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PROCESS DESIGN OF FANS AND BLOWERS

(PROJECT STANDARDS AND SPECIFICATIONS)

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TABLE OF CONTENT

SCOPE

This Project Standards and Specifications is intended to provide guidelines for process engineers for selection of proper type and preparation of process data sheets for fans used in Oil and Gas industries.

It contains basic reference information, data and formulas necessary for fan selection.

REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

API (American Petroleum Institute)

Standard No. 673 "Special Purpose Centrifugal Fans for Refinery Service"

DEFINITIONS AND TERMINOLOGY

Evase - Is a diffuser or a diverging discharge transition piece.

Fan impeller - Is the assembly of the fan wheel and the hub(s). (API Std. 673, Section 1.4).

Fan plane - Is a flow area perpendicular to the flow of gas at the specified reference plane; that is, inlet flange or outlet flange. (API Std. 673, 1.4).

Fan rated point - Is defined as (1) the highest speed necessary to meet any specified operating condition and (2) the rated capacity required by fan designs to meet all operating points. (The Vendor shall select this capacity point to the best encompass specified operating conditions within the scope of the expected performance curve.) (API Std. 673, 1.4).

Maximum continuous speed (rotations per minute) - Is the speed at least equal to the product of 105 percent and the highest speed required by any of the specified operating conditions. (Modification to API Std. 673, 1.4).

Normal operating point - Is the point at which usual operation. Is expected and optimum efficiency is desired. Unless otherwise specified, fan performance shall be guaranteed at the normal operating point. (API Std. 673, 1.4).

Standard air density - Is 1.2007 kg per cubic meter.

The fan inlet area - Is the inside area of the fan inlet collar.

The fan outlet area - Is the inside area of the fan outlet.

The mechanical efficiency of a fan - Is the ratio of power output to the power input.

The power input to a fan - Is expressed in kilowatts and is the measured kilowatt delivered to the fan shaft.

The power output of a fan - Is expressed in kilowatts and is based on fan volume and fan total pressure.

The static efficiency of a fan - Is the mechanical efficiency multiplied by the ratio of the static pressure to the total pressure or $e_s = e_t \times P_s / P_t$.

The static pressure (P_s) of the fan - Is the total pressure (P_{tf}) diminished by the fan velocity pressure (P_v).

The total pressure (P_{tf}) of a fan - Is the rise of pressure from fan inlet to fan outlet as measured by two impact tubes, one in the fan inlet duct and one in the fan discharge duct, corrected for friction to the fan inlet and outlet respectively. Where no inlet duct is used, total pressure on the inlet side is zero.

The unit of pressure - Is the mm. of water column of density of 997.423 kg per cubic meter and/or Pa (1 mm H_2O conventional= 9.80665 pascals).

The velocity pressure (Pv) of a fan - Is the pressure corresponding to the average velocity determination from the volume of air flow at the fan outlet area.

The volume handled by a fan - Is the number of cubic meters of air per hour expressed at fan outlet conditions.

SYMBOLS AND ABBREVIATIONS

SYMBOL/ABBREVIATION	DESCRIPTION
BkW	Brake(shaft) kilowatt of Fan in (kilowatts, kW);
D	Wheel Diameter, in (m);
D	Relative Density, (dimensionless);
e_s	Static Efficiency, in (fractions);
e_t	Mechanical (Total) Efficiency in (fractions);
F_1	Temperature Correction Factor, in (kg/m^3);
F_2	Altitude Correction Factor, in (kg/m^3);
FkW	Fan Power, in (kilowatts);
GkW	Gas (Air) kilowatt of Fan, in (kilowatts, kW);
K	Ratio of Specific Heats, C_p/C_v, (dimensionless);
P_1	Fan Inlet Pressure, in [mm H^2O (abs.)], or (in [Pa(abs.)];
P_s	Static Pressure of Fan, in [mm H^2O (abs.)], or in [Pa(abs.)];
P_{s2}	Fan Outlet Static Pressure, in [mm H_2O (abs.)], or in [Pa(abs.)];
P_t	Total Pressure in (mm H_2O), or in (Pa);
P_{tf}	Fan Total Pressure in (mm H_2O), or (Pa);
P_v	Velocity Pressure of Fan, in (mm H_2O), or (Pa);
p_{v2}	Fan Outlet Velocity Pressure, in [mm H_2O (abs.)], or [Pa(abs.)];
r/min	Rotational Speed, in (rotations per minute);
T_1	Gas Temperature at Fan Inlet, in (K);
V_1	Fan inlet Rate, in (m^3/h);
V_m	Gas Velocity, in (m/s);
V_p	Peripheral Velocity, in (m/s);
T	Temperature Rise, in (K or degree °C);
ρ(rho)	Density (Mass Density), in (kg/m^3);
π(pi)	Constant, equal to 3.1416;

Subscripts:

T	Based on total pressure;
S	Based on static pressure;
1	At inlet conditions;
2	At outlet conditions.

UNITS

This Standard is based on International System of Units (SI) except where otherwise specified.

GENERAL

Fan Identification

Fans are rather generally identified as machines with relatively low pressure rises which move air or gases or vapors by means of rotating blades or impellers and change the rotating mechanical energy into pressure or work on the gas or vapor. The result of this work on the fluid will be in the form of pressure energy or velocity energy, or some combination of both.

Pressure Limit of Application

Fans for all services handling air or gas, on process duties (excluding those for direct cooling or ventilating) and which develop less than 35 kPa (0.35 bar) from atmospheric pressure, shall conform to API Std. No. 673.

Types of Fan

For types of fan refer to Appendix E of this Standard.

Performance

1. Fan performance shall be based on the static pressure differential across the fan inlet and outlet flanges. To obtain this differential, silencer and inlet losses, including control system losses, shall be added by the fan vendor to the purchaser's specified inlet and outlet static pressures.(API Std. 673,2.1.6).
2. Performance curves shall have a continuous rising pressure characteristic from the rated point, as specified, to 60 percent or less of the rated flow. Performance curves, corrected for the specified gas at the specified