

MATERIAL AND EQUIPMENT STANDARD

FOR

AXIAL FLOW CENTRIFUGAL COMPRESSORS

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0. INTRODUCTION

This specification gives the amendment and supplement to API Standard 617 fifth edition, April 1988, "Centrifugal Compressors for Refinery Services".

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

For ease of reference, the clause or section numbering of API Std. 617 has been used throughout of this specification.

Clauses in API Std. 617 not mentioned remain unaltered.

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

Sub. (Substitution) : The API Std. clause is deleted and replaced by the new clause.

Del. (Deletion) : The API Std. clause is deleted with no replacement.

Add. (Addition) : A new clause with a new number is added.

Mod. (Modification) : Part of the API Std. clause is modified, and/or a new statement is added to that clause.

1. GENERAL

1.1 Scope

This specification, contains the minimum requirements for axial flow compressors in process air or gas services, and their driver for use in refinery services, chemical plants, gas plants, petrochemical plants and where applicable in exploration, production and new ventures.

Compliance with the provisions of this standard specification does not relieve the vendor of the responsibility of furnishing compressors of proper design, mechanically suited to meet operating guarantees at the specified service conditions.

No deviations or exceptions from this standard shall be permitted, without explicit approval of the Company.

Intended deviations shall be separately listed by the vendor, supported by reasons thereof and submitted for Company's consideration. (Mod.)

1.2 Alternative Design

Equivalent SI unit systems, dimensions and ratings shall be used, unless otherwise specified. (Mod.)

1.3 Conflicting Requirements

In case of conflict between documents relating to the inquiry or purchase order the following priority of documents (whichever more stringent realized by company) shall apply:

- First priority : Purchase order (including attachments) and variations thereon.
- Second priority : Data-requisition sheets and drawings.
- Third priority : This specification.

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

1.5 Referenced Publication

1.5.1 The following standards and specifications shall, to the extent specified herein, form a part of this standard:

IPS (IRANIAN PETROLEUM STANDARD)

M-PM-240	"General Purpose Steam Turbines"
M-PM-250	"Special Purpose Steam Turbines"
M-PM-260	"Industrial Combustion Gas Turbine for Process Services"
M-PM-300	"Special Purpose Gear Units for Process Services"
M-PM-320	"Lubrication, Shaft Sealing, and Control Oil Systems for Special Purpose Applications"
M-PM-310	"Special Purpose Couplings"
M-ME-220	"Shell and Tube Heat Exchangers"

M-ME-245	"Air Cooled Heat Exchangers"
M-EL-132	"Induction Motors"
E-EL-110	"Electrical Area Classification & Extent"
E-SF-900	"Noise and Vibration Control"
M-PM-115	"Centrifugal Pumps for General Services"
M-PM-280	"Internal Combustion Diesel Engines"

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIAL)

A105	"Forgings, Carbon Steel, for Piping Components"
A285	"pressure Vessel Plates, Carbon Steel Low and Intermediate-Tensile Strength"
B 111	"Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock"
E 94	"Radiographic Testing"
E 165	"Liquid Penetrant Inspection" (Mod.)

API (AMERICAN PETROLEUM INSTITUTE)

API 616	"Type H Industrial Combustion Gas Turbines for General Refinery Services" (Mod.)
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2. BASIC DESIGN

2.1 General

2.1.1 Compressors ratings shall not exceed the limits of the vendor’s design, but shall be well within the range of the manufacturer’s actual experience. Only equipment which has proven its reliability in service is acceptable.

Manufacturer shall prepare and submit with his proposal the lists showing compressors of the same size or model previously manufactured and operating under similar conditions of service, speed and power, and location of such installation. (Mod.)

2.1.8 Unless otherwise specified, compressors and auxiliaries shall be suitable for outdoor installation in the climatic zone specified. (Mod.)

2.1.9 Compressors shall be designed to minimize the generation of noise conforming to the requirements of IPS Std. E-SF-900.

