ASET-EU

Air System Engineering and Technology Conference - Europe

5 November 2019

Anthony Breen

Walk through of standards

QUALITY PRODUCTS : OUTSTANDING CUSTOMER SERVICE : PROFIT TO OUR BUSINESS

NUAIRE. FOR THE COMPLETE VENTILATION SOLUTION.

Agenda

- Introduction.
- Background.
- The ISO Suite of Standards.
- Regulations & their influence.
- Proposed EN standards.

EN 12101-3 2015

Example of fan after an EN 12101-3 burn test.

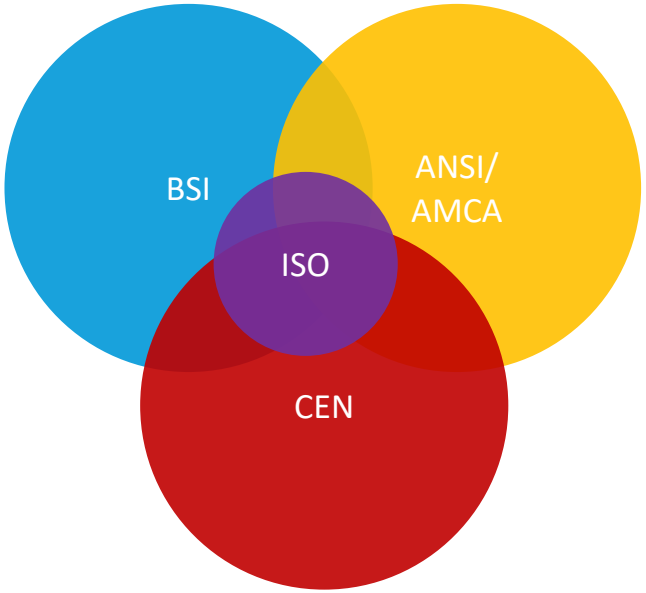
Standards

- “A document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose. Standards can relate to anything, including definitions and classifications, manufacturing, process management or service delivery.”

History

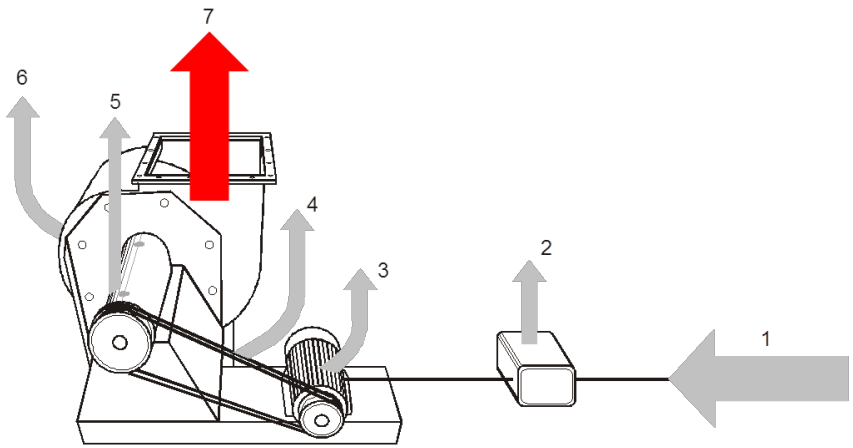
- 1920 – Standardisation Committees.
- 1925 to 1996 - National Fan Standards.
- 1963 - ISO Technical Committee 117 (ISO TC 117).
- 1997 - 1st Ed ISO 5801.

ISO is made up of…



ISO 5801 Air Performance

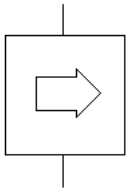
- Reverting back to the three main points for fan characteristics Air Performance is probably the most critical element, this has been addressed in ISO 5801.



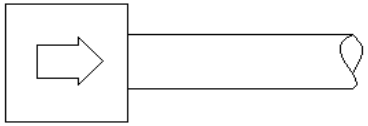
EN ISO 5801

Standard test configurations

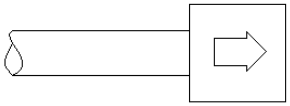
A. Non-ducted.



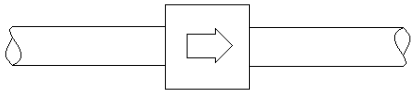
B. Ducted on fan outlet.



