MATERAL AND EQUIPMENT STANDARD

FOR

SPECIAL PURPOSE CENTRIFUGAL FANS

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APPENDICES

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 a 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 Standard contains the minimum requirements for special purpose fans for special application for use in refinery services, chemical, petrochemical and gas plants and where applicable in production, exploration and new ventures.

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. Neither does it relieve him of the responsibility of furnishing equipment assembled and prepared for shipment in professional manner.

No deviation or exception from this Standard shall be permitted without written approval of the Company. The intended deviations shall be listed separately, supported by reasons thereof and submitted for purchaser's consideration. (Mod.)

1.2 Alternative Designs

Unless otherwise specified, equivalent SI unit system dimensions and ratings in accordance with IPS-E-GN-100 shall be used. (Mod.)

1.3 Conflicting Requirements

In the 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 and variation thereto
- second priority : data sheets and drawings
- third priority : this standard specification

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

1.4 Definition of Terms

"Hazardous service" for fans and auxiliaries is taken as a service for process streams containing:

- hydrogen sulfide above 600 mg/kg
- toxic or lethal products

"High temperature service" for fans and auxiliaries is defined as a service for air or other gases with a fan inlet temperature greater than 200 °C. Fans in this service will be indicated as 'High temperature fans'. (Mod.)

Diameter Nominal, the international nomenclature written as DN, 15, 25, etc. has been used for pipe sizes in accordance with ISO 6708 and Appendix E of this Standard.

Pressure Nominal, the international nomenclature written as PN, 20, 50, etc. has been used for flange ratings in accordance with ANSI-B16.5, ISO 7268 and Appendix F of this Standard.

1.5 Referenced Publications

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-M-PM-240	"Steam Turbines, General Purpose"
IPS-M-PM-250	"Steam Turbines, Special Purpose"
IPS-M-PM-300	"Special Purpose Gear Units"
IPS-M-PM-310	"Special Purpose Couplings"
IPS-M-PM-320	"Lubrication, Shaft Sealing, for Special Purpose Applications"
IPS-E -SF -900	"Noise and Vibration Control"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

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

NACE (NATIONAL ASSOCIATION OF CORROSION ENGINEERS)

MR 0175-88	"Sulfide Stress Cracking Resistant Metallic Material for Oil Field Equipment"

2. DESIGN

2.1 General

2.1.1 Fans shall not exceed the limits of the ratings of 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, the fan unit and its auxiliaries shall be suitable for outdoor operation without shelter. (Mod.)

2.1.10 Fans shall be mechanically designed for operation at least 50°C above maximum specified inlet gas temperature.(Mod.)

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

2.1.15 Fans shall comply with the requiements of IPS-E-SF-900. (Mod.)

2.1.21 For fan trains having other than gas turbine drivers, the fan vendor shall assume unit responsibility for the entire system consisting of fan, drivers, power transmissions and associated auxiliary equipment. This include, but is not limitted to, engineering responsibility for the following:

a) Torsional analysis

b) Lateral analysis

c) Selection and rating of power

d) Lube oil system design

e) Equipment layout

f) Obtain engineering data for train components and furnish to purchaser.(Add.)

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

For a two component train - fan + driver:

Sound Pressure Limit in dB re 20 μ pa	
Fan	**87 dB(A)**
Fan + driver	**90 dB(A)**

For a three component train - fan + gear + driver :

Per component	**85 dB(A)**
Complete train	**90 dB(A)**

If the above equipment produces impulsive and/or narrow band noise, the above limits shall be taken 5 dB(A) lower.

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

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

2.1.15.2 Noise control measures shall cause neither hindrance to operation nor any obstruction to routine maintenance activities.(Add.)

2.1.20 The combined performance of the fan and its driver under all operating conditions, including starting and reacceleration, shall be the vendor's responsibility. It should 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 substantial as well on its permanent foundation under all specified conditions, as it did on the manufacturer's test stand. (Mod.)

2.2 Fan Housing

2.2.1 Small fans with a casing mass of less than 150 kg shall have the casing connected to the bearing housing without additional supports.

Large fans with a casing mass over 150 kg and high-temperature fans shall have the casing center-line supported and guided in order to allow for thermal expansion without affecting the casing's centerline position. In this case due attention shall be paid to the connection of the casing to the seal housing to ensure that the seal housing will not be distorted due to forces by thermal expansion of the casing and/or by piping or ducting forces. A flexible connection between casing and seal housing and a rigid connection between seal housing and bearing bracket is required.

Casings of fans shall include in their design a proven heat barrier construction, between fan casing and bearing housing. (Mod.)

2.2.2 Access doors shall be provided as follows:

a) Hinged doors to allow insertion of a lance for steam or water washing of fan impeller during operation.

b) A minimum of one inspection door located in the lower side of the fan housing permitting access to the impeller.

c) An inspection door located for access to the inlet guide vanes. Internal bolting for fan housing, inlet box and access doors shall be self-locking. (Mod.)

