, Chemical, and Gas Industry Services

Downstream Segment

API STANDARD 675
THIRD EDITION, NOVEMBER 2012

ERRATA, JUNE 2014



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Foreword

This standard is based on the accumulated knowledge and experience of manufacturers and users of reciprocating, controlled volume pumps. The objective of this standard is to provide a purchase specification to facilitate the procurement and manufacturer of controlled volume pumps for use in petroleum, chemical, and gas industry services.

The primary purpose of this standard is to establish minimum requirements.

Energy conservation is of concern and has become increasingly important in all aspects of equipment design, application, and operation. Thus innovative energy conserving approaches should be aggressively pursued by the manufacturer and the user during these steps. Alternative approaches that may result in improving energy utilization should be thoroughly investigated and brought forth. This is especially true of new equipment proposals, since the evaluation or purchase options will be based increasingly on total life costs as opposed to acquisition cost alone. Equipment manufacturers, in particular, are encouraged to suggest alternatives to those specified when such approaches achieve improved energy effectiveness and reduced total life costs without sacrificing safety or reliability.

This standard requires the Purchaser to specify certain details and features. Although it is recognized that the Purchaser may desire to modify, delete, or amplify sections of this standard, it is strongly recommended that such modifications, deletions, and amplifications be made by supplementing this standard, rather than by rewriting or incorporating sections thereof into another standard.

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually by API, 1220 L Street, NW, Washington, DC 20005.

Suggested revisions are invited and should be submitted to the Standards Department, API, 1220 L Street, NW, Washington, DC 20005, standards@api.org.

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Positive Displacement Pumps—Controlled Volume for Petroleum, Chemical, and Gas Industry Services

1 Scope

This standard covers the minimum requirements for reciprocating, controlled volume pumps and pump units for use in the petroleum, petrochemical, and gas industry services. These pumps are either hydraulic diaphragm or packed plunger design. Rotary positive displacement pumps are not included. Diaphragm pumps that use direct mechanical actuation are also excluded.

NOTE See API 674 for positive displacement reciprocating pumps and API 676 for positive displacement rotary pumps.

This standard requires the Purchaser to specify certain details and features. A bullet (●) at the beginning of a paragraph indicates that either a decision by, or further information from, the Purchaser is required. Further information should be shown on the data sheets (see example in Annex A) or stated in the quotation request and purchase order.

Alternate Designs and Conflicting Requirements are now located in Section 6.

NOTE A bullet (●) at the beginning of a paragraph indicates that either a decision is required or further information is to be provided by the purchaser. This information should be indicated on the data sheets (see Appendix A); otherwise, it should be stated in the quotation request or in the order.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. The hierarchy of documents shall be specified.

NOTE Typical documents are user, industry, and API specifications, data sheets, meeting notes and supplemental agreements.

API Specification 5L, *Specification for Line Pipe*

API Recommended Practice 520, *Sizing, Selection and Installation of Pressure-Relieving Devices in Refineries, Part I—Sizing and Selection*

API Recommended Practice 520, *Sizing, Selection and Installation of Pressure-Relieving Devices in Refineries, Part II—Installation*

API Standard 526:2002, *Flanged Steel Pressure Relief Valves*

API Standard 541:2002, *Form-wound Squirrel Cage Induction Motors — 250 Horsepower and Larger*

API Standard 546:1997, *Brushless Synchronous Machines — 500 kVA and Larger*

API Standard 614 *Lubrication, Shaft-sealing, and Control-oil Systems and Auxiliaries for Petroleum, Chemical, and Gas Industry Services*

API Standard 671, *Special Purpose Couplings for Refinery Services*

API Recommended Practice 500, *Classification of Locations for Electrical Installations in Petroleum Refineries*

API Recommended Practice 686, *Machinery Installation and Installation Design*

AGMA 6013-A06: 2006 ¹, *Standard for Industrial Enclosed Gear Drives*

AGMA 6022-C93: 1994 (R 2008), *Design Manual for Cylindrical Wormgearing*

¹ American Gear Manufacturers Association, 500 Montgomery Street, Suite 350, Alexandria, Virginia 22314, www.agma.org



ANSI/AGMA 2015-1:2001, *Accuracy Classification System — Tangential Measurements for Cylindrical Gears*

ANSI/AGMA 9002:2001, *Bores and Keyways for Flexible Couplings (Inch Series)*

ANSI/ABMA 7:1995 ², *Shaft and Housing Fits for Metric Radial Ball and Roller Bearings (Except Tapered Roller Bearings) Conforming to Basic Boundary Plan*

ASME Boiler and Pressure Vessel Code ³, Section V:2001, *Non-destructive Examination*

