

MATERIAL AND EQUIPMENT STANDARD
FOR
LIGHT DUTY CENTRIFUGAL PUMPS

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0. INTRODUCTION

This Standard Specification gives the amendments and supplements to ANSI Standard B 73.1M-1984 Edition, "Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process".

For ease of reference, the clauses and paragraph numbering of ANSI Standard B 73.1M have been used throughout this Standard.

Clauses and paragraphs in ANSI Standard not mentioned, are remained unchanged.

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

Sub. : The ANSI Standard clause or paragraph is deleted and substituted by a new clause or Paragraph.

Add. : A new clause or paragraph with a new number is added.

Mod. : Part of the ANSI Standard, clause or paragraph is modified, and/or a new statement or comment is added to that clause.

Del. : The ANSI Standard clause is deleted without any replacement.

1. SCOPE

This Standard covers the minimum requirements for light duty pumps having rated capacity of 63 m³/h or less for refinery services, gas, chemical and petrochemical plants and where applicable in explorations, productions and new ventures.

Compliance by the pump manufacturer with the provisions of this Standard does not relieve him of the responsibility of furnishing pump and accessories of proper design, mechanically suited to meet guarantees at the specified service conditions. (Mod.)

1.1 Conflicting Requirements

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 sheets and drawings.
- **Third Priority** : This Standard Specification.

All conflicting requirements shall be referred to the purchaser in writing. The purchaser will issue confirmation document if needed for clarification. (Add.)

2. ALTERNATIVE DESIGN

No deviations or exceptions from this Standard shall be permitted without the written prior approval of the purchaser.

Intended deviations shall be separately listed by the vendor and supported by reasons thereof for purchaser consideration. (Mod.)

2.1 Units

Unless otherwise specified, International System of Units "SI" shall be applied. (Add.)

3. NOMENCLATURE AND DEFINITIONS

3.2 Diameter Nominal, written as DN 15, 25, etc., has been used for pipe sizes in accordance with ISO 6708 and Appendix B of this Standard. (Add.)

3.3 Pressure Nominal, written as PN 20, 50, etc., has been used for flange ratings in accordance with ANSI-ASME, B 16.5 (1981), ISO 7268 (1983) and Appendix C of this Standard. (Add.)

4. DESIGN AND CONSTRUCTION FEATURES

4.3 Casing

4.3.2 Gage connections if required shall be DN 15 (½ inch) minimum. (Mod.)

4.3.3 For temperatures higher than 177°C the casing shall be center-line supported. (Mod.)

4.3.5 Jacket connections shall be DN 15 (½ inch) minimum. (Mod.)

4.3.7 The stress used in design for any given material shall not exceed the values given for that material in Section VIII, Division 1 of the ASME Code. For cast materials, the factor specified in the code shall be applied. Pressure casing shall comply with the applicable rules of Section VIII, Division 1 of the ASME Code. Manufacturers' data report forms and stamping, as specified in the code, are not required. (Add.)

4.3.8 The pressure casing shall be designed for the maximum discharge pressure plus allowances for head and speed increases at the pumping temperature, with a minimum corrosion allowance of 3 millimeters. (Add.)

4.4 Impeller

4.4.1 Close type impellers are preferred. (Mod.)

4.4.3 Delete second sentence of this clause. (Mod.)

4.4.4 Impellers shall be keyed to the shaft. (Mod.)

4.5 Shaft

4.5.1 Shaft sleeves shall extend beyond seal end plate for pumps, employing throttle bushing. (Mod.)

4.6 Stuffing Box

4.6.1 a) Packed stuffing boxes shall be flushed at the throat bushing if the liquid contains abrasive particles such as catalyst of coke in concentrations of 11.98 kg/cm³ or more, or fails to provide the required lubrication for the packing.

b) Sealing liquid at a positive pressure shall be injected into the seal cage of a packed stuffing box operating at vacuum pressure. (Mod.)

4.6.6 Mechanical seals shall be furnished, unless otherwise specified. (Add.)

4.6.7 Mechanical seals shall be of the single balanced type (one rotating face per seal chamber) unless approved otherwise by the purchaser. (Add.)

4.7 Bearing

4.7.7 Drain size shall be DN 15 (½") minimum. (Mod.)

4.8 Material

Chaplets in casings other than cast iron not completely fused into pressure casings, or other defects, shall be replaced by weld metal equivalent to the casing composition. Casings shall be heat treated following any major repair. For hydrocarbon services cast iron casings shall not be used. (Mod.)

Note:

A major 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.

