

MATERIAL AND EQUIPMENT STANDARD
FOR
GENERAL PURPOSE CENTRIFUGAL FANS

CONTENTS :	PAGE No.
0. INTRODUCTION	3
1. GENERAL	4
1.1 Scope	4
1.2 References	5
1.3 Conflicting Requirements	5
1.4 Definition and Terminology.....	5
1.5 Units	4
2. DESIGN	5
2.1 General.....	5
2.2 Fan Housing	6
2.3 Fan Housing Connections.....	6
2.5 Rotating Element.....	6
2.6 Shaft Sealing of Fans.....	6
2.7 Critical Speed and Balance.....	6
2.8 Bearing and Bearing Housing.....	6
2.9 Lubrication.....	7
2.10 Materials	7
2.11 Nameplates	7
3. ACCESSORIES.....	8
3.1 Drivers.....	8
3.2 Couplings and Guards.....	8
3.3 Mounting Plates	8
3.4 Controls and Instrumentation.....	9
3.5 Piping and Appurtenances.....	10
3.6 Coatings Insulation, and Jacketing.....	10
4. INSPECTION AND TESTING.....	10
4.1 General.....	10
4.4 Testing	10
4.5 Preparation for Shipment.....	11
5. GUARANTEE AND WARRANTY	11
5.1 Mechanical.....	11
5.2 Performance	11

6. VENDOR'S DATA 12

 6.1 Proposal..... 12

 6.2 Contract Data 12

APPENDICES:

APPENDIX A TYPICAL DATA SHEETS 13

APPENDIX E PIPE COMPONENTS-NOMINAL SIZE 14

APPENDIX F PIPE FLANGES PRESSURE TEMPERATURE RATING 15

0. INTRODUCTION

This Specification gives the amendment and supplement to API Standard 673, first edition, January 1982:

"Special-Purpose Centrifugal Fans for General Refinery Services".

It shall be used in conjunction with data/requisition sheets for centrifugal fans.

For ease of reference, the clause or section numbering of API Std. 673 has been used throughout of this specification.

Clauses in API Std. 673 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 without any replacement.

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

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

1. GENERAL

1.1 Scope

This Specification, contains the minimum requirements for general purpose fans including their associated driver, power transmission and auxiliaries for use in refinery services, chemical plants, gas plants, petrochemical plants and where applicable, in exploration, production and new ventures. It is intended for fans that are in intermittent duty, non-process services and which are generally spared.

Compliance by the fan vendor with this Standard specification does not relieve him of the responsibility of furnishing fans and accessories 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 written approval of the Company. Intended deviations shall be separately listed by the Vendor and supported by reasons thereof for purchaser's consideration. (Mod).

1.2 References

The latest edition of the following standards, codes, or specifications shall, to the extent specified herein, form a part of this Standard.

AGMA (AMERICAN GEARS MANUFACTURERS ASSOCIATION)

218 "Rating the Pitting Resistance and Bending Strength of Spur and Helical Involute Gear Teeth"

API (AMERICAN PETROLEUM INSTITUTE)

673 "Special Purpose Centrifugal Fans for General Refinery Services"

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIAL)

A 193 "Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service"

A 194 "Carbon and Alloy Steel Nuts and Bolts for High Pressure and High-Temperature Service"

IPS (IRANIAN PETROLEUM STANDARD)

E-SF-900 "Noise and Vibration Control"

M-EL-132 "Induction Motors"

M-IN-280 "Miscellaneous Instrumentation"

M-PM-240 "General Purpose Steam Turbines"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

6708 "Pipe Components Definition of Nominal Size"

7268 "Pipe Components Definition of Nominal Pressure"

1.3 Conflicting Requirements

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

- **First priority :** Purchase order and variation thereto
- **Second priority:** Data sheets and drawings
- **Third priority :** This Standard Specification (Sub.)

1.4 Definition and Terminology

Diameter Nominal (DN) is the international nomenclature for pipe size in accordance with ISO 6708-1980 Edition, and Appendix "E" of this Standard.

Pressure Nominal (PN) is the international nomenclature for flange rating in accordance with ISO 7268, 1983 Edition, and Appendix "F" of this Standard. (Mod.)

1.5 Units

Unless otherwise specified, equivalent System International (SI) units, dimensions, and ratings shall be used. (Mod.)

2. DESIGN

2.1 General

2.1.1 Fans, drivers, and auxiliaries shall be designed for at least 12000 hours of continuous service, unless otherwise specified. (Mod.)