ASME Boiler and Pressure Vessel Code, Section VIII:2001, *Rules for Construction of Pressure Vessels, Division 1*

ASME Boiler and Pressure Vessel Code, Section IX:2001, *Welding and Brazing Qualifications*

ASME B1.1:2003, *Unified Inch Screw Threads, UN and UNR Thread Form*

ASME B16.1:1998, *Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250*

ASME B16.5:2003, *Pipe flanges and Flanged Fittings NPS 1/2 through NPS 24*

ASME B16.11:2001, *Forged Fittings Socket Welding and Threaded*

ASME B16.20:1998, *Metallic Gaskets for Pipe Flanges*

ASME B16.42:1998, *Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300*

ASME B31.3 *Process Piping* (for pipeline applications see also ASME B31.4)

AWS D1.1:2003 ⁴, *Structural Welding Code — Steel*

DIN 910:2004 ⁵, *Heavy-duty Hexagon Head Screw Plugs*

EN 287:1997 (all parts) ⁶, *Qualification Test of Welders — Fusion Welding*

EN 288:1997 (all parts), *Specification and Approval of Welding Procedures for Metallic Materials*

EN 13445:2002 (6 parts), *Unfired Pressure Vessels*

IEC 60034 ⁷, *Rotating Electrical Machines — Part 1: Rating and Performance*

IEC 60079 (all parts: latest editions published prior to June 1, 2004), *Electrical Apparatus for Explosive Gas Atmospheres*

IEEE 841:2001 ⁸, *Standard for the Petroleum and Chemical Industry — Severe Duty Totally Enclosed Fan-cooled (TEFC) Squirrel Cage Induction Motors — up to and Including 370 kW (500 hp)*

ISO 7; part 1:1994; part 2: 2000 ⁹, *Pipe Threads where Pressure-tight Joints are Made on the Threads*

² American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, New York 10036, www.ansi.org.

³ ASME International, 3 Park Avenue, New York, New York 10016-5990, www.asme.org.

⁴ American Welding Society, 550 NW LeJeune Road, Miami, Florida 33126, www.aws.org.

⁵ Deutsches Institut für Normung E.V., Burggrafenstrasse 6, 10787 Berlin, Germany.

⁶ European Committee for Standardization, Avenue Marnix 17, B-1000, Brussels, Belgium, www.cen.eu.

⁷ International Electrotechnical Commission, 3, rue de Varembe, P.O. Box 131, CH-1211, Geneva 20, Switzerland, www.iec.ch.

⁸ Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, New Jersey 08854, www.ieee.org.

⁹ International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, www.iso.org.

ISO 228-1:2000, *Pipe Threads where Pressure-tight Joints are not Made on the Threads — Part 1: Dimensions, Tolerances, and Designation*

ISO 261:1998, *ISO General-purpose Metric Screw Threads — General Plan*

ISO 262:1998, *ISO General-purpose Metric Screw Threads — Selected Sizes for Screws, Bolts and Nuts*

ISO 281:1990; Amendment 1:2000; Amendment 2:2000, *Rolling Bearings — Dynamic Load Ratings and Rating Life*

ISO 286-2:1998, *ISO System of Limits and Fits — Part 2: Tables of Standard Tolerance Grades and Limit Deviations for Holes and Shafts*

ISO 724:1993, *ISO General-purpose Metric Screw Threads — Basic Dimensions*

ISO 965:2000 (5 parts), *ISO General-purpose Metric Screw Threads — Tolerances*

ISO 1328-1:1995, *Cylindrical Gears — ISO System of Accuracy — Part 1: Definitions and Allowable Values of Deviations Relevant to Corresponding Flanks of Gear Teeth*

ISO 3448:1992, *Industrial Liquid Lubricants — ISO Viscosity Classification*

ISO 3744, *Acoustics — Determination of Sound Power Levels of Noise Sources Using Sound Pressure — Engineering Method in an Essentially Free Field Over a Reflecting Plane*

ISO 5753:1991, *Rolling Bearings — Radial Internal Clearance*

ISO 6708:1995, *Pipework Components — Definition and Selection of DN (Nominal Size)*

ISO 7005-1:1992, *Metallic Flanges — Part 1: Steel Flanges*

ISO 7005-2:1998, *Metallic Flanges — Part 2: Cast Iron Flanges*

ISO 8501-1:1988 (supplement:1994), *Preparation of Steel Substrates Before Application of Paints and Related Products — Visual Assessment of Surface Cleanliness — Part 1: Rust Grades and Preparation Grades of Uncoated Steel Substrates and of Steel Substrates after Overall Removal of Previous Coatings*

