TECHNICAL SPECIFICATION

RECIPROCATING POSITIVE DISPLACEMENT PUMPS AND METERING PUMPS

DEP 31.29.12.30-Gen.

July 1983
(DEP Circular 19/97 has been incorporated)

DESIGN AND ENGINEERING PRACTICE

USED BY

COMPANIES OF THE ROYAL DUTCH/SHELL GROUP

PREFACE

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The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

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NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

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PART I INTRODUCTION

This specification, which is an upgrading and revision of Standard Specification P-5-3 dated March 1970, contains the minimum technical requirements for reciprocating positive displacement pumps and for metering pumps for use in oil refineries,chemical plants, gas plants and, where applicable, in exploration, production and new ventures.

This specification gives SIPM/SICM amendments and supplements to the two corresponding API Standards:

- API Standard 674, First Edition, May 1980, 'Positive Displacement Pumps - Reciprocating'
- API Standard 675, First Edition, March 1980, 'Positive Displacement Pumps - Controlled Volume

It shall be used in conjunction with data/requisition sheet DEP 31.29.12.93-Gen. for reciprocating pumps.

As a rule the requirements of this specification shall be adhered to.

However, national and/or local regulations may exist in which some of the requirements are more stringent.

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 specification 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 specification as closely as possible.

Unless otherwise authorized by SIPM, the distribution of this specification is confined to companies belonging to or managed by the Royal Dutch/Shell Group, and to contractors and manufacturers/suppliers nominated by them under cover of a secrecy agreement.

All publications referred to are listed in Part IV.

PART II GENERAL INFORMATION

This specification is written in four parts of which Part III, the principal part, gives SIPM/SICM amendments and supplements to API Std 674, First Edition, May 1980, and to API Std 675, First Edition, March 1980.

Problems stemming from the publication of revisions or amendments to the above standards by the American Petroleum Institute in 1983 or subsequent years shall be referred to the principal.

Reciprocating positive displacement pumps, direct-acting and power frame types, shall conform to API Std 674, as amended or supplemented by this specification.

Metering pumps shall conform to API Std 675, as amended or supplemented by this specification, and to those amendments/supplements to API Std 674 indicated by the symbol (M) in the margin.

For ease of reference, the clause (or paragraph) numbering of API Std 674 has been used throughout Part III of this specification.

Where an amendment or supplement to a clause in API Std 674 applies equally to a corresponding clause in API Std 675, the instruction relative to the clause concerned in API Std 674 also identifies the corresponding clause in API Std 675.

When there is no corresponding clause in API Std 675 to which reference can be made, when required, the symbol (M) in the left-hand margin indicates where metering pumps shall comply with the amendment/supplement concerned.

Clauses (paragraphs) in API Std 674 and in API Std 675 not mentioned remain unaltered. Where cross references are made the number of the section/sub-section/clause of this specification referred to is shown in brackets.

A bullet (•) in the margin against certain clauses (paragraphs) in API Std 674 and API Std 675 indicates that a decision by the principal is required. These decisions shall be indicated directly in data/requisition sheet DEP 31.29.12.93-Gen., when provisions are made for them; otherwise, they shall be indicated in the data/requisition sheet(s) under the heading 'Additional Requirements', or stated in the purchase order.

DEFINITIONS

For the purpose of this specification, the following definitions shall hold:

Shall and Should -the word 'shall' is to be understood as mandatory, and the word 'should' as strongly recommended to comply with the requirements of this specification.

The **Principal** is the party which 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, authorized to act for the Principal.

* For Group operating companies having a service agreement with SIPM or SICM, the term Principal shall be taken as referring to SIPM - MFEE/21.

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction and commissioning for the project. The Principal may sometimes undertake all or part of the duties of the Contractor.

The **Purchaser** is the party which buys the pump and its auxiliaries for its own use or as agent for the owner. The Purchaser may be either Principal or Contractor.

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

The term **'Vendor'** is considered to be synonymous with the term Manufacturer/Supplier as defined above.

Pipe sizes: The international nomenclature - **Diameter Nominal** - written as DN 15, 25, 40, 50, etc., has been used for pipe sizes in this specification; the inch sizes have also been retained and are shown in brackets.

PART III AMENDMENTS/SUPPLEMENTS TO API STANDARD 674 AND API STANDARD 675

The following amendments/supplements are coordinated on API Std 674, see (Part II) of this specification.

SECTION 1 GENERAL

1.1 SCOPE

Delete this clause and note, and 1.1 and note of API Std 675, and replace by:

This specification covers the minimum requirements for reciprocating positive displacement pumps.

Direct-acting and power frame type pumps and metering pumps are covered by this specification. Metering pumps include both packed-plunger and diaphragm types; diaphragm pumps that use direct mechanical actuation are excluded.