4.12 Miscellaneous Design Features

4.12.1 Delete when specified from last sentence of this clause and add; "dry flexible disc couplings shall be supplied unless otherwise approved by purchaser". (Mod.)

4.12.6 Flanged suction and discharge nozzles shall be integral with the casing. (Add.)

4.12.7 All required vents shall be valved. (Add.)

4.13 General Design Features (Add.)

- 4.13.1**
- a) The head curve for the pump shall be continuously rising from the specified capacity point to the shut off point.
 - b) The pump head at shut-off shall be at least 110%, but not exceed 120%, of the head at the specified capacity point
 - c) Pumps for parallel operation shall have equal head rise to shut-off.
 - d) Pump suction specific speed shall not exceed 216 in SI Unit System and 13000 in customary units. (Add.)

4.13.2 Unless otherwise specified the pumps and auxiliaries shall be suitable for outdoor installation, in the climatic zone specified. (Add.)

5. GENERAL INFORMATION

5.1 Application

5.1.2 Flange loading

The following requirements shall apply to steel, and cast iron pumps regardless of nozzle size.

- a) Each nozzle shall be capable of withstanding forces from external piping loads as follows:
 - 1) For forces parallel to the nozzle axis:
 $F < 200 \text{ lb}_f \text{ per in. of nominal nozzle diameter.}$
 - 2) For forces perpendicular to the nozzle axis:
 $F < 100 \text{ lb}_f \text{ per in. of nominal nozzle diameter.}$
 - 3) For tensile forces parallel to the nozzle axis in top nozzles 4 in. in diameter and less:
 $F < 100 \text{ lb}_f \text{ per in. of nominal nozzle diameter.}$

b) Each nozzle shall be designed to withstand a bending moment imposed at the nozzle flange from external piping as determined by the following formula:

$$M = S \times Z$$

Where:

M = Design bending moment, lb_f-in.

S = Nozzle bending stress limitation, psi, equivalent to the lesser of:

1) Carbon or alloy steel pumps: $0.75 S_h$ or $\frac{1.5}{D} S_h$, psi

2) Cast iron pumps: $0.75 S_h$ or $\frac{18.000}{D}$, psi

S_h = Allowable hot stress for the pump casing material, psi (stresses per ANSI B 31.3 Appendix A, Table 1).

D = Nominal nozzle size, in.

Z = Section modulus of pipe, in.³, for pipe of Diameter D, and thickness equivalent to:

1) ANSI Class 400 or lower rating flanges: Schd. standard.

2) ANSI Class 600 or higher rating flanges: Schd extra strong.

Note:

In calculations using SI terms for Nozzle Force (F) and Design Moment (M) per subpar. a. and b. above:

Specified Term	Acceptable Metric Equivalent
F < 200 lbf/in.	F < 35.6 N/mm
F < 100 lbf/in.	F < 17.8 N/mm
M, lbf. in.	M, N.m
$\frac{1.5}{D} S_h$ psi	$\frac{0.26}{D} S_h$ N/mm ²
$\frac{18.000}{D}$ psi	$\frac{3100}{D}$, N/mm ²
S_h psi	No change use ANSI B31.3 values psi
D, in.	(25) × in. = mm
Z, in.³	(1.65 × 10⁻⁵) × in.³ = m³ (Mod.)

5.1.3 Noise

The sound pressure level in dB (re 20 μ Pa) shall not exceed 87 dB(A) for the pump, or 90 dB(A) for the pump and its driver, at any measuring point, 1m from the equipment surface, unless otherwise specified. (Mod.)

5.2 Tests

5.2.1 Hydrostatic

Change 10 minutes minimum to 30 minutes minimum. (Mod.)

5.2.2 Performance

Pumps shall be given a performance test. (Mod.)

5.3 Nameplates

The text on nameplates shall be in English language and unless otherwise specified the data in SI. The information on nameplate shall include item number, year of manufacture, and the name of manufacturer. (Mod.)

5.4 Drivers

5.4.1 The type of driver will be specified by the purchaser. The driver shall be sized to meet the maximum specified operating conditions, including bearing, mechanical seal, and coupling losses, as applicable, and shall be in accordance with the applicable specification, as stated in the inquiry and order. The driver shall be suitable for satisfactory operation under the utility and site conditions specified by the purchaser. (Add.)

5.4.2 Motor drivers shall comply with IPS Std. M-EL-132, and turbine drivers with IPS Std. M-PM-240. (Add)

5.4.3 The starting conditions for the driven equipment will be specified by the purchaser, and the starting method shall be mutually agreed upon by the purchaser and the vendor. The driver's starting-torque capabilities shall exceed the speed-torque requirements of the driven equipment. (Add.)