Unless otherwise specified the following limits shall be met at any measuring location 1 m from the equipment surface:

$$\text{Compressor} = 87 \text{ dB and compressor} + \text{Driver} = 90 \text{ dB.}$$

Where acoustic insulation and/or noise hoods are proposed, prior approval of the purchaser shall be obtained. Noise control measures shall cause no hindrance to operations nor any obstruction to routine maintenance activities. (Sub.)

2.1.12 The combined performance of the compressor and its driver under all operating conditions, including starting and reacceleration, shall be the vendor’s responsibility.

It shall be noted that reacceleration of an electric-motor-driven unit may be required when the motor is in full phase opposition, resulting in high torques.

The combined unit shall perform substantially as well on its permanent foundation as it did on the manufacturer's test stand. (Sub.)

2.1.14 All electrical components and installations shall meet also the requirements of IPS-E-EL-110. (Mod.)

2.1.16 Compressors shall be "run in" on air. Vendor shall provide air performance curves, operating guidelines, and any additional features required for this "run in". (Mod.)

2.2 Casings

2.2.7 Ductile (nodular) iron casings are not acceptable. (Mod.)

2.3 Interstage Diaphragms and Inlet Guide Vanes

2.3.7 An antisurge device shall be utilized if system requirements indicate that the compressor may operate in surge for extended periods. (Add.)

2.4 Casing Connections

2.4.1 General

2.4.1.3 All casing openings shall be not less than DN 20 ($\frac{3}{4}$ in NPS) and shall be flanged or machined and studded. (Mod.)

2.4.2 Main process connections

2.4.2.3 For nozzle connections over DN 600 (24" NPS), Vendor shall furnish mating pipe flanges.

Flanges shall be welding neck type with bolt hole spacing and bolt circle diameter exactly matching the machine flanges. (Mod.)

2.4.3 Auxiliary connections

2.4.3.1 The list of casing connections is modified as follows:

- a) vent, connections are not required.
- b) pressure and temperature gage connections are not required.
- c) Flanged casing drain connections are required.(Mod).

2.6 Rotating Elements

2.6.2 Shaft ends for coupling fits shall conform to API Std. 671 as amended/supplemented by IPS-M-PM-310. (Sub.)

2.6.7 Rivetted type impeller vanes are not acceptable. (Mod.)

2.7 Bearings and Bearing Housings

2.7.1.2 Unless otherwise specified, bearings shall be equipped with thermocouples.

Thermocouples shall be placed in 50% of the active thrust pads (alternate pads) in the area of maximum oil film temperature.

They shall be embedded in the steel backing at the babbitt interface. Inactive thrust bearings shall have at least two thermocouples diametrically opposed and located at the top and bottom pads. The thermocouples shall be type 316 stainless steel sheathed, mineral insulated and shall be provided with splice-free extension wires to a locally mounted junction box supplied by vendor. Thermocouple material shall be ironconstantan. (Sub.)

2.8 Shaft Seals

2.8.2 Delete "when specified" from this clause. (Mod.)

2.8.3 Shaft seals in inert gas service shall be of the labyrinth type. Shaft seals in toxic gas services shall be of the liquid-film type, unless otherwise specified. (Mod.)

2.8.4 The guaranteed figure for total waste seal oil leakage per case shall not exceed 50 lit/day.

No waste oil shall be returned to the oil system, unless all contaminating components are removed. (Mod.)

2.8.7 Piping for continuous buffer gas injection shall include a 100 mesh (150 μ m) strainer, automatic differential pressure controller and low pressure alarm and buffer gas pressure gage. If buffer gas is used for "run-in" only, a hand control valve without pressure alarm is acceptable. Piping downstream of strainer shall be stainless steel. (Mod.)

2.9 Dynamics

2.9.1 Critical speeds

2.9.1.7 Unless otherwise specified, the compressor vendor shall be unit responsible for train critical speed calculations, and shall furnish satisfactory verification of critical speed calculations, including all driver train components prior to submittal of certified composited outline drawings.

Both torsional and lateral vibration analysis are the complete responsibility of the compressor vendor. The vendor shall furnish a copy of this analysis and related data for Company's review. (Mod.)

