MATERAL AND EQUIPMENT STANDARD

FOR

CENTRIFUGAL FANS

FOR

PETROLEUM, CHEMICAL, AND GAS INDUSTRY SERVICES

ORIGINAL EDITION

NOV. 1993

This standard specification is reviewed and updated by the relevant technical committee on July 2002(1) and Aug. 2015(2). The approved modifications are included in the present issue of IPS.

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS

Throughout this Standard the following definitions shall apply.

COMPAN:

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER:

Means the “Company” where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract document.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR:

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR:

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

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0. INTRODUCTION

This specification gives the amendment and supplement to API Standard 673, Third Edition, December 2014:

"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. SCOPE

This Standard contains the minimum requirements for centrifugal fans 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.)**

Note 1:

This standard specification is reviewed and updated by the relevant technical committee on July 2002. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No 151 on July 2002. These modifications are included in the present issue of IPS.

Note 2:

This standard specification is reviewed and updated by the relevant technical committee on Aug. 2015. The approved modifications by T.C. were sent to IPS users as amendment No. 2 by circular No 458 on Aug. 2015. These modifications are included in the present issue of IPS.

5.3 Alternative Designs

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

5.4 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.)**

2. Normative References

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-G-SF-900	"Noise and Vibration Control"
IPS-M-EL-132	"Material and Equipment Standard for Medium and High Voltage Induction Motors"
IPS-M-IN-280	"Material Standard for Miscellaneous Instrumentation"
IPS-G-PM-260	"General Standard for Gas Turbines for Petroleum, Chemical and Gas Industry Services"

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"

6. DESIGN

6.1 General

6.1.34 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. **(Add.)**

6.1.17 Unless otherwise specified, the fan unit and its auxiliaries shall be suitable for outdoor operation without shelter. **(Mod.)**

6.1.3 The fan vendor shall assume unit responsibility for the entire system consisting of fan, driver, power transmission and associated auxiliary equipment. This include, but is not limited to, engineering responsibility for the following:

a) Torsional analysis

b) Lateral analysis

c) Selection and rating of power transmission components

d) Lube oil system design

e) Equipment layout

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

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

6.1.7 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:

Equipment	Sound Pressure Limit in dB Reference Equivalent (RE) 20 µPa
Fan	87 dB (A)
Fan + driver	90 dB (A)

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

Equipment	Sound Pressure Limit in dB Reference Equivalent (RE) 20 µPa
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. **(Mod.)**

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

6.1.7.2 Fans shall comply with the requirements of IPS-G-SF-900. **(Add.)**

6.1.21 "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. **(Mod.)**

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

6.2 Fan Housing

6.2.1 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.)**

6.2.2 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 (In 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 (Adjacent to the inlet guide vanes). **(Mod.)**

6.3 Fan Housing Connections

6.3.1 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.)**

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

6.3.2.12.11 Unless otherwise specified, Drain connections shall be equipped with valves. **(Mod.)**

6.3.3 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.)**

6.5 Rotating Elements

6.5.2 Blade design shall be manufacturer's proposal, however subject to the purchaser approval. **(Mod.)**

6.5.3 Fan wheel material shall be suitable for operation with the gas specified on the data/requisition sheet, considering corrosion, erosion and temperature.

6.5.5 For overhung types of fans, the impeller shall be mounted on the shaft with a hydraulic keyless taper fit to allow the impeller hub to be removed to replace or maintain bearing or sealing elements, lock-nuts, if used shall be self-locking (counter rotation thread) and positively located by means of lock screws or a lock plate fastened to the shaft and impeller by cap screws, rather than by using a keyed construction. **(Mod.)**

6.5.6 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.)**

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

6.6 Shaft Sealing of Fans

6.6.1 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.

d) Non-contacting dry gas seals be applied if approved by the principal.