2.3 Fan Housing Connections

2.3.1 The inlet and discharge connections shall be oriented as specified in the data sheet.

Flanges shall have a thickness of not less than three times the casing wall thickness. (Mod.)

2.3.2 Pipe sizes of DN 45, DN 65, DN 90, and DN 130 shall not be used (Mod.)

2.3.3 Drain connections shall be valved. (Add.)

2.3.4 Tapped holes for bolting in pressure part shall be kept to a minimum; studs are preferred to cap screws.

Clearance shall be provided at bolting locations to permit the use of socket or box wrenches. (Add.)

2.5 Rotating Elements

2.5.2 Blade design shall be manfacturer's proposal, however subject to the purchaser approval. (Mod.)

2.5.7 The shaft design of high-temperature fans shall be such, that heat transmission from the process side to the shaft sealing and bearings is minimized. For this reason the manufacturer may consider the application of cooling disks. Optimization of shaft design with respect to the above is required prior to the application of inert gas as a cooling and sealing medium.(Mod.)

2.6 Shaft Sealing of Fans

2.6.1 Shaft seals shall be one of the following types, as specified in the data sheet.

a) Labyrinth : This type may include-carbon ring packing in addition to the labyrinths, if approved by the purchaser. If required, connections for an inert gas sealing system shall be supplied. Provision shall be made for measurement of the differential pressure between seal gas and process gas. The vendor shall specify in his proposal the required seal gas flow and supply pressure.

b) Restrictive-ring : This type shall include rings(carbon or other suitable material) mounted in retainers or spacers. If required inert gas sealing shall be supplied as for (a) above.

c) Double mechanical (contact) : This type shall be provided with labyrinths and slingers to prevent oil leakage to the atmosphere or into the fan.

Oil or other suitable liquid supplied under pressure to the faces shall be provided from a seal liquid system.

Vendor shall specify and guarantee the maximum specified seal fluid leakage.

High-temperature fans shall not be equipped with mechanical contact type seals. (Sub.)

2.6.4 Seals shall be accessible without dismantling duct work or fan casing. (Mod.)

2.6.5 Shaft sleeves under seal rings shall be either hardened or hard-face overlayed, e.g. colmonoy-6. (Mod.)

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

2.7 Critical Speed and Balance

2.7.2 Results of the vibration analysis shall be furnished to the purchaser for approval.

the vendor shall submit the calculation procedure and summary of shaft stresses. (Mod.)

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

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

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

2.8 Bearing and Bearing Housing

2.8.6 Transparent oil containers shall be of the glass type. (Mod.)

2.8.8 Water cooled bearings shall be provided with drain or other suited means to prevent freezing of the coolant during shutdown conditions. (Mod.)

2.8.15 Shaft bearings shall be accessible without dismantling ductwork or fan casing. (Add.)

2.9 Lubrication

2.9.2 The lube oil system shall be in accordance with IPS-M-PM-320. (Mod.)

2.9.3.5 Pumps shall have steel cases.

Reservoir mounted pumps are not acceptable. (Sub.)

2.10 Materials

2.10.1 General

2.10.1.8 Materials for components in contact with gas containing hydrogen sulphide, including trace quantities, shall conform to the requirements of NACE standard MR-01-75, 1988 revision.

The H_2S limitation includes trace quantities for any operating condition including startup and shutdown.

Components include (but not limited to)impellers, shaft sleeves, impleller locking nuts, bolting and other fasteners. (Mod.)

2.10.2.2 Details of all repairs shall be recorded and reported to the purchaser before any repair is carried out. (Mod.)

2.11 Nameplates

2.11.2 The text on nameplates shall be in the 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

3.1.1 General

3.1.1.2 Drivers for high temperature fans shall be sized for operation of the unit on nitrogen or air at 0 °C at rated speed and rated operating point. (Mod.)

3.1.1.4 Belt or chain drives are unacceptable. (Add.)

3.1.2 Motors

3.1.2.4 Electric motor drivers and motors for auxilliaries shall comply with IPS-M-EL-132. (Mod.)

3.1.3 Turbines

3.1.3.1 Steam turbine drivers shall comply with IPS-M-PM-240 or M-PM-250 whichever is applicable.

Turbine drivers shall be capable of continuously developing 110% of the power required for each of the purchaser's specified operating conditions while operating at that corresponding speed under specified steam conditions. (Sub.)

3.1.3.2 Gas turbine shall comply with IPS-M-PM-260 and shall be sized by mutual agreement between the purchaser and the vendor. (Sub.)

3.1.4 Gears

3.1.4.2 If a gear is specified, it shall conform to IPS Std. M-PM-300. (Mod.)

3.2 Couplings and Guards

3.2.1 Couplings and guards shall conform to IPS-M-PM-310.(Mod.)

3.3 Mounting Plates

3.3.2.4 Unless otherwise specified anchore bolts shall be furnished by the vendor. (Mod.)

3.3.3.1 Where a baseplate is specified:

a) Driver and gear combinations shall be mounted on a common baseplate.