2.9.2 Lateral analysis

2.9.2.3 A train lateral analysis, considering the effect of other equipment in the train on the damped unbalance response analysis, shall be quoted as an option by the vendor who is assigned unit responsibility. (Mod.)

2.9.2.4.b Calculated unbalance response curves of shaft deflection against rotor speed at each bearing, at shaft mid span, and at shaft two ends shall be submitted to purchaser for review. (Mod.)

2.9.4 Torsional analysis

2.9.4.5 For compressors driven through a gear, both the gear and compressor vendors shall perform an independent torsional analysis on the complete train using basic equipment dimension and stiffness data. (Mod.)

2.9.5 Vibration and balancing

2.9.5.3 Vibration and shaft movement alarms and shut-down shall be utilized to avoid destructive failures. (Mod.)

2.9.5.5 For the assembled machine operating at maximum continuous speed or at any other specified speed within the operating range, the overall unfiltered peak-to-peak amplitude of vibration, including run-out, in any plane measured on the shaft adjacent and relative to each radial bearing shall not exceed the following values.

SPEED r/min	PERMISSIBLE SHAFT VIBRATION IN μm
BELOW 3000	50
3000-15000	$10 \frac{75000}{n}$
ABOVE 15000	$\frac{335000}{n}$

in which n = maximum continuous speed in revolutions per minute At the trip speed of the driver, the vibration shall not exceed the above values plus 25%. (Mod.)

2.10 Lube-oil and Seal-oil Systems

2.10.5 Lube and seal oil systems shall be as per IPS-M-PM-320. (Mod.)

2.11 Materials

2.11.1 General

2.11.1.2 When vendor’s quoted material specification is DIN, JIS or other foreign standard, the proposal shall include the nearest above named American Specification equivalent along with exact and specific deviations, (chemical properties, physical properties, tests, type of heat treatment, etc.) if such exist, for purchaser’s evaluation of equivalence for service intended. (Mod.)

2.11.2 Pressure - containing parts

2.11.2.6.1 Steel casting repair shall comply with ASTM A 488/A 488M.

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

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

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.

Details of all major weld repairs, and of the heat treatment where applicable, shall be recorded and reported to the purchaser. (Sub.)

2.11.4 Material inspection of pressure containing parts

2.11.4.1.3 Support leg attachment welds, and welds in end covers of vertically split casings shall be examined by the magnetic particle method; or if of non-magnetic materials, examination shall be by the dye penetrant method. (Mod.)

2.11.5 Impellers

2.11.5.3 After examination, each impeller shall be balanced dynamically. (Mod.)

2.12 Nameplates and Rotation Arrows

2.12.3 The text on nameplates shall be in English language and unless otherwise specified the data shall be in SI Units. The information on nameplates shall include the year of manufacture. (Mod.)

3. ACCESSORIES

3.1 Drivers

3.1.4 Steam turbine drivers shall comply with IPS-M-PM-240 or IPS-M-PM-250 whichever is applicable. (Mod.)

3.1.5 Motor driven units shall comply with IPS-M-EL-132. (Mod.)

3.1.6 Gas turbine drivers shall conform to IPS-M-PM-260. (Sub.)

3.1.7 Speed increasers and reducers shall be in accordance with IPS-M-PM-300 whenever applicable. (Mod.)

3.3 Mounting Plates

3.3.2 Baseplate

3.3.2.2 Delete, "when specified" from this clause. (Mod.)

3.3.2.8 a) Turbine and motor driven compressors shall be mounted on common baseplates, unless otherwise specified.

b) The baseplate beneath gears shall have all structural members extended to the bottom of the main compressor baseplate members. (Mod.)

3.4 Controls and Instrumentation

3.4.1 General

3.4.1.4 All controls, instrumentation, and enclosures shall be suitable for the specified area classification and environmental exposure. (Sub.)

3.4.2 Control systems

3.4.2.3 Motor driven compressor shall be controlled by varying stator blade angles. (Mod.)

3.4.2.4 The vendor shall consider combinations of variable speed and adjustable stator blades to meet all specified operating conditions including, start up, shutdown, and surge protection of the compressor. (Mod.)