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.)**

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

6.6.7 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.)**

6.7 Dynamics

6.7.4.5 Results of the vibration analysis shall be furnished to the purchaser for approval. **(Add.)**

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

6.7.5.2.2 Delete "if specified" from this clause. **(Mod.)**

6.7.2.2 Delete "if specified" from this clause. **(Mod.)**

6.8 Bearings and Bearing Housings

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

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

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

6.9 Lubrication

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

6.9.5 The lube oil system shall be in accordance with IPS-M-PM-320. As minimum, Pressure Lubrication System shall be accordance to IPS-M-PM-320. Lubricating oil pressure shall be higher than cooling water pressure at oil coolers, to prevent contamination of oil in case of cooler failure. **(Mod.)**

6.10.1.20 All oil-containing pressure components shall be stainless steel, transparent oil containers shall be of the glass type. **(Add.)**

6.9.10 Pumps shall have steel cases. **(Add.)**

Reservoir mounted pumps are not acceptable. **(Sub.)**

6.10 Materials

6.10.1 General

6.10.1.15 Materials for components in contact with gas containing hydrogen sulphide, including trace quantities, shall conform to the requirements of NACE standard MR0175. Components include (but not limited to) impellers, shaft sleeves, impeller locking nuts, bolting and other fasteners. **(Mod.)**

6.10.1.11 The H_2S limitation includes trace quantities for any operating condition including startup and shutdown. **(Mod.)**

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

6.11 Nameplates and Rotation Arrows

6.11.4 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.)**

7. ACCESSORIES

7.1 Drivers

7.1.1 General

7.1.1.2 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.)**

7.1.1.5 Belt or chain drives are unacceptable. **(Add.)**

7.1.2 Motors

7.1.2.1 Electric motor drivers and motors for auxiliaries shall comply with IPS-M-EL-131 and IPS-M-EL-132. **(Mod.)**

7.1.3 Steam Turbines

7.1.3.1 Steam turbine drivers shall comply with IPS-M-PM-240 or IPS-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.)**

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

7.1.4 Gears Units

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

7.2 Couplings

7.2.2 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. **(Mod.)**

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

7.2.11 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.)**

7.3 Belt Drivers

7.3.1 Belt Drives are acceptable for driver power transmission under 150 kW if specified by owner. **(Mod.)**

7.4 Mounting Plates

7.4.1 General

7.4.1.12 Unless otherwise specified anchor bolts shall be furnished by the vendor. **(Mod.)**

7.4.2 Baseplates

7.4.2.1 Where a baseplate is specified:

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.)**

7.5 Controls and Instrumentation

7.5.1 General

7.5.1.1 Instrumentation and installation, including any panels shall conform to IPS-M-IN-280. **(Mod.)**

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

7.5.1.10 The automatic starting controls for auxiliary lube oil pumps and all protective system except over speed trips shall be designed to permit testing during fan operation. **(Add.)**

7.5.1.11 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.)**

7.5.1.12 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.)**

7.5.3 Control systems

Note: The control signal range shall be 20 to 100kPa for pneumatic instruments and 4 to 20 mA for electronic instruments. **(Add.)**

7.5.3.5 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.)**

7.5.4 Dampers and inlet guide vanes

7.5.4.1 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.)**

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

7.5.4.4 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.)**

7.5.4.5 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 distribute the air flow. **(Mod.)**

7.5.4.6 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. **(Add.)**

7.6 Piping

7.6.1 General

7.7.1 Inlet trash screen

All construction materials for inlet trash screens and rain hoods shall be stainless steel type 316. The screen shall be fabricated from 0.125 inch (3.18 millimeters) minimum diameter wire, with a mesh of $1^{1/2}$. **(Mod.)**

7.9 Insulation and Jacketing

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

7.10 Turning Gear

7.10.2 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.)**

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

8. INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

8.1 General

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

8.1.3 All mechanical running tests, and performance tests when required, will be witnessed.**(Mod.)**

8.2 Inspection

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

8.3 Testing

8.3.3 a) All fans shall have a shop mechanical running 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 un-interrupted 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 inspection 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.)**

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

8.3.4.1.3 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.)**

8.4 Preparation for Shipment

8.4.1 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.)**

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

10. GUARANTEE AND WARRANTY (Add.)

10.1 Mechanical

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

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

a) All equipment and component parts shall be warranted by the vendor against defected materials, design and workmanship for 1 years after start-up or 18 months after shipment, whichever is longer.

b) If any mal-performance or defects occur during the guarantee and warranty period, the vendor shall make all necessary alterations, repairs and replacements free of charge, with no field labor charges, on the purchaser's job site. **(Add.)**

10.2 Performance

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

9. VENDOR DATA

9.2 Proposals

9.2.3 Technical Data

f) 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.)**

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

r) 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.