C. Ducted on fan inlet.

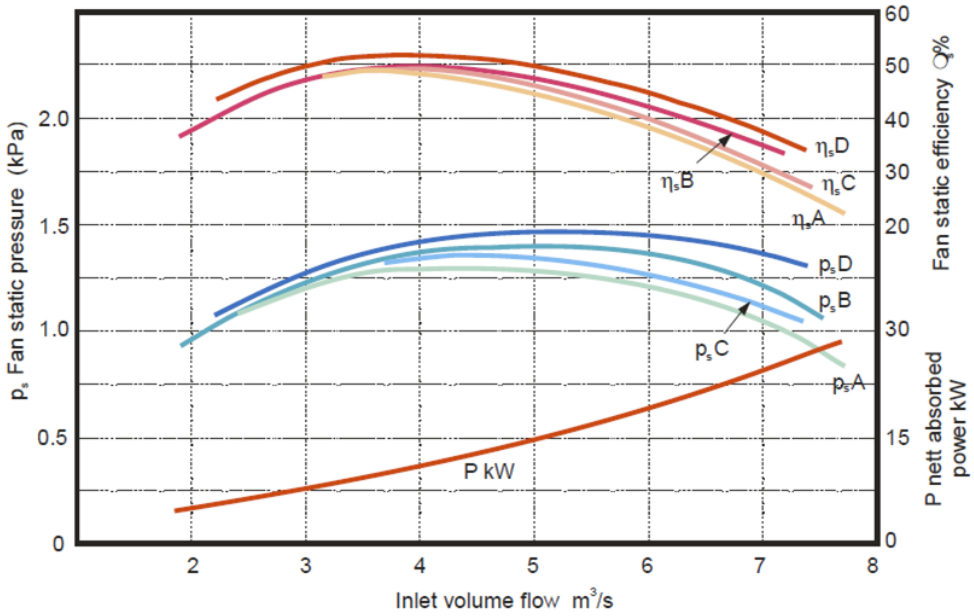


D. Ducted on the fan inlet and outlet.



EN ISO 5801

Typical Performance curves for a forward curved centrifugal fan to different installation categories.



ISO Suite of Standards

- ISO 5801:2017 Fans - Performance testing using standardized airways.
- ISO 5802:2001 and ISO 5802:2001/Amd 1:2015 Industrial fans - Performance testing in situ.
- ISO 12499:1999 Industrial Fans - Mechanical safety of fans – Guarding.
- ISO 12759-2:2019 Fans - Efficiency classification for fans - Part 2: Standard losses for drive components.
- ISO 12759:2010 and ISO 12759:2010/Amd 1:2013 Fans - Efficiency classification for fans - Part 3: Fans without drives at max operating speed.
- ISO 13347-1:2004 and ISO 13347-1:2004/Cor 1:2006 and ISO 13347-1:2004/Amd 1:2010 Industrial Fans - Determination of fan sound power levels under standardised laboratory conditions - Part 1: General overview.
- 14ISO 13347-2:2004 and ISO 13347-2:2004/Cor 1:2006 Industrial Fans - Determination of fan sound power levels under standardized laboratory conditions - Part 2: Reverberant room method.
- 16ISO 13347-3:2004 and ISO 13347-3:2004/Cor 1:2006 and ISO 13347-3:2004/Amd 1:2010 Industrial Fans - Determination of fan sound power levels under standardized laboratory conditions - Part 3: Enveloping surface methods.
- 19ISO 13347-4:2004 and ISO 13347-4:2004/Cor 1:2006 Industrial Fans -Determination of fan sound power levels under standardized laboratory conditions - Part 4: Sound intensity method.
- 22ISO 13348:2007 Industrial Fans - Tolerances, methods of conversion and technical data presentation.
- 24ISO 13349:2010 Fans - Vocabulary and definitions of categories.
- 25ISO 13350:2015 Fans - Performance testing of jet fans.
- 28ISO 13351:2009 Fans - Dimensions.
- 30ISO 14694:2003 and ISO 14694:2003/Amd 1:2010 Industrial Fans - Specifications for balance quality and vibration levels.
- 32ISO 14695:2003 and ISO 14695:2003/Cor 1:2009 Industrial Fans - Method of measurement of fan vibration.
- 35ISO 27327-1:2009 Fans - Air curtain units - Part 1: Laboratory methods of testing for aerodynamic performance rating.
- ISO 27327-2:2014 Fans - Air curtain units - Part 2: Laboratory methods of testing for sound power levels.

ASET-EU

Air System Engineering and Technology Conference - Europe

5 November 2019

ISO 5802: 2001

Industrial fans.
Performance testing in situ.