3.4.2.6 A check valve shall be installed in each compressor discharge system where there is the possibility of reverse rotation resulting from back flow of gases through the compressor. (Add.)

3.4.2.7 A high discharge temperature alarm set above the specified operating temperature, but at least 25°F below the maximum allowable temperature of the compressor, and a shutdown device set to stop the temperature may be installed at the compressor discharge from each stage of compression. (Add.)

3.4.3 Instrument and control panels

3.4.3.1 Delete "when specified" from this clause. (Mod.)

3.4.5 Alarm and shutdowns**3.4.5.2 Alarm and trip switches**

3.4.5.2.3 As a minimum alarm and trip shall be as per following table: (Add.)

SERVICE	ALARM LIGHTS	ALARM SWITCHES	SHUT DOWN DEVICE
LOW LUBE OIL PRESSURE	LP - (F) MB - (C)	LM - [F]	(F)
LOW DIFFERENTIAL PRESSURE OF SEAL OIL (LOW LEVEL IN OVERHEAD TANK)	LP - (F)	LM (F)	NONE
HIGH DIFFERENTIAL PRESSURE OF SEAL OIL (HIGH LEVEL IN OVERHEAD TANK)	LP (F)	LM (F)	NONE
HIGH LUBE OIL TEMP. OF OIL COOLER	LP (F)	LM (F)	NONE
HIGH COMPRESSOR DISCHARGE TEMPERATURE	MB - (C) LP - (F)	LM (F)	(F)
LOW LEVEL IN LUBE OIL RESERVOIR	LP - (F)	LM (F)	NONE
LOW LEVEL IN SEAL OIL RESERVOIR	LP - (F)	LM (F)	NONE
AXIAL MOVEMENT OF COMPRESSOR SHAFT HIGH VIBRATION OF COMPRESSOR	LP - (F)	LM (F)	(F)
MAIN SEAL OIL PUMP FAILURE	LP - (F)	LM - (F)	(F)
MAIN LUBE OIL PUMP FAILURE	LP - (F) MB - (C)	LM - (F)	NONE
START STANDBY LUBE OIL PUMP	LP - (F) MB - (C)	LM (F)	NONE
START STANDBY SEAL OIL PUMP	LP - (F) MB - (C)	LM - (F)	NONE
HIGH TEMPERATURE IN LUBE OIL RESERVOIR (IF HEATING COIL FITTED)	LP - (F)	LM - (F)	NONE
	LP - (F)	LM (F)	NONE

The nominal supplies and location of each instrument written in the table shall be indicated by the following coded notes.

- (F) Furnished by compressor manufacturer
- (C) Furnished by others
- (LM) Locally mounted
- (LP) Local panel mounted
- (MB) Main control board mounted

3.5 Piping and Appurtenances

3.5.3 Process piping

3.5.3.3 If specified, the vendor shall supply the inlet system for process air compressors per the applicable portions of API 616. In addition the following requirements apply:

- a) The free area of the inlet screen shall be at least 2½ times the cross-sectional area of the air compressor inlet flange. Inlet screen shall be 5 × 5 mesh, 3.5 mm. avg. opening, 1.6 mm wire type 304 stainless steel. The free

area of this screen arrangement is 47% of total actual area; therefore, the actual area of inlet screen shall be at least 2.5/0.47 or 5.3 times the compressor inlet area.

- b) Louvers, if used, shall have a free area at least equal to the free area of the screen.
- c) Provide a flanged opening DN 150 (6 in. NPS) minimum diameter on the inlet ducting to permit future on-stream cleaning of compressor blading. (Add.)

3.5.3.4 The vendor furnishing the discharge blowoff silencers for air compressors (Downstream side of blowoff valves) shall submit cross-sectional drawings and at least one example of prior satisfactory experience to purchaser for approval. The experience case(s) submitted shall be for the same diameter and flow rate range as the proposed silencer. (Add.)

4. INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT

4.1 General

4.1.2 Auxiliary equipments such as drivers, gears, and oil systems shall be inspected, and tested in accordance with the specified IPS and/or API standards for the equipment as well as the requirements (including specified optional test) of this standard. (Sub.)