1.3 CONFLICTING REQUIREMENTS

Delete this clause and 1.3 of API Std 675, and replace by:

In the case of conflict between documents relating to the inquiry or order, the following priority of documents shall apply:

- first priority: purchase order and variations thereto
- second priority: data/requisition sheets and drawings
- third priority: this specification.

1.4 DEFINITION OF TERMS

Add to this clause, and to 1.4 of API Std 675:

Unless otherwise specified, the terms listed below, when used on data/ requisition sheets, shall have the following definitions:

Continuous operation

Uninterrupted operation for a period of at least 16 000 hours at the specified operating conditions.

Intermittent operation

Any operation which is not classed as continuous operation. This definition may apply to such duties as:

- pumps started up and stopped automatically at intervals by process operated controls
- pumps started up and stopped at intervals by manual control for the batch transfer of liquid.

Hazardous service

Hazardous service for pumps and auxiliaries is defined as a service for process streams containing:

- hydrogen sulphide above 600 mg/kg
- toxic or lethal products (for a list of lethal products, reference is made to DEP 30.10.02.31-Gen.)
- hydrogen plus hydrocarbons, when the partial pressure of hydrogen exceeds 0.7 MPa (7 bar)
- hydrocarbons at an operating temperature above the auto-ignition temperature.

1.5 REFERENCED PUBLICATIONS

1.5.1 Delete from this clause:

API Std 615: Sound control of mechanical equipment for refinery services.

Add to this clause, and to 1.5.1 of API Std 675:

All publications referred to in this specification are listed in Part IV.

SECTION 2 BASIC DESIGN

2.1 GENERAL

2.1.2 Delete this clause and replace by:

(M) Noise control

Pumps shall be designed to minimize the generation of noise and shall not exceed the noise limits given in the supplementary clauses below.

2.1.2.1 General

All definitions, notations, measuring equipment, measuring procedures, test reporting, calculation methods and calculation procedures shall be in accordance with OCMA publication NWG-1.

2.1.2.2 Noise limits

Unless otherwise specified, the following limits shall be met at any measuring location not less than 1 m from the equipment surface:

Sound Pressure Limit in dB re 20 µPa

Pump	87 dB (A)
Pump + driver	90 db (A)

If the equipment produces impulsive and/or narrow band noise, the above limits shall be taken 5 dB (A) lower, thus 82 dB (A) for pump and 85 dB (A) for pump + driver.

Noise levels shall have an upper tolerance of + 0 dB.

The above requirements apply in absence of reverberation and background noise from other sources, and for all operating conditions between minimum flow and rated flow.

In the event that more stringent limits apply, then these will be indicated in the data/requisition sheet DEP 31.10.00.94-Gen. which forms part of the requisition. In such cases, the equipment shall not exceed the sound power or sound pressure limit stated in the requisition.

2.1.2.3 Noise abatement

Where excessive noise from equipment cannot be eliminated by low noise design, corrective measures should, preferably, take the form of acoustic insulation for pipes, gearboxes, etc. Where noise hoods are proposed, prior approval of the principal shall be obtained regarding construction, materials and safety requirements.

Noise control measures shall cause no hinderance to operations nor any obstruction to routine maintenance activities.

2.1.2.4 Information to be submitted with tender

The manufacturer shall state in data/requisition sheet DEP 31.10.00.94-Gen., as requested, either the sound pressure level not less than 1 m from the equipment surface in octave bands and in dB(A), or the maximum sound power level of the equipment, in octave bands and in dB(A).

The manufacturer shall also indicate what special silencing measures, if any, have been applied in order to obtain these levels.

2.1.5 Delete this clause, and 2.1.4 of API Std 675, and replace by:

All electrical components and installations shall be suitable for the area classification and

grouping specified in the data/requisition sheet.

2.1.10 Delete this clause, and 2.1.9 of API Std 675, and replace by:

Pumps and auxiliaries shall be suitable for outdoor installation and shall be able to operate continuously under a 3° tilt angle.

The environmental conditions in which the equipment will operate shall be specified in the data/requisition sheet, and the manufacturer shall indicate in his proposal any special protection required by the purchaser.

2.2 SELECTION OF TYPES

(M) Insert under this heading:

Pump type(s) shall be as specified in the data/requisition sheet(s).

2.3 RATINGS

2.3.1 Add to this clause:

Table 1 is deleted and replaced by (Table 1) of this specification.