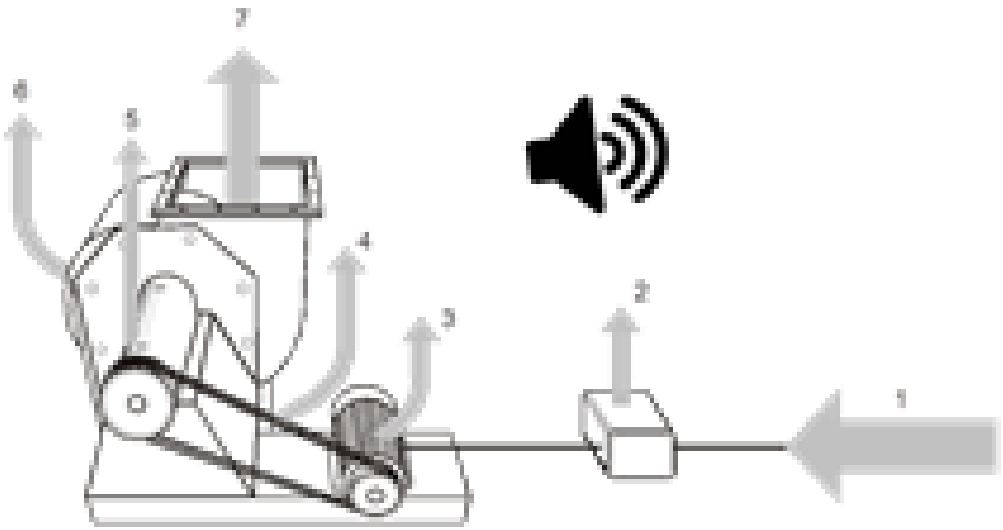
ISO 5802

In-situ testing.

- 6MW motor driven 5m diameter Power Plant Axial flow ID fan courtesy of Howden Fan.

ISO 13347 Sound Measurement

Reverting back to the three main points for fan characteristics Sound is the next characteristic of fans, which I will cover now with ISO 13347.



ISO 13347 Part 2

Reverberant Sound Cell.

ASET-EU

Air System Engineering and Technology Conference - Europe

5 November 2019

ISO 13348

Tolerances, methods of conversion and technical data presentation.

ISO 13348 Tolerance Grades

- Series Produced Non Certified Fans & Non Series Produced Fans.
- Guide for Fan 'Air and Noise' Tolerance Grades 1 to 4.

Tolerance grade (air and noise)	Typical application	Material of, and manufacturing processes used for, major aerodynamic components	Approx. min. power [a] kW
AN1	Mining (e.g main fan), process engineering, power stations (e.g. exhaust fan), wind tunnels, tunnels, etc.	Machined in some places, cast (high accuracy)	> 500
AN2	Mining, power stations, wind tunnels, tunnels, process engineering, air conditioning	Sheet or plastic material, partly machined, cast (medium accuracy)	> 50
AN3	Process engineering, air conditioning, industrial fans, tunnels, power station fans and industrial fans for harsh (abrasive or corrosive) conditions	Sheet material, cast (medium to low accuracy), special surface protection (e.g. hot-dip galvanizing, moulded plastics	> 10
AN4	Process engineering, ships fans, agriculture, small fans, power station fans and industrial fans for harsh (abrasive or corrosive) conditions	Sheet material, special surface protection (e.g. rubber coating), moulded or extruded plastics	—

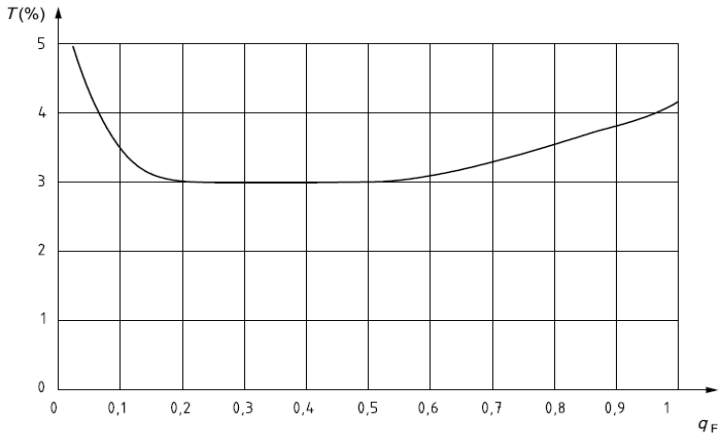
ISO 13348 Tolerance Grades

Manufacturing tolerance grades.