4.1.3 The vendor shall notify the purchaser not less than 15 days before the date that equipment will be ready for test. (Mod.)

4.1.5 The purchaser's representative shall have the right to reject equipment or any parts of the equipment which do not conform to purchase order. (Mod.)

4.2 Inspection

4.2.1 The following additional data shall be given to the inspector if inspection is specified, or sent to the purchaser if equipment is not inspected:

- h) Physical and chemical data for all pressure containing parts (preferably actual test data taken from the melt or heat from which the part is made).
- i) Evidence, such as purchase specifications or bills of material, to establish that other major parts are specified materials.
- j) Measured critical speed and shaft vibration at point of measurement.
- k) 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 charge number, batch number or heat-lot number.
 - 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.

- 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. (Mod.)

4.3 Testing

4.3.1 General

Acceptance of shop test does not constitute a waiver of equipment to field performance under specified operating conditions nor does inspection relieve the vendor of his responsibilities. (Mod.)

4.3.3 Impeller overspeed test

Each impeller shall be subjected to an overspeed test for a minimum duration of 3 minutes, at not less than 115 percent of maximum continuous speed. (Mod.)

4.3.4 Mechanical running test

4.3.4.1.3 Delete "API Standard 614" and substitute IPS Standard M-PM-320. (Mod.)

4.3.4.2.4 The amount of inward oil leakage (contaminated oil) from each seal with approximate design differential pressure established, shall be measured during the four hours test. Seal leakage rates, per seal shall not exceed the guaranteed maximum rates stated in vendor's proposal. (Mod.)

4.3.4.3.6 Delete "when specified" and add:

Vendor shall make tapes starting with initial shop run, even if not witnessed or observed. (Mod.)

4.3.4.3.7 Delete "when specified" from this clause. (Mod.)

4.3.4.4.5 If the compressor is designed with variable stator geometry, the linkage, servo-motor and stator blade seal shall be checked during mechanical test. (Add.)

4.3.6 Optional test

4.3.6.1 Performance test

4.3.6.1.1 If specified, closed loop performance tests shall be conducted for gas compressors in accordance with ASME power test code 10 with pressure levels, gas molecular weight, and other operating conditions simulating compressor actual internal flow conditions as nearly as practical.

Air shall not be used for closed loop testing. Reynolds number correction shall not be applied to performance test data as allowed by ASME power test code 10. (Mod.)

4.3.6.8 Following the mechanical run test, the compressor shall be opened for internal inspection.

For gas compressors, a leak test per par. 4.3.5 shall be conducted after reassembly. (Mod.)

4.4 Preparation for Shipment

4.4.1 The preparation shall make the equipment suitable for 12 months of outdoor storage from the time of shipment. (Mod.)

4.4.3.1 Coating of unmachined exterior surfaces for corrosive or marine atmospheres will be specified. (Mod.)

4.4.3.2 Unless otherwise specified, the rust preventive applied to unpainted exterior machined surfaces shall be of a type: (1) to provide protection during outdoor storage for a period of twelve months exposed to a normal industrial environment, and (2) to be removable with mineral spirits or any stoddard solvent. (Sub.)

4.4.3.6 The height of shanks shall be at least 35 mm. (Mod.)

4.4.3.9 Separate shipment of the material is not permitted unless approved otherwise by Company. (Mod.)

5. VENDOR'S DATA

5.1 Proposals

h) A list of spare parts for two years of continuous operation, including price list shall be submitted.

Vendor's proposal for spare parts (other than spare rotor) shall include proposed method of protection from corrosion during shipment and subsequent storage. (Mod.)

y) The vendor shall list the types of standard bearings which can be used interchangeably with the machine proposed. (Add.)

z) Type of rust preventive to be applied to the compressor interior and bearing surfaces. (Add.)