TABLE 1 MAXIMUM ALLOWABLE SPEED RATINGS FOR POWER PUMPS IN CONTINUOUS SERVICE

Stroke length	Speed rating			
	Single-acting plunger-type pumps		Double-acting piston-type pumps	
mm	revolutions per minute	metres per second	revolutions per minute	metres per second
50	375	0.62	70	0.12
75	265	0.66	-	-
100	210	0.70	58	0.19
125	180	0.75	-	-
150	155	0.77	50	0.25
175	145	0.84	-	-
200	130	0.86	-	-
250	-	-	42	0.35
300	-	-	39	0.39
350	-	-	37	0.43
400	-	-	35	0.46

(M) The maximum allowable speed ratings for metering pumps in continuous service shall not be above 125 revolutions per minute.

2.4 CYLINDERS AND PRESSURE-RETAINING PARTS

2.4.2 Delete this clause and replace by:

(M) The maximum allowable working pressure of the cylinder shall be at least 120 % of the rated discharge pressure.

2.5 CYLINDER CONNECTIONS

2.5.1 Delete this clause, and 2.3.1 of API Std 675, and replace by:

Inlet and outlet connections shall be flanged, or machined and studded, and oriented as specified in the data/requisition sheets.

If bored and tapped nozzles are the manufacturer's standard practice, they may be used for sizes DN 40 (1½ in.) and smaller. Flanged nozzles shall be used for pipe sizes DN 50 (2 in.) and larger.

Screw-on flanges and ring-type joint flanges shall not be used.

2.5.7 Delete this clause, and 2.3.4 of API Std 675, and replace by:

Amended per Circular 19/97

NOTE: Sub-clauses 2.5.7.1 through 2.5.7.5, and 2.3.4.1 through 2.3.4.3 of API Std 675, shall apply unless amended by this specification.

Flanges shall conform to ANSI B16.1 for cast iron and bronze pumps, and to ANSI B16.5 or BS 1560 for pumps made from other materials.

Flange facing finish shall be in accordance with ASME/ANSI B16.5.

2.5.7.1 Delete this clause, and 2.3.4.1 of API Std 675, and replace by:

Cast iron flanges and bronze flanges shall be flat-faced and shall be ANS class 250 minimum thickness for sizes DN 200 (8 in.) and smaller.

2.5.7.2 Delete this clause, and 2.3.4.2 of API Std 675, and replace by:

Flat-faced flanges in cast iron and bronze are acceptable. For other materials, flat-faced flanges are subject to approval by the principal.

2.7 POWER END AND RUNNING GEAR

2.7.1 Delete 'When specified' from this clause

2.7.11 Delete this clause and replace by:

This distance piece shall be equipped with gasketed solid covers. Access openings for solid covers shall be surfaced and drilled.

2.10 MATERIALS

2.10.1.1 General

Add to this clause, and to 3.1 of API Std 675:

Materials of construction shall be as specified in the data/requisition sheet.

The pump manufacturer may offer alternative materials if, based on his experience, these would render equal or better service.

Add to this clause, and delete 3.8 of API Std 675, and replace by:

Cast iron, except nodular cast iron, shall not be used for pressure-containing parts.

2.10.1.2 Add to this clause, and to 3.3 of API Std 675:

The manufacturer shall furnish material certificates giving chemical composition and mechanical data for pressure-containing parts and for all main components of the pump, in accordance with the requirements of (4.2) of this specification.

2.10.1.8 Add to this clause, and to 3.3 of API Std 675:

Materials for components exposed to wet hydrogen sulphide, including trace quantities, shall conform to the requirements of NACE Standard MR-01-75, 1980 revision.

2.10.2 Castings

2.10.2.3 Delete this clause, and 3.5, 3.5.1 and 3.5.2 of API Std 675 and replace by:

The repair of leaks and defects in pressure-containing castings by peening or burning-in, or by impregnation with plastics or cement compounds is prohibited.

Repair by welding or by plugging shall be undertaken only when permitted by the material specification, and then only in accordance with the procedures detailed below.

Repair by welding

Weldable grades of castings may be repaired by welding subject to the following criteria:

1. Approval by the principal shall be obtained before any major* weld repair is carried out.

   * Refer to definition included after item 6.

2. All repairs shall meet the inspection requirements and acceptance standards for the original material.

3. For steel castings, the repair welding procedure and the repair welder's qualifications shall both be in accordance with ASTM A 488. For non ferrous alloy castings, refer to the principal for recommended repair procedures. Repair procedures are subject to approval by the principal.

4. The total quantity of weld metal deposited shall be less than 10% of the mass of the casting.

5. After weld repair, castings shall be suitably heat-treated if this is specified in the relevant material specification.

   A major* weld, repair shall always be followed by a suitable heat treatment.

6. Details of all major weld repairs, and of the heat treatment where applicable, shall be recorded and reported to the principal.