Parameter	Tolerance grade (air and noise)				Additional information
	AN1	AN2	AN3	AN4	
Volume flow rate, q_V	± 1 %	± 2,5 %	± 5 %	± 10 %	$\Delta_{q_V} = t_{q_V} \cdot q_V$
Fan pressure p_F	± 1 %	± 2,5 %	± 5 %	± 10 %	$\Delta_{p_F} = t_{pF} \cdot p_F$
Power, P_r [a, b]	+ 2 %	+ 3 %	+ 8 %	+ 16 %	$\Delta_P = t_P \cdot P_r$ Negative deviations are permissible. For small fans, P, shall be the motor input power.
Efficiency, η	− 1 %	− 2 %	− 5 %	− 12 %	$\Delta_\eta = t_\eta$ i.e. the value of t_η is identical with the permissible tolerance of the efficiency. Positive deviations are permissible.
A-weighted sound power level, L_{WA} [c]	+ 2 dB	+ 3 dB	+ 4 dB	+ 6 dB	$\Delta_{L_{WA}} = t_{L_{WA}}$ The value of $t_{L_{WA}}$ is a permissible tolerance of the sound power level. Negative deviations are permissible.

ISO 13348

- Series produced certified programme fan tolerances.

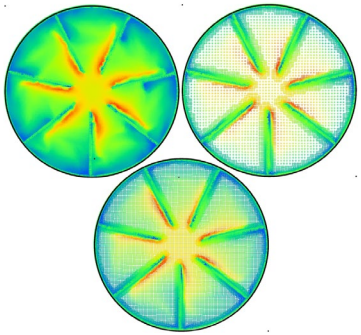


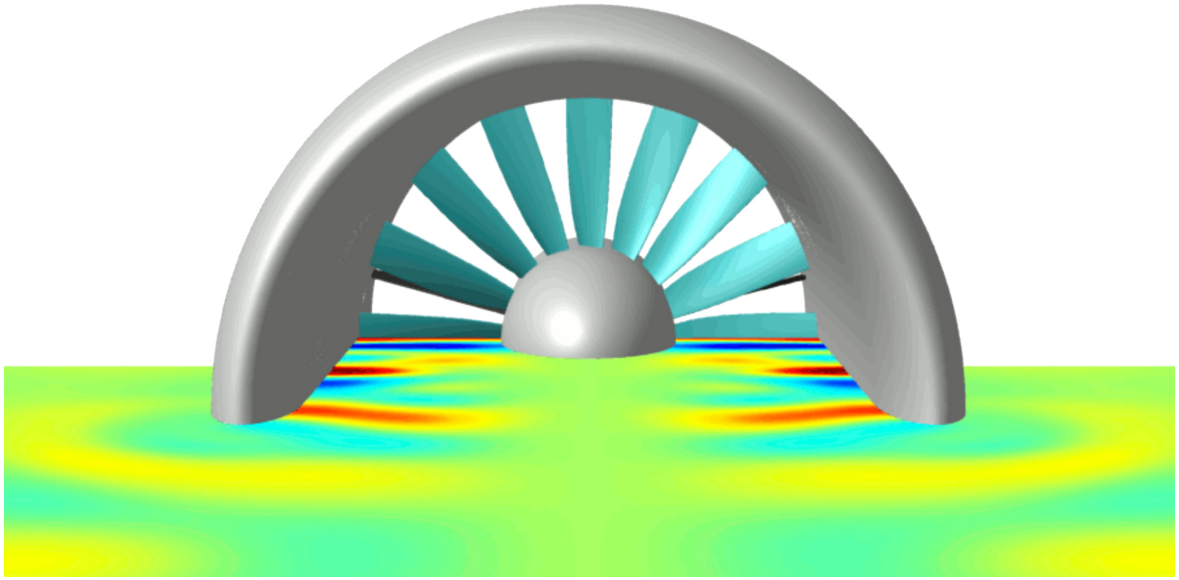
Airflow Tolerance Curve

4kW, tube axial fan	ISO 13348 series produced certified ratings fan program tolerance	ISO 13348 series produced non-certified ratings fan tolerance
Operating point	50% of maximum flow	50% of maximum flow
Air volume flowrate	3%	10 %
Pressure	6 %	10 %
Power	5%	16 %

ISO 13348 series produced non-certified ratings fan tolerance	4kW, tube axial fan	75kW, tube axial fan
Operating point	50% of maximum flow	50% of maximum flow
Air volume flowrate	10 %	2.5 %
Pressure	10 %	2.5 %
Power	16 %	3 %