5.2 Contract Data

5.2.3 Drawings

5.2.3.5 g) The coupling drawings shall give all dimensions necessary for the detailed design on the connections between shafts including space requirements for assembly and dismantling. (Mod.)

o) The thrust bearing, journal bearing, seal, and coupling assembly drawings (Appendix C, items 4,5,6,7) shall be dimensioned. (Add.)

5.2.3.9 The cross-sectional drawing (Appendix C, item 2) shall be dimensioned to show all radial and axial clearance. (Mod.)

5.2.5 Data

5.2.5.2 Item C

6) Expected variation in bearing clearances and oil viscosity. (Add.)

5.2.5.8 Input data required for an axial compressor performance check:

1) Number of stages.

2) Presence of inlet guide vanes (IGV) and exite guide vanes (EGV).

3) Number of blades in each blade row (rotor, stator, IGV, EGV).

- 4) Inlet and outlet blade angles as a function of blade height for rotor, stator, IGV, EGV.
- 5) Stator blade angles for alternate operating setting if machine has variable stator geometry.
- 6) Design incidence angle and loss coefficients at mean radius for each rotor and stator blade row.
- 7) Rotor blade area ratio (tip profile area/base profile area).
- 8) Hub and tip radii for inlet and exit to each blade row (rotor, stator, IGV, EGV).
- 9) For each rotor and stator blade row the chord length as a function of blade height and the solidity (chord/pitch ratio) at the mean radius.
- 10) Type of airfoil (subsonic or transonic).
- 11) Statement if free-vortex flow is assumed.
- 12) Tangential velocity of gas at rotor blade tip.
- 13) Rotor and stator blade thickness as a function of chord length.
- 14) Young's modulus, density and material for rotor blades.
- 15) Any additional mass (i.e. shrouds, lacing, wire, etc.) and radius of application.
- 16) Total temperature rise per stage.
- 17) Polytropic efficiency for each stage (rotor & stator, IGV + rotor + stator and rotor + stator + EGV).
- 18) Minimum flow at design speed and alternate speed conditions. (Add.)

6. GUARANTEE AND WARRANTY (Add.)

6.1 Mechanical

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

- 1) All equipment and component parts shall be warranted by the vendor against defective materials, design, and workmanship for 1 year after being placed in service (but not exceeding 18 months after date of shipment).
- 2) If any malfunction or defects occur during the guarantee and warranty period, the vendor shall make all necessary alterations, repairs, and replacements free of charge, free on board (f.o.b.) factory. Field labor charges, if any, shall be subject to negotiation between vendor and purchaser.

6.2 Performance

The compressor shall be guaranteed for head, capacity, and satisfactory performance at all specified operating points and further shall be guaranteed for horsepower at the normal operating point (see Fig. 1 in Standard 617).

For variable-speed compressors, the head and capacity shall be guaranteed with the understanding that the horsepower may vary +4 percent. The operating speeds specified in the proposal are not guaranteed, but where changes in specified speeds are needed to meet head requirements, the vendor shall adjust operating range and guarantee to be no closer to a critical or to a trip speed than the percentages in 1.4 and 2.8.1 of Standard 617.

For constant-speed compressors, the specified capacity shall be guaranteed with the understanding that the head shall be within +5 percent and -0 percent of that specified; the horsepower shall not exceed stated horsepower by more than 4 percent.

For compressors handling side loads or for two or more compressors driven by a single driver, the required performance guarantee for each compressor "section" shall be agreed upon by the purchaser and the vendor.

APPENDICES**APPENDIX A
TYPICAL DATA SHEETS**

Unless other wise specified SI unit data sheets shall be used. (Mod.)

**APPENDIX G (Add.)
PIPE COMPONENTS NOMINAL SIZE**

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

TABLE G . 1

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	40
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 H (Add.)
PIPE FLANGE PRESSURE TEMPERATURE RATINGS**

The purpose of this Appendix is to present the equivalent identities for the pipe flange nominal pressure temperature ratings in SI and Imperial Systems.

TABLE H . 1

PN RATING - * BAR	ANSI RATING CLASS
20	150
50	300
65	400
100	600
150	900
250	1500
420	2500

* The indicated PN ratings are introduced by ISO Standard No. 7268.