   * The definition of a major weld repair is to be taken as either a removal of more than 50% of the wall thickness, or a length of more than 150 mm in one or more directions, or a total surface area of all repairs exceeding 20% of the total casting surface area.

Repair by plugging

Cast gray iron or nodular iron may be repaired by plugging within the limits specified in ASTM A 278, ASTM A 536 or ASTM A 395 respectively. The drilled holes for plugs shall be carefully examined by dye penetrant to ensure removal of all defective material.

All necessary repairs not covered by ASTM shall be subject to approval by the principal.

Details of all repairs shall be recorded and reported to the principal, who shall be informed of the need for plugging before any repair is carried out.

2.10.2.4 (M) This clause shall also apply to metering pumps.

2.10.5 Low temperature

Delete this clause, and 3.11 of API Std 675, and replace by:

For pressure-containing parts operating at temperatures of 0 °C and below, selected material shall have an impact strength sufficient to qualify under the minimum impact energy requirements specified in DEP 30.10.02.31-Gen.

SECTION 3 ACCESSORIES

3.1 DRIVERS

3.1.5 Delete this clause, and 4.1.3 of API Std 675, and replace by:

Drivers shall be in accordance with the appropriate specifications as shown in the relevant data/requisition sheets.

Electric motor drivers shall comply with DEP 33.66.05.31-Gen. and data/requisition sheet DEP 33.66.05.93-Gen.

3.1.6 (M) Delete this clause and replace by:

Electric motors for auxiliary equipment shall comply with (3.1.5) of this specification.

3.1.7 Delete this clause and replace by:

Steam turbines shall comply with API Std 611 as amended/supplemented by DEP 31.29.60.30-Gen. or with API Std 612 as amended/supplemented by DEP 31.29.60.31-Gen. and data/requisition sheet DEP 31.29.61.95-Gen. or DEP 31.29.61.93-Gen., whichever is applicable.

3.2 COUPLINGS

3.2.2 Delete this clause, and 4.2.2 of API Std 675, and replace by:

The coupling type shall be as specified in the data/requisition sheet.

3.4 MOUNTING PLATES

3.4.1 Delete this clause and replace by:

The equipment shall be furnished with a baseplate as specified in the data/requisition sheet. In the following paragraphs, the term 'mounting plate' refers to baseplates.

3.5 GEAR, BELT AND CHAIN DRIVES

3.5.3 Add to this clause:

Gear service factors shall be in accordance with AGMA 420.04, and in no case shall the service factor be less than 2.0.

3.6 NAMEPLATES AND ROTATION ARROWS

3.6.4 Add to this clause, and to 4.5 of API Std 675, and delete last sentence of 4.5 of API Std 675:

In addition to appearing on the nameplate, the pump serial number shall be plainly stamped on the pump casing.

Unless otherwise specified, the text on nameplates shall be in the English language and the data shall be in SI units.

Add to information required on nameplates: Year of manufacture.

3.7 PIPING AND APPURTENANCES

3.7.1.2 Add to this clause, and to 4.6.2 of API Std 675:

The instrumentation required shall be as specified in the data/requisition sheet and shall

conform to the requirements of DEP 32.31.09.31-Gen.

If the pump should be subjected to on-stream condition monitoring, which shall be specified in the data/requisition sheet (under the heading 'Additional Requirements'), instrumentation ports shall be provided at suitable positions in pump inlet and discharge for pressure and temperature measurements, and drain cocks shall be provided for luboil sampling.

3.7.1.10 Add to this clause:

The minimum size of cooling water connections shall be DN 20 (3/4 in. nominal size).

3.7.4 Pulsation suppression devices

3.7.4.1 Add to this clause, and to 2.7.1 of API Std 675:

Unless otherwise specified, the type of pulsation device furnished shall be as described in item 3.

3.7.4.2 Add to this clause, and to 2.7.2 of API Std 675:

Pulsation in the liquid flow entering and leaving the pump should not exceed plus or minus 1½% of the operating pressure in the suction or discharge manifold respectively.

3.8 RELIEF VALVES

3.8.1 Delete this clause and replace by:

Separate external relief valves shall be provided for power pumps, and for direct acting pumps if the stall pressure or the ram pressure exceeds the maximum allowable working pressure. Relief valves integral with the pump casing are not permitted. Unless otherwise specified, the principal will furnish the relief valves.

SECTION 4 INSPECTION AND TESTS

4.1 GENERAL

Add to this clause, and to 3.1.1. of API Std 675:

When there are a number or series of identical pumps to be inspected and tested, each individual pump shall be inspected and tested in accordance with the requirements of this specification. Random inspection and testing is not permitted.

Shop inspection

Shop inspection shall be carried out as follows prior to tests and performance testing.