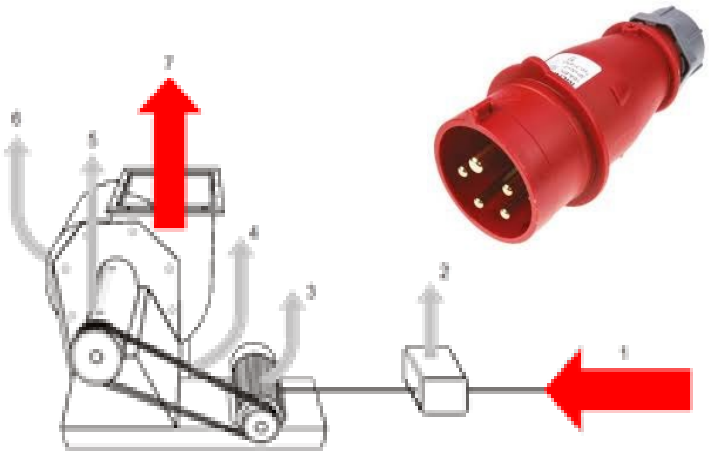
CFD





EN ISO 12759 – FANS - Efficiency classification for fans

Reverting back to the three main points for fan characteristics Input power is the next characteristic of fans, which I will cover now and its relevance to efficiency and EN ISO 12759.

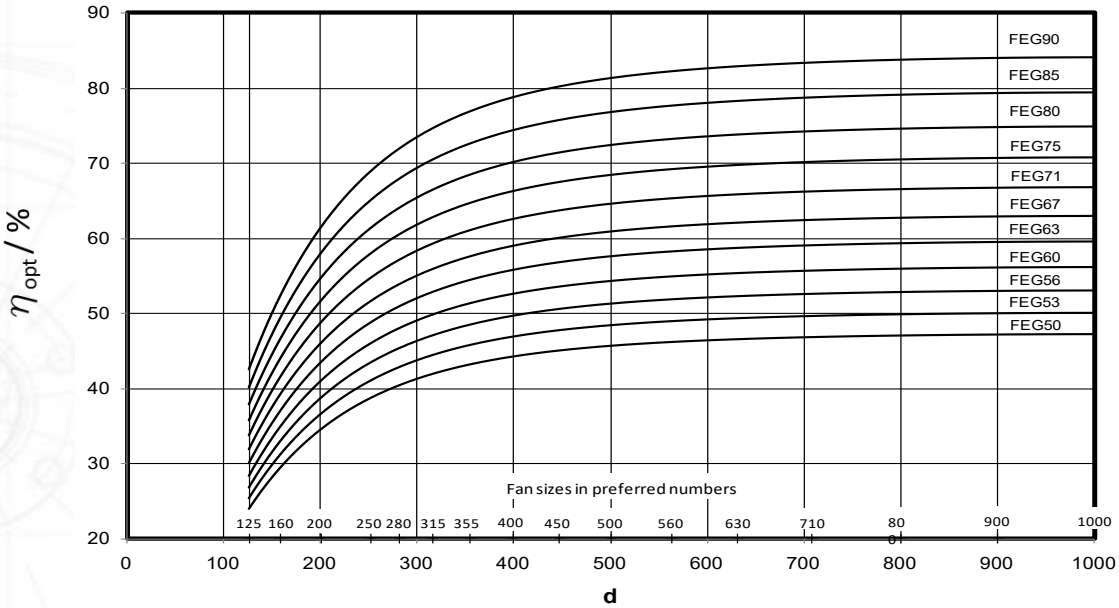


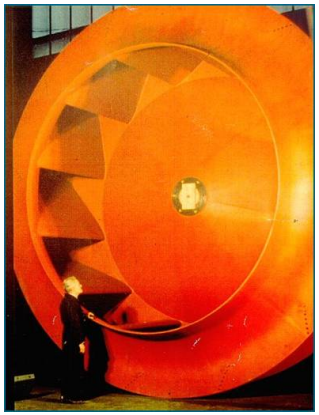
ISO 12759

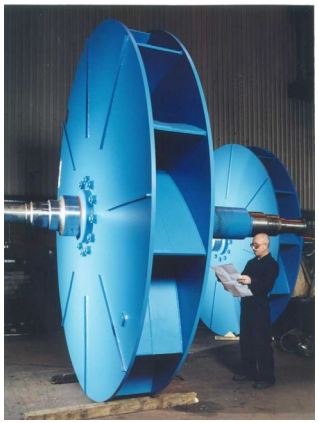
- ISO WD 12759-1 Fans - Efficiency classification for fans - Part1: General requirements.
- ISO 12759-2: 2019 Fans - Efficiency classification for fans - Part 2: Standard losses for drive components.
- ISO 12759-3: 2019 Fans - Efficiency classification for fans - Part 3: Fans without drives at maximum operating speed.
- ISO 12759-4: 2019? Fans - Efficiency classification for fans - Part 4: Driven fans at maximum operating speed.
- ISO DIS 12759-5 Fans - Efficiency classification for fans - Part 5: Jet fans.
- ISO DIS 12759-6 Fans – Efficiency classification for fans - Part 6: Fan Energy Index.

