SLOVENSKI STANDARD
oSIST prEN ISO 12759-2:2017

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Ventilatorji - Klasifikacija učinkovitosti za ventilatorje - 2. del: Standardne izgube za pogonske sestavne dele (ISO/DIS 12759-2:2017)

Fans - Efficiency classification for fans - Part 2: Standard losses for drive components (ISO/DIS 12759-2:2017)

Ventilatoren - Effizienzklassifizierung für Ventilatoren - Teil 2: Standardverluste für Antriebskomponenten (ISO/DIS 12759-2:2017)

Ventilateurs - Classification du rendement des ventilateurs - Partie 2: Détermination à charge partielle (ISO/DIS 12759-2:2017)

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Part 2:
Standard losses for drive components

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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The committee responsible for this document is ISO/TC 117.

Introduction

This standard provides a method to estimate the input power and overall efficiency of an extended fan system.

An extended fan system is composed of a fan and an electric motor, but may also include a transmission and a motor controller. While direct measurement of fan system performance is preferred, the large number of fan system configurations often makes testing impractical. This standard offers a standardized method to estimate fan system performance by modelling commonly used components. Calculations reported in accordance with this standard offer fan users a tool to compare alternative fan system configurations in a consistent and uniform manner.

Fans — Efficiency classification for fans —

Part 2:
Standard losses for drive components

1 Scope

The scope of this standard includes all electric motor driven fan systems that utilize a specific combination of components as defined below:

1) Fan airflow performance tested in accordance with ISO/Standard 5801, *Industrial fans -- Performance* Testing Using Standardized Airways.

2) Polyphase induction motors within the scope of the US Energy Independence and Security Act of 2007, IEC 60034-30, Rotating electrical machines - Part 30-1: Efficiency classes of line operated AC motors, or GB 18613, Minimum Allowable Values of Energy Efficiency and Energy Efficiency Grades for Small and Medium Three-Phase Asynchronous Motors. Other types of motors are explicitly excluded.

3) Pulse-width modulated variable frequency drives (VFD) for use with single motors. Single VFDs that service multiple, parallel fan motors are excluded.

4) Mechanical power transmissions that utilize V-belts, flat belts, cog belts, or couplings.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5801, *Industrial fans — Performance testing using standardised airways*

ISO 5802, *Industrial fans — Performance testing in situ*

ISO 13348, *Industrial fans — Tolerances, methods of conversion and technical data presentation*

ISO 13349, *Fans — Vocabulary and definitions of categories*

IEC 60034-2-1:2008, *Rotating electrical machines — Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)*

IEC 60034-30-1, *Rotating electrical machines — Part 30-1: Efficiency classes of line operated AC motors*

3 Terms and definitions

3.1 Fan system

A fan product that includes all appurtenances, accessories, motors, drives and controllers necessary or applied to the fan.

See Table 1 for symbols and subscripts.

Table 1 — Symbols and Subscripts

Symbol	Description	Unit
η_T	Transmission efficiency (see note)	dimensionless
η_m	Motor efficiency	dimensionless
η_{mreg}	Regulated (nominal) motor efficiency	dimensionless
η_c	Motor controller efficiency	dimensionless
η_{es}	Overall static efficiency	dimensionless
η_e	Overall efficiency	dimensionless
η_{mc}	Combined motor and motor control efficiency	dimensionless
P_e	Fan system input power	kW
P_a	Fan input power	kW
P_u	Fan output power	kW
P_{mo}	Motor output power	kW
P_{mrat}	Motor rated output power (nameplate)	kW
P_{mi}	Motor input power	kW
P_{co}	Motor controller output power	kW
P_{crat}	Motor controller rated output power	kW
L_m	Motor load ratio	dimensionless
L_c	Motor controller load ratio	dimensionless
N	Fan speed	rpm
f_L	Mains line frequency	Hz
η_s	Fan static efficiency	dimensionless
η	Fan efficiency	dimensionless
n	Number of poles in induction motor	dimensionless

NOTE The symbol η_T, transmission efficiency, should not be confused with η, fan efficiency.

4 Fan system energy calculations

This section describes the calculations required to estimate the extended fan system input power and overall extended fan system efficiency. Calculations start with the fan performance and then progress to each fan system component.

4.1 Components

4.1.1 Fan

Fan input power, P_a, is the starting point for the system calculation. Fan performance shall be determined in accordance with an accepted performance standard such as ISO 5801 or AMCA Standard 260. The fan laws and ISO 13348 shall be used to determine fan performance at operating conditions other than those tested. For calculation of fan system input power (P_e), the following performance variables must be available for the desired fan operating point:

P_a Fan input power

N Fan speed

To calculate the overall fan system efficiency, the following must also be available:

η_s Fan static efficiency

or

η Fan efficiency

4.1.2 Power transmission

The power transmission is a component of the fan system that transfers power from the motor to the fan, often involving a speed change.

4.1.2.1 V-belt power transmission

The efficiency of a v-belt transmission is calculated as

$$\eta_T = 0.96\left(\frac{P_a}{P_a + 1.64}\right)^{0.05}$$

4.1.2.2 Cog Belt transmission

The efficiency of a flat or cog belt is calculated as

P_a <= 1kW, $\eta_{T = 0.94}$

1 kW < P_a < 5kw, $\eta_{T = 0.01}$ P_a + 0.93

P_a => 5kw, $\eta_{T = 0.98}$

4.1.2.3 Coupling

The efficiency of a coupling is calculated as

$$\eta_T = 0.98$$

4.1.2.4 No power transmission

If there is no power transmission and the fan impeller is directly coupled to the motor, then

$$\eta_T = 1$$

4.1.3 Motor and controller

The following sections detail the calculations for various motor and motor/controller combinations. Fan systems incorporating components other than those described here are not covered by this standard.

4.1.3.1 Regulated polyphase induction motors controlled by a VFD

Calculations presented here are limited to certain regulated polyphase induction motors driven by pulse-width modulated variable frequency drives at the drive's rated nameplate voltage.

The following motor and component parameters must be known:

P_{mrat} Motor nameplate output power

n number of motor poles

f_L line frequency

Motor enclosure TEFC or ODP