For all pumps, shop inspection shall include a dimensional check against approved outline drawings combined with a visual check for good workmanship.

The dimensional check shall include:

- all main dimensions
- baseplate and location of foundation bolt holes
- bore of coupling half
- size, position and rating of flanges
- size and type of threaded connections
- coupling guard.

For process pumps and metering pumps, shop inspection shall include the following additional requirements:

- a check of wall thicknesses of cylinders and pressure-retaining parts, and a check of any shop repairs carried out on these
- a measurement of the actual running clearances throughout the pump
- a check on material hardnesses where applicable - see (4.2.9) of this specification an inspection of all internals for good workmanship and finish, and for material defects
- an inspection of flange face finish, in accordance with (2.5.7) of this specification.

4.2 INSPECTION

4.2.1 Add to this clause, and to 5.1.2 of API Std 675:

Certification of materials

The requirements for, and the certification of, materials test data are set out be low and shall be adhered to.

4.2.1.1 The different types of certificate which shall be used by the manufacturer for verifying that the requirements of the specification and contract are met are distinguished below.

Type A

Certificates by which the manufacturer confirms that the product supplied corresponds to what was specified, on the basis of test results taken from the in-production testing of products of the same material and the same manufacturing method as the delivery concerned.

Type B

Certificates by which the manufacturer's inspector confirms that the product supplied corresponds to what was specified, on the basis of tests carried out on the delivery itself or on standards-specified test specimens related to the delivery.

The necessary testing shall have been carried out by a testing centre which is in dependent of production in the manufacturing works and which has the necessary facilities at its disposal. When the independence of the testing centre can not be established, a Type C certificate shall be submitted.

Type C

Certificates as described under Type B with the additional requirement that the tests shall be witnessed by an independent inspector who shall be approved by the principal. Certificates shall be valid only when stamped and signed by this in dependent inspector.

4.2.1.2 All certificates shall contain the following information:

- name of manufacturer
- purchase order number and date
- manufacturer's order number
- identification number of certificate and its date of issue
- material specification(s)
- dimensions in SI units, unless otherwise specified or applicable
- material charge number, batch number or heat-lot number
- mechanical properties recorded from test results
- chemical composition recorded from results of chemical analyses
- NDT methods and results, where applicable
- heat treatment procedures, furnace charge number and heat treatment records, where applicable
- such supplementary or additional information as may be required.

Additionally, all Type C certificates shall state:

- name of independent inspector who has witnessed the test(s)
- this independent inspector's identification symbol.

  Unless otherwise specified, the material concerned shall be stamped with an identical symbol using low-stress dies.

4.2.1.3 As a minimum, material certificates in accordance with Type A are required for:

- pressure-containing parts in non-hazardous and in non-hydrocarbon services with operating temperatures above 0 °C, and for non-ferrous materials except those used in hazardous and hydrocarbon services
- all metering pump components, including pump body, valves and valve seats, plungers and membranes
- all reciprocating pump components, including pistons, plungers and piston rods, valves and valve seats, and crankshafts.

4.2.1.4 As a minimum, material certificates in accordance with Type B are required for pressure-containing parts in hydrocarbon services.

4.2.1.5 Material certificates in accordance with Type C shall be furnished for pressure containing parts in services for which impact testing is required by DEP 30.10.02.31-Gen. and in hazardous services.

4.2.3 Delete this clause and 4.2.4 and 4.2.5 and replace by:

(M) Material/Parts inspection

The type of inspection and its application set out in the following supplementary clauses shall be adhered to.

4.2.3.1 Classification

There are three different classes of inspection, defined as follows:

Inspection class A:

Visual inspection in accordance with (4.2.3.2) of this specification.

Inspection class B:

Visual inspection (class A) plus magnetic particle or dye-penetrant inspection in accordance with (4.2.3.3) or (4.2.3.4) of this specification, as applicable.

Inspection class C:

Visual inspection plus magnetic particle or dye-penetrant inspection (class B) plus radiographic or ultrasonic inspection in accordance with (4.2.3.5) or (4.2.3.6) of this specification, as applicable.

4.2.3.2 Visual inspection

Casting surfaces, including steel castings for valves, flanges, fittings and other piping components, shall be examined visually by the manufacturer and shall be free of adhering sand, scale, cracks and hot tears.

Other surface discontinuities shall meet the visual acceptance standards specified in MSS SP 55.

4.2.3.3 Magnetic particle examination

Magnetic particle examination shall be carried out as described in ASTM E 709. All surfaces, including machined gasket seating surfaces, shall be examined.