2.1.2 Fans shall not exceed the limits of the ratings of the vendor's design, but shall be well within the range of manufacturer's actual experience. Only equipment which has proven its reliability is acceptable. (Mod.)

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

2.1.4 Bearing arrangements No. 1, impeller overhung designs are acceptable. (Mod.)

2.1.8 Remove 1200 and substitute 1450 in this Clause. (Mod.)

2.1.15 Fan Vendor shall submit noise emission data for the quoted machine as per IPS-E-SF-900. (Mod.)

2.1.21 Fan vendor shall assume unit responsibility for the entire machinery system consisting of fan, driver, power transmission and associated auxiliary equipment. This includes but not limited to engineering responsibility for:

- a) Torsional analysis
- b) Selection and rating of power transmission components
- c) Lube Oil system design
- d) Equipment layout

Fan vendor shall resolve all engineering questions relating to the equipment design. (Add.)

2.2 Fan Housing

2.2.1 Fan housing shall be designed and constructed to withstand the erosive and corrosive affects of the product handled. (Mod.)

2.2.2 Access doors shall be provided in the following locations:

- a) In the fan housing permitting access to the impeller.
- b) Adjacent to the inlet guide vanes. (Mod.)

2.2.4 Internal bolting, if used within the fan housing, shall be self-locking. (Add.)

2.3 Fan Housing Connections

2.3.2 Unless otherwise specified, drain connections shall be valved. (Mod.)

2.5 Rotating Element

2.5.2 Blade design shall be manufacturer's standard. (Mod.)

2.5.8 Impeller overhung designs shall have provisions for supporting the rotor during bearing maintenance. (Add.)

2.6 Shaft Sealing of Fans

2.6.4 Seals shall be accessible without dismantling duct work of fan housing. (Mod.)

2.6.6 Induced draft fans operating in hot gas service shall be provided with a deflector plate between the shaft seal and bearing housing to deflect hot gas leakage away from the bearing housing. (Add.)

2.7 Critical Speed and Balance

2.7.2 For variable speed fan units which include a gear unit, a complete system torsional vibration analysis is required.

Results of the study shall be furnished to the purchaser for approval by the Company's Engineer. (Mod.)

2.7.8 No torsional modes shall be closer than 5% to twice any shaft operating speed. (Mod.)

2.7.10 The rotating elements shall be dynamically balanced. (Mod.)

2.7.12 All fans shall be tested. The peak-to-peak amplitude of vibration (including run-out) in any plane measured on the shaft adjacent to the bearing housing shall not exceed 50 m throughout the specified speed range. (Mod.)

2.8 Bearing and Bearing Housing

2.8.1 Radial bearings shall be of the vendor's standard. (Mod.)

2.8.2 Thrust bearings shall be of the vendor's standard. (Mod.)

2.8.3 Selection of antifriction bearings shall be based on following ratings:

- a) DN factor less than 300,000.

- b) Minimum L-10 life factor of 25,000 hours in continuous operation at rated fan conditions, but not less than 16,000 hours at maximum axial and radial loads and rated speed.
- c) Load factor less than 2,700,000. (Mod.)

2.8.15 Shaft bearings shall be accessible without dismantling duct work and where applicable fan housing. (Add.)

2.9 Lubrication

2.9.2 Unless specified otherwise, pressurized lubrication system shall not be used. Where a pressurized lubrication system is required for the fan, its driver, or gear unit, the lube oil system shall be mounted within the confines of the main unit base area unless mounting on a console assembly base is specified. (Mod.)

2.9.3 As a minimum, instrumentation to be furnished for a fan or gear unit utilizing pressurized lubrication shall measure:

- a) Lube oil outlet temperature at each bearing.
- b) Lube oil header pressure.
- c) Lube oil filter pressure drop. (Mod.)

2.9.3.6 Lubricating oil pressure shall be higher than cooling water pressure at oil coolers, to prevent contamination of oil in case of cooler failure. (Mod.)

2.10 Materials

2.10.1 General

2.10.1.1 Fan housing and inlet box construction shall be of carbon steel unless otherwise specified. (Mod.)

2.10.1.8 a) Free machining steels are not permitted for construction of fan components exposed to H₂S. Free machine steels are those which contain any of the following elements in the quantities shown:

- 1) > 0.06% phosphorous
- 2) > 0.06% sulfur
- 3) Intentional lead additions in excess of 0.05%
- 4) Intentional selenium additions in excess of 0.05%

Note:

Type 416 nuts complying to ASTM A 194 Gr 6F with Selenium are acceptable for use with ASTM A 193 Gr B6 bolts.