6. REFERENCES

6.2 Other Publication

The latest edition of the following Standards to the extent specified herein shall be part of this Standard:

ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

"Boiler and Pressure Vessel Code: Section VIII"

"Rules for Construction of Pressure Vessels"

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

E 44 "Guide for Radiographic Testing"

E 125 "Reference Photographs for Magnetic Particle Indications on Ferrous Casting"

E 142 "Method for Controlling Quality of Radiographic Testing"

E 709 "Practice for Magnetic Particle Examination"

IPS (IRANIAN PETROLEUM STANDARD)

M-EL-132	"Induction Motors"
M-PM-240	"General Purpose Steam Turbines"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

6708	"Pipe Components-Definition of Nominal Size"
7268	"Pipe Components-Definition of Normal Pressure"

7. INSPECTION (Add.)**7.1 General**

7.1.1 After advance notification of the Vendor by the purchaser, the purchaser's representative shall have entry to all vendor and subvendor plants where manufacturing, testing, or inspection of the equipment is in progress. (Add.)

7.1.2 The Vendor shall provide sufficient advance notice to the purchaser before conducting any inspection or test that the purchaser has specified to be witnessed or observed. (Add.)

7.1.3 The purchaser will specify the extent of his participation in the inspection and testing. (Add.)

7.1.4 When shop inspection has been specified by the purchaser, the purchaser and the vendor shall coordinate manufacturing hold points and inspectors' visits. (Add.)

7.1.5 The Purchaser's representative shall have the right to reject any parts of the equipment which do not comply with the purchase order. (Add.)

7.1.6 The Vendor shall keep the following data available for at least 5 years for examination by the purchaser or his representative upon request:

- a) Necessary certification of materials, such as mill test reports.
- b) Purchase specifications for all items on bills of materials.
- c) Test data to verify that the requirements of the specification have been met.
- d) Results of documented tests and inspections.
- e) Final-assembly maintenance and running clearances. (Add.)

7.1.7 Pressure-containing parts shall not be painted until the specified inspection of the parts is completed. (Add.)

7.2 Material Inspection (Add.)

When radiographic, ultrasonic, magnetic particle, or liquid penetrant inspection of welds or materials is required or specified, the criteria in 7.2.1 through 7.2.4 shall apply unless otherwise are specified by the purchaser. Cast iron may be inspected in accordance with 7.2.3 and 7.2.4 welds, cast steel, may be inspected in accordance with 7.2.1 through 7.2.4 .

7.2.1 Radiography

Radiography shall be in accordance with ASTM E 94 and ASTM E 142. The acceptance standard used for welded fabrication shall be Section VIII Division 1, UW-52, of the ASME Code. The acceptance standard used for castings shall be Section VIII, Division 1, Appendix 7 of the ASME Code. (Add.)

7.2.2 Ultrasonic inspection

Ultrasonic inspection shall be in accordance with Section V, Article 5 of the ASME Code.

The acceptance standard used for welded fabrications shall be Section VIII, Division 1, Appendix 12 of the ASME Code. The acceptance standard used for castings shall be Section VIII, Division 1, Appendix 7 of the ASME Code. (Add.)

7.2.3 Magnetic particle inspection

Both wet and dry methods of magnetic particle inspection shall be in accordance with ASTM E 709.

The acceptance standard used for welded fabrications shall be section VIII, Division 1, Appendix 6 of the ASME Code. The acceptability of defects in castings shall be based on a comparison with the photographs in ASTM E 125. For each type of defect, the degree of severity shall not exceed the limits of Table 1. (Add.)

TABLE 1 - MAXIMUM SEVERITY OF DEFECTS IN CASTINGS

TYPE	DEFECT	MAXIMUM SEVERITY LEVEL
I	LINEAR DISCONTINUITIES	1
II	SHRINKAGE	2
III	INCLUSIONS	2
IV	CHILLS AND CHAPLETS	1
V	POROSITY	1
VI	WELDS	1

7.2.4 Liquid penetrant inspection

Liquid penetrant inspection shall be in accordance with Section V, Article 6 of the ASME Code.

The acceptance standard used for welded fabrications shall be Section VIII, Division 1, Appendix 8 of the ASME Code. The acceptance standard used for castings shall be Section VIII, Division 1, Appendix 7 of the ASME Code. (Add.)