Acceptability of defects shall be based on a comparison with the reference photographs given in ASTM E 125. For each type of defect, the degree of severity shall not exceed the limits in the following table:

Type	Degree
I	1
II	2
III	2
IV	1
V	1
VI	1

Irrespective of these generalized limits, it shall be the manufacturer's responsibility to review the design limits of all castings in the event that more stringent requirements are specified.

4.2.3.4 Dye-penetrant inspection

Dye-penetrant inspection shall be used only when magnetic particle inspection is not

feasible.

Dye-penetrant inspection shall be carried out as described in ASTM E 165. All surfaces, including machined gasket surfaces, shall be examined.

Acceptability of defects shall be based on a comparison with the reference photographs given in ASTM E 125. For each type of defect, the degree of severity shall not exceed the limits given in the table of (4.2.3.3) of this specification.

Irrespective of these generalized limits, it shall be the manufacturer's responsibility to review the design limits of all castings in the event that more stringent requirements are specified.

4.2.3.5 Radiographic inspection

Radiographic inspection shall be carried out in accordance with the procedures described in ASTM E 94. It shall be applied to all critical areas, such as abrupt changes of section, weld ends, at the junction of risers, gates or feeders to the casting, and to areas of highest stress. Prior to inspection, the manufacturer shall agree with the principal those areas which are critical in this respect.

The interpretation of radiographs shall be in accordance ASTM E 186, ASTM E 280, or ASTM E 446, whichever is applicable. For each type of defect, the degree of severity shall not exceed the limits in the following table:

Thickness mm	Gas and blow holes	Sand spots and inclusions	Internal shrinkage	Cracks and hot tears
			Types 1,2,3 and 4	
Below 25	2	2	2	Not Allowed
25-50	3	3	2	
51-114	3	3	2	
Over 114	3	3	2	

4.2.3.6 Ultrasonic inspection

Ultrasonic inspection shall be used where radiography is not possible.

Ultrasonic inspection shall be carried out as described in ASTM A 609. For each range of wall thickness, the level of acceptance shall be in accordance with the following table:

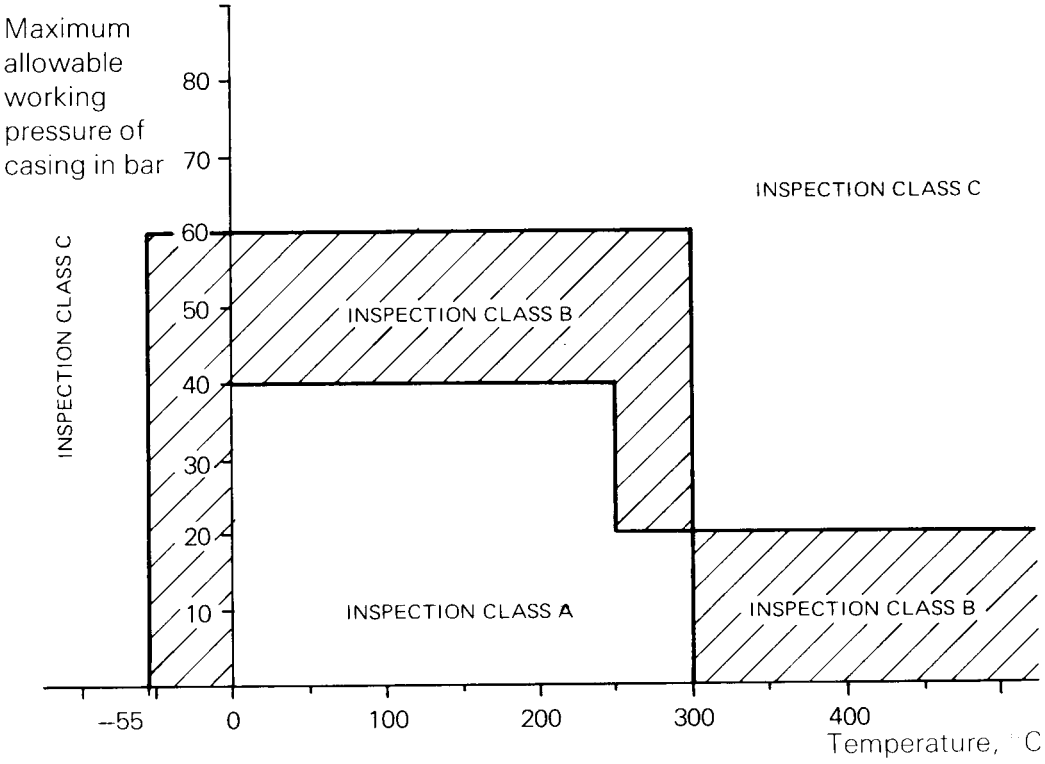
Thickness mm	Acceptance level
Below 50	2
50-100	3
Over 100	4

4.2.3.7 Application of inspection classes

Pressure-containing castings

Unless otherwise specified, pressure-containing castings (ASME P number 1), shall be inspected in accordance with the maximum allowable working pressure/pumping temperature relationship shown in Fig. 1 on page 22.