EN ISO 12759

Template for efficiency grades for fans without drives.

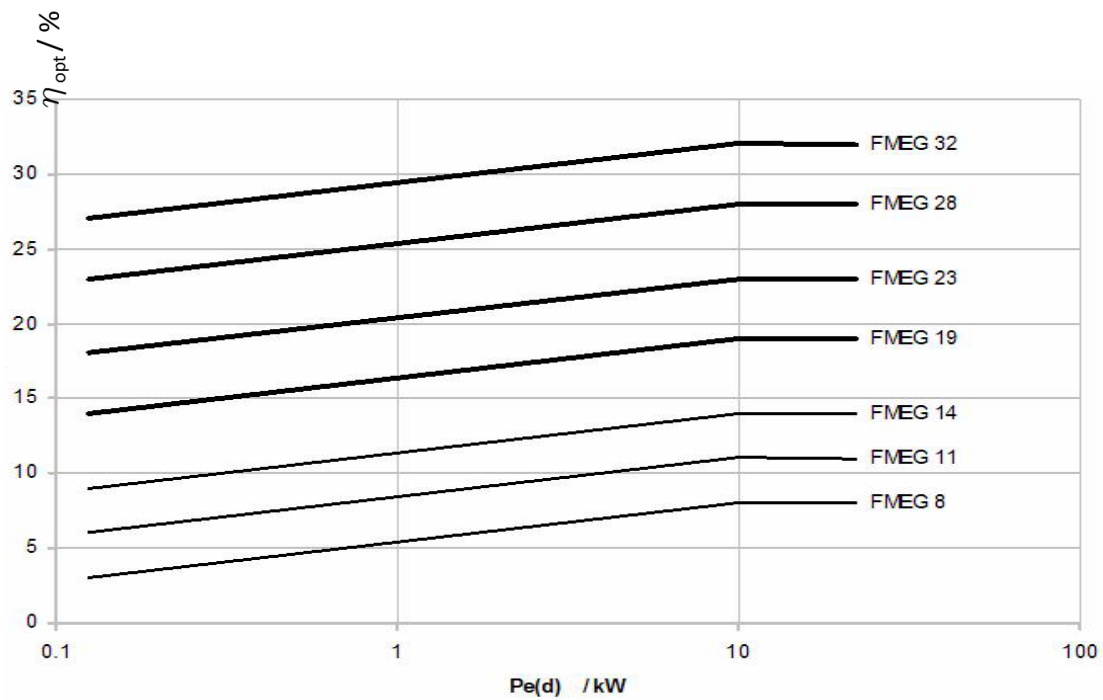






EN ISO 12759

- Efficiency grade template for cross flow fans.



ASET-EU

Air System Engineering and Technology Conference - Europe

5 November 2019

EU 327/2011

EU 327/2011

- Regulations:
- COMMISSION REGULATION (EU) No 327/2011 of March 2011.
- Implementing Directive 2009/125/EC of the European Parliament and of the council with regard to the ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500kW.
- Official Journal of the European Union (6.4.2011).

EU 327

Second tier minimum energy efficiency requirements for fans from 1 January 2015.

Fan types	Measurement category (A-D)	Efficiency category (static or total)	Power range P in kW	Target energy efficiency	Efficiency grade (N)
Axial fan	A, C	static	$0{,}125 \leq P \leq 10$	$\eta_{target} = 2{,}74 \cdot \ln(P) - 6{,}33 + N$	40
			$10 < P \leq 500$	$\eta_{target} = 0{,}78 \cdot \ln(P) - 1{,}88 + N$	
	B, D	total	$0{,}125 \leq P \leq 10$	$\eta_{target} = 2{,}74 \cdot \ln(P) - 6{,}33 + N$	58
			$10 < P \leq 500$	$\eta_{target} = 0{,}78 \cdot \ln(P) - 1{,}88 + N$	