ISO 10438:2003 (all parts), *Petroleum and Natural Gas Industries — Lubrication, Shaft-sealing and Control-oil Systems and Auxiliaries*

ISO 10816-1, *Mechanical Vibration*

ISO 14691, *General Purpose Couplings*

NACE MR0175/:2003 (3 parts)¹⁰, *Petroleum and Natural Gas Industries — Materials for Use in H₂S-Containing Environments in Oil and Gas Production*

NACE MR0103/:2003 (3 parts), *Petroleum and Natural Gas Industries — Materials for Use in H₂S-containing Environments in Oil and Gas Production*

NFPA 70:2002¹¹, *National Electrical Code*

SSPC SP 6:2000¹², *Commercial Blast Cleaning*

¹⁰ NACE International (formerly the National Association of Corrosion Engineers), 1440 South Creek Drive, Houston, Texas 77218-8340, www.nace.org.

¹¹ National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts 02169-7471, www.nfpa.org.

¹² The Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburgh, Pennsylvania 15222, www.sspc.org.

3 Terms and Definitions

For the purposes of this document, the following definitions apply.

3.1

alarm point

A preset value of a parameter at which an alarm is activated to warn of a condition that requires corrective action.

3.2

anchor bolt

Bolt used to attach the baseplate to the support structure (concrete foundation or steel structure).

3.3

acceleration pressure

anticipated system acceleration pressure

The estimated pressure change due to changes in velocity in the piping system. It is an important factor in the application of reciprocating pumps because of the pulsating nature of the flow in the pump suction line, in addition to NPSHR, vapor pressure, and pressure required to overcome suction line losses.

NOTE This factor is accounted for in the standard calculation for NPIP. See the definition of NPIP, NPIP_a, and NPIP_r.

3.4

baseplate

Component on which the drive train and pump are bolted, which is then fastened to the support structure using anchor bolts.

3.5

Certified Material Test Report

CMTR

mill cert

Certified report documenting the actual chemical composition and/or physical properties of critical materials.

3.6

controlled volume pump

A reciprocating pump in which precise volume control is provided by varying effective stroke length.

NOTE Such pumps are also known as proportioning, chemical injection, dosing, or metering pumps.

3.7

datum elevation

Elevation to which values of NPIP are referred (the underside of the pump mounting plate); also see **net positive inlet pressure available** and Annex E.

3.8

design

Manufacturer's calculated parameter.

NOTE A term used by the equipment manufacturer to describe various parameters such as design power, design pressure, design temperature, or design speed. It is not intended for the Purchaser to use this term.

3.9

diaphragm pump

A pump designed such that the process fluid is isolated from the plunger by means of a hydraulically actuated flat or shaped diaphragm.

3.10**differential pressure**

The difference between discharge pressure and suction pressure.

3.11**discharge pressure**

The motive energy of the pumped liquid due to its pressure as measured immediately downstream of the pump discharge connection.

3.12**displacement**

Volume displaced per stroke. Displacement depends only on the physical dimensions of the pumping element.

3.13**drive train components**

Item of the equipment used in series to drive the pump. (Examples: Motor, gear, fluid drive, etc.)

3.14**fail safe**

System which will cause the equipment to revert to a permanently safe condition (shutdown and/or depressurized) in the event of a component failure or failure of the energy supply to the system.

3.15**flow repeatability**

Expressed as a percent of rated capacity, describes the reproducibility of pump flow rate under a given set of conditions when capacity setting is varied and then returned to the set point being tested.

3.16**gauge board**

Bracket or plate used to support and display gauges, switches, and other instruments.

NOTE A gauge board is open and not enclosed.

3.17**hold down bolt****mounting bolt**

Bolt holding the equipment to the baseplate.

NOTE For small controlled volume pumps baseplates and hold down bolts are sometimes omitted.

3.18**inspection and test plan****ITP**

Single project-specific document used to consolidate all inspection and test elements, the criteria required to be met, and the roles and responsibilities.

3.19**linearity**

The relationship between the actual volume of liquid discharged at a given capacity setting and a best fit straight line drawn through the plotted points of volume and capacity setting determined during calibration tests of a pump. The deviation from this line is expressed as percent of the rated capacity of the pump.

3.20**liquid end assembly**

The pump liquid end assembly (also called the *reagent head assembly* or *wet end*) includes all parts that contact the liquid being pumped.

3.21**local**

Position of devices mounted on or near the equipment or console.

3.22**lost motion**

A means of changing displacement of a constant stroke pump by altering the effective stroke length during each cycle. This may be accomplished either mechanically or hydraulically.

3.23**maximum allowable working pressure****MAWP**

Maximum continuous pressure for which the manufacturer has designed the equipment (or any part to which the term is referred) when handling the specified fluid at the specified maximum operating temperature.