FIG. 1 INSPECTION CLASSES FOR PRESSURE-CONTAINING CASTINGS



Alloy steel castings

Alloy steel castings (ASME P numbers 3 and higher), shall be inspected at least in accordance with class B.

Nozzle welds

All nozzle welds shall be inspected in accordance with class C.

Casting defects

Whenever major defects are found, see (2.10.2.3) of this specification, the casting shall be inspected again, either in accordance with the next more severe inspection class, or to increased inspection requirements as agreed by the principal with the manufacturer.

Weld repairs

All weld repairs shall be inspected by the same procedure and to the same standards as applied to the initial inspection of the casting.

Whenever a major weld repair has been carried out, see (2.10.2.3) of this specification, the repair shall be inspected in accordance with the more severe inspection requirements as applied after the defects were found.

4.2.9 Add to this clause:

For components exposed to wet hydrogen sulphide, including trace quantities, the hardnesses shall be verified as being within the limits allowable by NACE Standard MR-01-75, 1980 revision.

4.2.11 Insert new clause, and new 5.1.4 to API Std 675:

Marking

Marking is required only for component parts certified under material certificates Type B and Type C, see (4.2.1.4) and (4.2.1.5) of this specification.

Parts with a wall thickness in excess of 5 mm, except those items manufactured from austenitic stainless steel or from nickel alloys, shall be legibly marked by hard-die stamping on to a painted background, and at a point clearly visible later. Pipes should be marked at a point approximately 250 mm from one end.

Only low-stress stamps shall be used for hard-die stamping, and the stamps shall be round-nosed with a minimum radius of 0.25 mm.

For items manufactured from austenitic stainless steel or from nickel alloys, and for items with a wall thickness of 5 mm or less, the marking shall be applied by stencil using a water insoluble ink which contains no injurious substances such as metallic pigments, sulphur, sulphides or chlorides which could attack or harmfully affect the material.

The stamping/marking shall include:

- manufacturer's symbol; the stamp shall be identical to symbol on certificate*
- material and product identification
- charge or batch number
- heat treatment chart or furnace charge reference number, where applicable

* Where applicable, the third-party agency identification stamp or mark shall be identical to the stamp/mark on the certificate.

- heat treatment symbol or code, where applicable
- non-destructive testing symbol or code, where applicable
- size and schedule
- hydrostatic test pressure in bar, where applicable.

NOTE: Where the size of the fitting does not permit complete marking, the identification marks may be omitted in the reverse order presented above, or another form of identification may be used with the prior agreement of the principal.

4.3 TESTS

4.3.1 General

4.3.1.1 Add to this clause, and to clause 5.2.1.1 of API Std 675:

In order to obtain accurate test data, the capacity test shall be repeated at least three times.

4.3.1.3 Add to this clause, and to 5.2.1.3 of API Std 675:

Only gauges, instruments and manometers which have been checked and verified shall be used for tests. Care shall be taken with respect to dampening devices for gauges to ensure accuracy of readings.

The range of these instruments shall be such that the maximum pressure to be indicated is between 40% and 60% of the total gauge pressure range. Suction pressures shall be measured with a U-tube manometer filled with a stable fluid.

4.3.1.6 Add to this clause:

(M) In respect of the tests specified in items 1 through 6 above, the following tests shall be performed on all pumps, unless otherwise specified:

1. A witnessed performance test in accordance with 4.3.3 or 4.3.4 of API Std 674, or with 5.2.3 of API Std 675, whichever is applicable.
2. A witnessed hydrostatic test in accordance with 4.3.2 of API Std 674, or with 5.2.2 of API Std 675, both as amended by this specification, which ever is applicable.
4. A non-witnessed NPSH test in accordance with 4.3.6.

In certain cases which shall be specified, the NPSH test shall be witnessed.

4.3.2 Hydrostatic tests

4.3.2.4 Add to this clause, and to 5.2.2.3 of API Std 675:

Any leakage during tests shall be cause for rejection.

Repairs shall be subject to prior approval of the principal, and shall be carried out in accordance with (2.10.2.3) of this specification and shall be subject to approval by the principal's inspector before commencing a second or subsequent test.

4.4 PREPARATION FOR SHIPMENT

4.4.1 Add to this clause, and to 6.1 of API Std 675:

Preparation for shipment shall be in accordance with the requirements of the inquiry and of the purchase order(s) and the supplements appertaining thereto.