ASET-EU

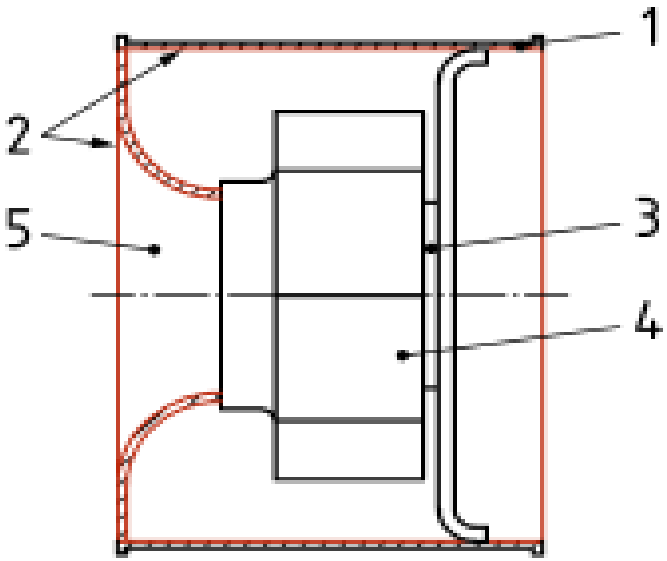
Air System Engineering and Technology Conference - Europe

5 November 2019

FprEN 17166:2019 (E) – Compliance for fans to EU 327

FprEN 17166:2019 (E)

Mixed flow fan where the impeller, motor, mounting arrangements, housing, inlet cone and outlet guide vanes are within the boundary.

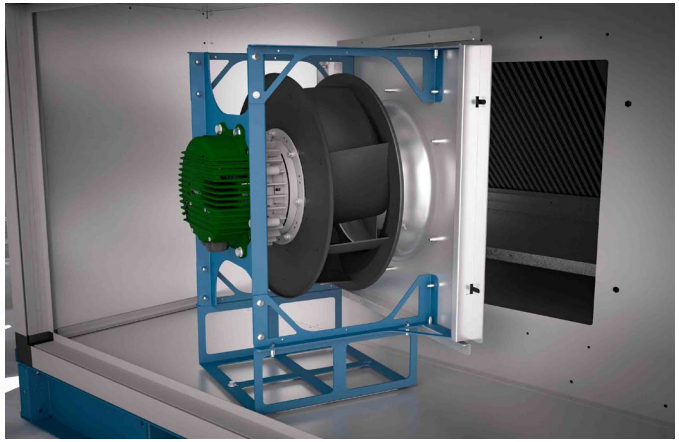


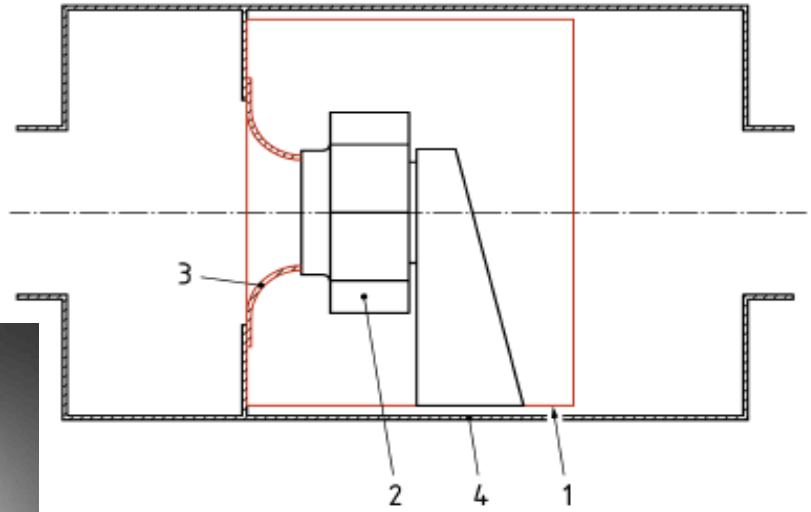
Key

1. Housing
2. Boundary
3. Impeller
4. Motor
5. Inlet cone

FprEN 17166:2019 (E)

In-line centrifugal fan where the impeller, motor, mounting arrangements, inlet cone and housing are within the boundary.