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

3.3.3.4 During lifting, the beam deflection of the baseplate shall be less than 1/1200 of the total length. (Mod.)

3.4 Controls and Instrumentation

3.4.1 General

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

3.4.1.5 The automatic starting controls for auxillary lube oil pumps and all protective system except overspeed trips shall be designed to permit testing during fan operation. (Add.)

3.4.1.6 Solenoid operated valves shall be used only in clean, dry instrument air service. If required for other services, the solenoid valve shall act as a pilot valve of pneumatic, hydraulic valves, etc. Solenoid valves shall not be used in continuous services affecting normal operation. They may be used only in intermittent services such as starting or emergency controls. (Add.)

3.4.1.8 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 system

3.4.2.5 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. (Mod.)

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 fully welded to, a shaft spindle.

b) Spindles shall be supported externally at both ends by permanently lubricated type bearings. (Mod.)

3.4.3.3 Manual operation of the damper from grade level is required.(Mod.)

3.4.3.4 Each variable guide vane operating-lever shall be connected to the external control ring by means of adjustable ball-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 peripheral ring mechanism shall be protected by a dust cover which shall allow full access to all parts for inspection.

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 of fillets to disturbe the air flow. (Mod.)

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

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 of any subassembly which it furnishes. (Mod.)

3.5.2 Inlet trash screen

All construction materials for inlet trash screens and rain hoods shall be stainless steel type 316. (Mod.)

3.6 Coatings, Insulation, and Jacketing

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

3.7 Turning Gear

3.7.2 For fans with pressurized lube system, The turning device shall be designed so that it can not be engaged unless lube oil pressure is established. (Mod.)

3.7.3 The turning gear shall be driven by an electric motor unless noted otherwise. (Mod.)

4. INSPECTION AND TESTING

4.1 General

4.1.1 All fans and gears shall be inspected by the purchaser's representative. (Mod.)

4.1.3 All mechanical run tests, and performance tests when required, will be withnessed. (Mod.)

4.2 Inspection

4.2.3 Buttwelded joints of pressure casings shall be 100% radiographed. (Mod.)

4.4 Testing

4.4.1 a) All fans shall have a shop mechanical run test using oil of equivalent viscosity grades 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 uninterupted 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.

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) Bearings shall be removed, inspected, and reassembled in the fan after completion of the mechanical running test. The test and subsequent inspecition shall be repeated until a satisfactory test, and inspection results, are accepted by the inspector.

5) For fans with turbine drives, the fan rotor shall be subjected to an overspeed test of at least 110% of maximum continuous speed during 3 minutes. After the overspeed test each impeller shall be checked for cracks (by means of the dye penetrant method), and for deformation or other defects. After this inspection fan rotors shall be rebalanced dynamically. (Mod.)

4.4.2 The purchaser shall receive a written notice at least 20 days before the date of the equipment being ready for inspection. (Mod.)

4.4.5 For high-temperature fans, if specified on the data sheet, a performance test at rated speed and flow, at actual operating temperatures shall be carried out. The duration of this test shall be at least 8 hours. (Add.)

5. GUARANTEE AND WARRANTY (Add.)

5.1 Mechanical

The fans and components parts shall be guaranteed by the vendor against defective materials, design, and/or workmanship as per purchaser contract conditions. (Add.)

5.2 Performance

5.2.1 Fan performance shall be guaranteed to meet all operating conditions specified on the data sheet. (Add.)

6. VENDOR'S DATA

6.1 Proposals

12. Vendor's proposal shall include recommended spare parts for two years of continuous operation and also, the proposed method of protection from corrosion during their shipment and subsequent storage.

Spare rotor prices for fan, gear, and steam turbine drivers, shall be included. (Mod.)

21. Detailed drawings of dampers and guide vane control systems and linkages. Torque requirement for these devices shall be included. (Add.)

22. Vendor's proposal shall specify the type of rust preventive to be applied to the bearing and unpainted machine surfaces. (Add.)

APPENDICES

APPENDIX A
TYPICAL DATA SHEETS

4.1 SI UNITS DATA SHEETS SHALL BE APPLIED, UNLESS OTHERWISE SPECIFIED.

APPENDIX D
MAXIMUM RESIDUAL SPECIFIC UNBALANCE

FIGURE D - 2, SHOWN IN SI UNITS SHALL COMPLY.

APPENDIX E
PIPE COMPONENTS - NOMINAL SIZE

The purspose of this appendix is to establish an equivalent identity for the piping componente-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 .

APPENDIX F
PIPE FLANGES PRESSURE TEMPERATURE RATINGS

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)	PSIG (2)
20	150
50	300
68	400
100	600
420	2500

1 Pressure neminal, bar

2 Pounds per square inch, gage