SECTION 6 VENDOR'S DATA

6.1 PROPOSALS

Delete item 1, and 8.1.1.1 of API Std 675 and replace by:

1. Copies of the relevant data/requisition sheet(s) completed to the furthest extent practicable.

6.2 CONTRACT DATA

6.2.1 Drawings

6.2.5.1 Add to this clause, and to 8.2.1.5 of API Std 675:

The information shall include the documents for control and instrumentation as specified in DEP 32.31.09.31-Gen.

APPENDICES TO API STD 674 AND API STD 675

APPENDICES TO API Std 674

Appendix A	-	Reciprocating Pump Data Sheets Delete - see (Part I) of this specification.
Appendices B and C	-	These appendices should be applied as recommended.

APPENDICES TO API Std 675

Appendix A	-	Controlled Volume Pump Data Sheets Delete - see (Part I) of this specification.
Appendix B	-	This appendix should be applied as recommended.

PART IV REFERENCES

In this specification reference is made to the following publications.

NOTE: The latest issue of each Group publication should be used together with any amendments/supplements/revisions to such publications.

It is particularly important that the effect of revisions to international, national or other standards shall be considered when they are used in conjunction with DEPs, unless the standard referred to has been prescribed by date.

Metallic materials - Requirements for equipment for low-temperature service, and for equipment containing liquefied gas or lethal substances	DEP 30.10.02.31-Gen.
Data/requisition sheet for equipment noise limitations	DEP 31.10.00.94-Gen.
Data/requisition sheet for reciprocating pumps	DEP 31.29.12.93-Gen.
General-purpose steam turbines	DEP 31.29.60.30-Gen.
Special-purpose steam turbines	DEP 31.29.60.31-Gen.
Data/requisition sheet for special-purpose steam turbines	DEP 31.29.61.93-Gen.
Data/requisition sheet for general-purpose steam turbines	DEP 31.29.61.95-Gen.
Instrumentation for equipment packages	DEP 32.31.09.31-Gen.
Electric motors	DEP 33.66.05.31-Gen.
Data/requisition sheet for electric motors	DEP 33.66.05.93-Gen.

AMERICAN STANDARDS

Cast Iron Pipe Flanges and Flanged Fittings	ANSI B16.1
Steel Pipe Flanges and Flanged Fittings	ANSI B16.5

Issued by
American National Standards
Institute
1430 Broadway, New York,

Positive Displacement Pumps - Reciprocating	API Std 674 First edition, May 1980
Positive Displacement Pumps - Controlled Volume	API Std 675 First edition, March 1980

Issued by
American Petroleum Institute,
Publications and Distribution Section,
2101 L Street, NW,
Washington, DC 20037, USA

Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 °F (345 °C)	ASTM A 278
Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperature	ASTM A 395

Qualification of Procedures and Personnel for the Welding of Steel Castings	ASTM A 488
Ductile Iron Castings	ASTM A 536
Ultrasonic Examination of Carbon and Low-Alloy Steel Castings	ASTM A 609
Radiographic Testing	ASTM E 94
Magnetic Particle Indications on Ferrous Castings	ASTM E 125
Liquid Penetrant Inspection	ASTM E 165
Heavy-Walled (51 to 114 mm) Steel Castings	ASTM E 186
Heavy-Walled (114 to 305 mm) Steel Castings	ASTM E 280
Steel Castings up to 51 mm in Thickness	ASTM E 446
Magnetic Particle Examination	ASTM E 709

Issued by
American Society for Testing
and Materials,
1916 Race St., Philadelphia,
Pa. 19103, USA

Quality Standard for Steel Castings Visual Method	MSS SP-55

Issued by
Manufacturers Standardization Society,
5203 Leesburg Pike, Suite 502,
Falls Church, Virginia 22041, USA

Sulfide stress cracking resistant metallicmaterial for oil field equipment	NACE Standard MR-01-75 (1980 Revision)

Issued by
National Association of Corrosion
Engineers,
1440 South Creek, Houston,
Texas 77084, USA

Practice for Enclosed Speed Reducers or Increasers Using Spur, Helical, Herringbone and Spiral Bevel Gears	AGMA 420.04

Issued by
American Gear Manufacturers Association,
1901 North Fort Myer Drive, Suite 1000,
Arlington, Virginia 22209, USA

BRITISH STANDARDS

Steel pipe flanges and flanged fittings	BS 1560

Issued by
British Standards Institution,
2 Park Street,
London W1A 2BS,
England

OIL COMPANIES MATERIALS ASSOCIATION

Noise Procedure Specification

OCMA publication
NWG-1

Issued by
Heyden & Son Ltd
Hillview Gardens,
London, NW4 2JQ,
England