- b) The H₂S limitation includes trace quantities for any operating condition including start-up and shutdown.
- c) Components include (but not limited to) impellers, shaft sleeves, impeller locking nuts, bolting and other fasteners. (Mod.)

2.11 Nameplates

2.11.2 The text on nameplates shall be in English language. (Mod.)

3. ACCESSORIES

3.1 Drivers

3.1.1 General

3.1.1.4 Belt drives are acceptable for driver power ratings above 110 KW. (Add.)

3.1.1.5 Chain drives are unacceptable. (Add.)

3.1.2 Motors

3.1.2.1 Motors for main drivers shall comply IPS-M-EL-132. (Mod.)

3.1.2.4 Motors for auxiliary drivers shall be per IPS-M-EL-132. (Mod.)

3.1.3 Turbines

3.1.3.1 If a steam turbine is specified for the main driver, it shall be per IPS-M-PM-240, except hydraulic speed governors shall be NEMA SM 23 Class C or better, for fan units to be operated in parallel. (Mod.)

3.1.4 Gears

3.1.4.1 Anti-friction type thrust and radial bearings shall be oil lubricated and acceptable for gear units less than 110 kW. (Mod.)

3.1.4.2 Gears shall be furnished per AGMA 420 or 421, as applicable. (Sub.)

3.1.4.3 Gears shall have at least 80% no-load tooth contact, a surface finish of 1.6 m rms, and shall be designed for "High Reliability" as defined by AGMA 218. (Sub.)

3.1.4.4 Proposals to use a gear unit integral with steam turbine driver shall be submitted to purchaser only as an alternative to a separate gear unit, for approval by company's Engineer. (Mod.)

3.2 Couplings and Guards

3.2.1 Couplings between the fan, driver, and gear unit shall be forged steel, non lubricated, flexible couplings. Removable-type coupling guards shall be furnished and mounted. (Sub.)

3.2.3 The total coupling end float shall be 6 mm maximum and the total motor end float shall exceed the coupling end float by 6 mm minimum. The motor running center shall not exceed 2 mm from the geometric center of the motor rotor float, and shall be assumed to be at the float center for layout and insulation purposes. (Mod.)

3.3 Mounting Plates

3.3.1 Soleplates shall be provided for each bearing pedestal. (Mod.)

3.3.2 Baseplates

- 3.3.3.1** a) Driver and gear combinations shall be mounted on a common baseplates.
- b) The baseplate beneath gear units shall have all structural members extended to the bottom of the main baseplate members. (Mod.)

3.4 Controls and Instrumentation

3.4.1 General

- 3.4.1.1** Instrumentation and installation, including any panels shall conform to IPS-M-IN-280. (Mod.)
- 3.4.1.2** All controls, instrumentation and enclosures shall be suitable for the specified area classification and environmental exposure. (Mod.)
- 3.4.1.5** The automatic starting controls for auxiliary lube oil pumps and all protective systems except overspeed trips shall be designed to permit testing during fan operation. (Add.)
- 3.4.1.6** Alarm circuits shall be "normally energized" and protective system circuits shall be "normally de-energized" when the fan is in operation. Contacts shall open to alarm. (Add.)

3.4.2 Control systems

- 3.4.2.4** The control signal range shall be 20 to 100 kPa for pneumatic instruments and 4 to 20 mA for electronic instruments. (Mod.)
- 3.4.2.8** Automatically controlled guide vanes shall incorporate the following features:
- a) The operator shall be either the pneumatic or hydraulic type.
- b) If a hydraulic type operator is used, and a pressurized lubrication system is provided, the source of oil for the hydraulic operator shall be the fan lube oil system. (Add.)

3.4.3 Dampers and inlet guide vanes

- 3.4.3.1** If a louvered damper is specified:
- a) Each damper leaf shall be supported by, and continuously welded to a shaft spindle.
- b) Spindles shall be supported externally at both ends by permanently lubricated type bearings.
- c) Manual operation of the damper from grade level is required. (Mod.)
- 3.4.3.3** a) Each variable guide vane operating lever shall be connected to the external control ring by means of adjustable ball-end links. The external control ring shall be retained by steel rollers running in non-ferrous metal bushings. The entire vane mechanism shall be located so that a direct drive operating mechanism can be attached to the lug on the control ring. The control rings mechanism shall be protected by a dust cover which shall allow full access to all parts for inspection.
- b) A central or peripheral gear operated inlet guide vane assembly is not acceptable. (Mod.)
- 3.4.3.5** Variable inlet guide vanes shall be furnished with permanently lubricated ball or spherical bearings at each spindle support. Vanes shall not have any undercut or fillets. (Mod.)