3.24**maximum rated input speed**

Highest speed (in strokes per minute) at which the machine, as built and tested, is capable of continuous, efficient operation with the specified fluid at any of the specified operating conditions.

3.25**minimum allowable fluid temperature**

Lowest continuous fluid temperature for which the manufacturer has designed the equipment (or any part to which the term is referred) when handling the specified fluid at the specified maximum operating pressure.

3.26**minimum design metal temperature**

Lowest mean device material temperature (through the thickness) expected in service, including operation upsets, auto-refrigeration and temperature of the surrounding environment.

3.27**minimum allowable speed**

The lowest speed (in strokes per minute) at which the manufacturer's design will permit continuous operation.

3.28**minimum allowable ambient temperature**

The minimum continuous temperature for which the manufacturer has designed the equipment (or any part to which the term is referred).

3.29**multiple feed****multiplexing**

The combination of two or more pumping elements with a common driver.

3.30**net positive inlet pressure****NPIP**

Minimum instantaneous pressure determined at the datum elevation (underside of the pump mounting plate) during pressure pulsations, minus the vapor pressure of the fluid at the maximum operating temperature and at any specified operating point (see Annex E for further discussion).

3.31**net positive inlet pressure available****NPIPA**

NPIP determined by the Purchaser from the NPSHA and system design data. NPIP shall always include acceleration losses. Minimum pressure determined at the datum elevation (underside of the pump mounting plate) minus the vapor pressure of the fluid at the maximum operating temperature at any specified point. NPIP shall always include acceleration losses.

3.32**net positive inlet pressure required****NPIPR**

Minimum NPIP required by the pump to achieve the required performance with the specified fluid at any specified point, as determined by Vendor. NPIP shall always include acceleration losses.

3.33**net positive inlet pressure required test****NPIPR test**

Test conducted to measure the NPIPR.

3.34**net positive suction head****NPSH**

Total absolute suction pressure, determined at the underside of the pump mounting plate, minus the vapor pressure of the liquid [see Annex E for a discussion of NPSH and Net Positive Inlet Pressure (NPIP)].

NOTE 1 NPSH is expressed as head of water, in meters (feet).

NOTE 2 NPIP is the most appropriate term for any reciprocating positive displacement pump because NPIP includes the additional energy losses due to acceleration.

NOTE 3 NPIP is typically expressed in units of pressure kPa (bar, psi).

3.35**net positive suction head available****NPSHA**

Not the most appropriate term for reciprocating positive displacement pumps because this is only based on steady state energy losses and doesn't include acceleration (see 3.32).

3.36**net positive suction head required****NPSHR**

Not the most appropriate term for reciprocating positive displacement pumps because this is only based on steady state energy losses and doesn't include acceleration (see 3.33).

3.37**non-destructive examination****NDE**

Inspection of materials, components or assemblies by means of radiography, liquid penetrant, magnetic particle or ultrasonic testing are the typical methods employed. Other methods may be used if agreed to by the Purchaser and supplier.

3.38**observed [test]**

Inspection [test] for which the Purchaser is notified of the timing, and the inspection [test] is performed as scheduled regardless of whether the Purchaser or Purchaser's representative is present.

NOTE Supplier will not hold up production for Purchaser's convenience.

3.39**Owner**

Final recipient of the equipment who may delegate another agent as the Purchaser of the equipment.

3.40**packed-plunger pump****packed piston pump**

The process fluid is in direct contact with the plunger.

3.41**panel**

An enclosure used to mount, display, and protect gauges, switches, and other instruments.

3.42**performance test**

Running test conducted to measure flow rate at rated discharge pressure and power consumed at specified conditions.

NOTE Test results need to be corrected to service conditions, for example temperature and driver speed.

3.43**positive material identification****PMI**

Physical evaluation or test of a material to confirm that the material is consistent with the selected or specified alloy material designated.

3.44**pressure-containing part**

Any part that acts as a barrier between process or motive fluid and the atmosphere.

3.45**pressure-retaining part**

Any part whose mechanical failure would allow process or motive fluid to escape to the atmosphere.

3.46**pump efficiency**

Ratio of the pump's hydraulic power at discharge to its brake power input.

3.47**pumphead**

The displacement chamber for the pump hydraulic fluid that moves the diaphragm in a hydraulic diaphragm pump.

3.48**Purchaser**

Agency that issues the order and specification to the supplier

NOTE The Purchaser may be the Owner of the plant in which the equipment is to be installed or the Owner's appointed agent.

3.49**Ra (surface finish)**

Arithmetic average of the absolute value of the profile height deviations recorded within the evaluation length and measured from the mean line.