8. PREPARATION FOR SHIPMENT (Add.)

8.1 Equipment shall be suitably prepared for the type of shipment specified, including restraint of the rotor when necessary. The preparation shall make the equipment suitable for 6 months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals. If storage for a longer period is contemplated, the purchaser will consult with the vendor regarding the recommended procedures to be followed. (Add.)

8.2 The vendor shall provide the purchaser with the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the job site and before start-up. (Add.)

8.3 The equipment shall be prepared for shipment after all testing and inspection have been completed and the equipment has been approved by the purchaser. The preparation shall include that specified in 8.3.1 through 8.3.8. (Add.)

8.3.1 Packing used in tests shall be removed from the stuffing boxes. (Add.)

8.3.2 Exterior surfaces, except for machined surfaces, shall be given at least one coat of the manufacturer's standard paint. Stainless steel parts need not be painted. (Add.)

8.3.3 Exterior machined surfaces shall be coated with a suitable rust preventive. (Add.)

8.3.4 Internal areas of cast iron and carbon steel bearing housings and oil systems' components shall be coated with a suitable oil-soluble rust preventive. (Add.)

8.3.5 Flanged openings shall be provided with metal closures at least 5 millimeters thick, with rubber gaskets and at least four full-diameter bolts. For studded openings, all nuts needed for the intended service shall be used to secure closures. (Add.)

8.3.6 Threaded openings shall be provided with steel caps or round-head steel plugs in accordance with ANSI B 16.11. The caps or plugs shall be of material equal to or better than that of the pressure casing. In no case shall nonmetallic (such as plastic) caps or plugs be used. (Add.)

8.3.7 The equipment shall be identified with item and serial numbers. Material packed separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. No material shall be shipped separately. (Add.)

8.3.8 Exposed shaft couplings shall be wrapped with waterproof, moldable waxed cloth or vapor-phase-inhibitor paper. The seams shall be sealed with oilproof adhesive tape. (Add.)

8.4 Bearing assemblies shall be fully protected from the entry of moisture and dirt. If vapor-phase-inhibitor crystals in bags are installed in large cavities to absorb moisture, the bags must be attached in an accessible area for ease of removal. Where applicable, bags shall be installed in wire cages attached to flanged covers, and bag locations shall be indicated by corrosion-resistant tags attached with stainless steel wire. (Add.)

8.5 One copy of the manufacturer's standard installation instructions shall be packed and shipped with the equipment. (Add.)

9. GUARANTEE AND WARRANTY (Add.)

9.1 Mechanical

Unless exception is recorded by the vendor in his proposal, it shall be understood that the vendor agrees to the following guarantees and warranties:

During a period of 12 months after the date of commissioning, the Vendor shall, with all possible speed and without cost to the purchaser, replace or repair the goods or any part thereof found to be defective due to faulty material, workmanship or to any act or omission of the Vendor. In particular the Vendor shall reimburse any transportation and other charges incurred by the purchaser in effecting such replacement or repair at the point of use. (Add.)

9.2 Performance

The pump shall be guaranteed for satisfactory performance at all operating conditions specified on the data sheet. Performance tolerance should be:

Rated differential head	-2 to +5 (Percent)
Rated power (Add.)	-0 to +4 (Percent)

APPENDICES**APPENDIX A
DOCUMENTATION**

This Appendix shall be considered as an integral part of this Standard, and all requirements, shall be met by the Vendor.
(Mod.)

APPENDIX B

PIPE COMPONENTS NOMINAL SIZE (Add.)

The purpose of this Appendix is to establish an equivalent identity for the piping components nominal sizes in Imperial System and SI Unit System.

TABLE B1

NOMINAL SIZE		NOMINAL SIZE		NOMINAL SIZE		NOMINAL SIZE	
DN (1)	NPS (2)	DN	NPS	DN	NPS	DN	NPS
15	½	100	4	500	20	1000	40
20	¾	125	5	600	24	1050	42
25	1	150	6	650	26	1100	44
32	1¼	200	8	700	28	1150	46
40	1½	250	10	750	30	1200	48
50	2	300	12	800	32	1300	52
65	2½	350	14	850	34	1400	56
80	3	400	16	900	36	1500	60
90	3½	450	18	950	38	1800	72

1) Diameter nominal, mm.

2) Nominal pipe size, inch.

APPENDIX C
PIPE FLANGES PRESSURE TEMPERATURE RATING

The purpose of this Appendix is to establish an equivalent identity for the pipe flange nominal pressure temperature ratings in Imperial System and SI Unit System.

TABLE C1

PN (1)	ANSI RATING CLASS
20	150
50	300
68	400
100	600
250	1500
420	2500

1) Pressure Nominal, bar.