3.4.3.6 For a parallel fan operation each fan shall be provided with an outlet guillotine shutoff gate or louvered damper with a spectacle blind, as specified. (Add.)

3.5 Piping and Appurtenances

3.5.1 General

3.5.1.2 Vendor shall mount and pipe all instruments within the limits of the baseplate or any sub-assembly which is furnished. (Mod.)

3.5.4 Expansion joints

Vendor shall furnish expansion joints, when required. (Add.)

3.6 Coatings, Insulation, and Jacketing

3.6.1 Coatings

Painting of unmachined interior and exterior surfaces for corrosive and marine environments will be specified. (Mod.)

3.6.2 Insulation and jacketing

3.6.2.2 If insulation for personnel protection is specified, the insulation surface temperature shall be no greater than 65°C. (Mod.)

4. INSPECTION AND TESTING

4.1 General

4.1.1 All fans and gear units shall be inspected by the Company's representative. (Mod.)

4.1.3 All mechanical run tests, and performance tests when required shall be witnessed. (Mod.)

4.4 Testing

4.4.1 a) All fans shall have a shop mechanical run test using oil of equivalent viscosity grade as specified for use in the field.

b) Mechanical testing shall include:

1) Fan shall be operated from 0 to 110 percent of rated speed for turbine drives and at 100% of rated speed for motor drives, with an uninterrupted minimum period of 4 hours at these maximum speeds, to check bearing performance and vibration.

2) Operation and function of instrumentation and controls shall be demonstrated to the inspector, to the extent practical.

- 3) The vendor shall maintain a log of all final tests including vibration and bearing oil temperature data. Shaft vibration measurements shall be recorded throughout the specified speed range.
 - 4) Hydrodynamic type bearings shall be removed, inspected, and reassembled in the fan after completion of the mechanical running test. The test and subsequent inspection shall be repeated until a satisfactory test, and inspection results, are accepted by the inspector.
- c) Performance testing and test block conditions will be specified. (Sub.)

4.5 Preparation for Shipment

4.5.1 Unless otherwise specified, the rust preventive applied to unpainted 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 standard solvent. (Mod.)

4.5.2.8 Separate partial shipment of materials is not accepted. (Mod.)

5. GUARANTEE AND WARRANTY (Add.)

5.1 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 6 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.)

5.2 Performance

Fan performance shall be guaranteed to meet all operating conditions specified on the data sheet and shall be within the tolerances listed in Subpar. a or b. at the normal operating conditions.

a) For variable-speed fans, the static pressure and capacity shall be guaranteed with the understanding that the power shall not exceed +3%. The operating speeds specified in the proposal are not guaranteed, but where changes in speeds are needed to meet static pressure requirements, the vendor shall adjust operating range and guarantee to be no closer to the tip speed or to a critical speed than the percentages specified in Paragraphs 1.4 and 2.7.

b) For constant-speed fans the specified capacity shall be guaranteed with the understanding that the static pressure shall be within +5% and -0% of that specified; the power shall not exceed stated power by more than +3%. These tolerances shall not be additive. (Add.)

6. VENDOR'S DATA

6.1 Proposal

- 21.** Vendor's proposal for spare parts shall include an illustrated parts list and proposed method of protection from corrosion during shipment and subsequent storage.
- 22.** Detailed drawings of dampers and guide vane control systems and linkages. Torque requirements for these devices shall be included.
- 23.** Vendor's proposal shall specify the type of rust preventive to be applied to the bearing and unpainted machined surfaces. (Mod.)

6.2 Contract Data

6.2.3 Data

- 6.2.3.2 b.6.** Torsional analysis data as required by Paragraph 2.7.2 b. (Mod.)

APPENDICES**APPENDIX A
TYPICAL DATA SHEETS**

Unless otherwise specified, SI Unit data sheets shall be used. (Mod.)

**APPENDIX E
PIPE COMPONENTS-NOMINAL SIZE**

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

TABLE E-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	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.

(Add.)

**APPENDIX F
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 System.

TABLE F-1

PN (1)	ANSI RATING CLASS
20	150
50	300
68	400
100	600
150	900
250	1500
420	2500

1) Pressure Nominal, bar.

(Add.)