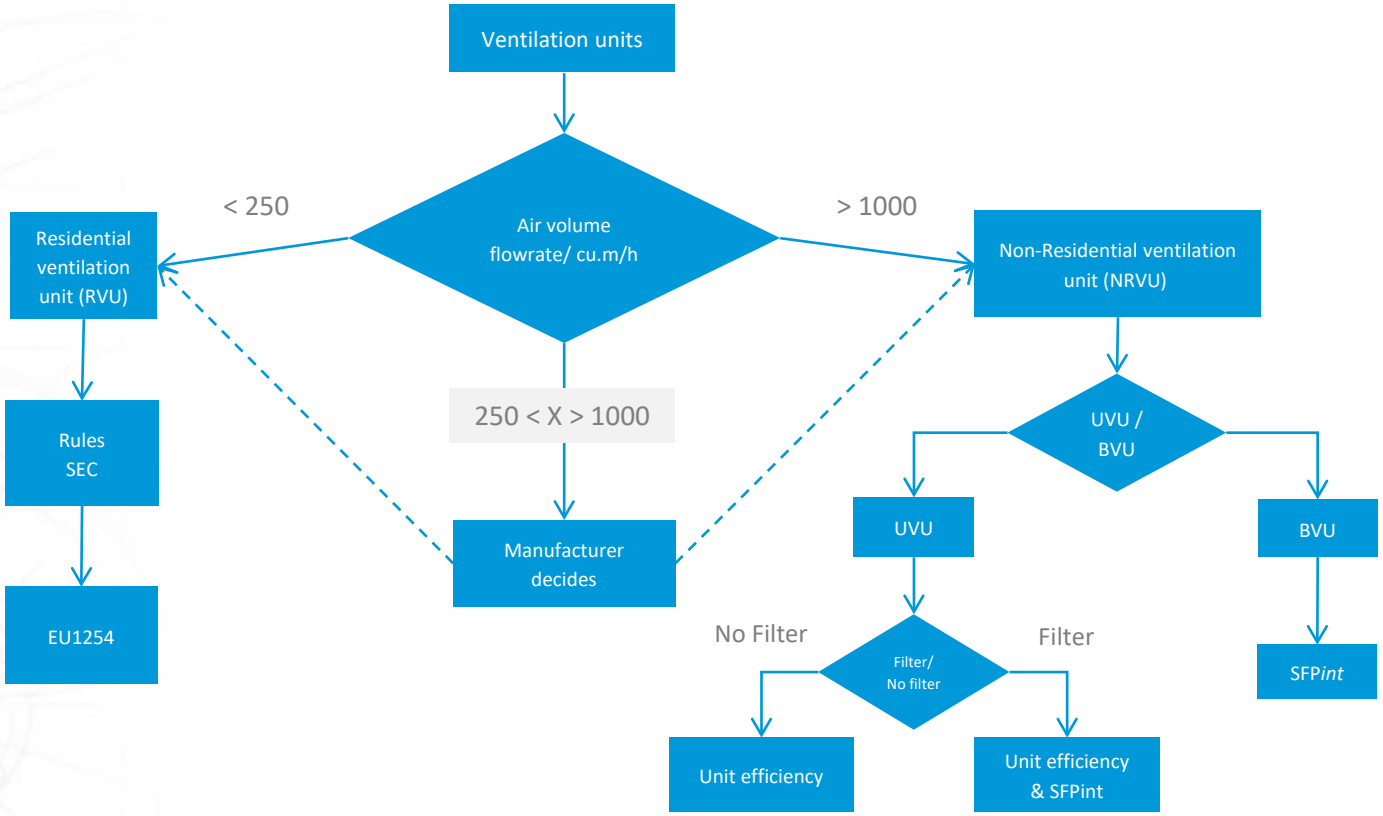
Key

1. Boundary
2. Impeller
3. Stator
4. Casing

EU 1253

Regulations:

- COMMISSION REGULATION (EU) No 1253/2014 of 7 July 2014.
- Implementing directive 2009/125/EC of the European Parliament and of the council with regard to ecodesign requirements for ventilation units.
- Official Journal of the European Union (25.11.2014).


Ventilation units
Air volume flowrate/ cu.m/h
< 250
> 1000
250 < X > 1000
Residential ventilation unit (RVU)
Rules SEC
EU1254
Manufacturer decides
Non-Residential ventilation unit (NRVU)
UVU / BVU
UVU
BVU
SFPint
Filter/ No filter
No Filter
Filter
Unit efficiency
Unit efficiency & SFPint

$$SEC = (ta \cdot pef \cdot qnet \cdot MISC \cdot CTRL^{x} \cdot SPI) - (t_h \cdot \Delta T_h \cdot \eta_h^{-1} \cdot c_{air} \cdot (q_{ref} - q_{net} \cdot CTRL \cdot MISC \cdot (1 - \eta_t)) + Q_{defr}$$

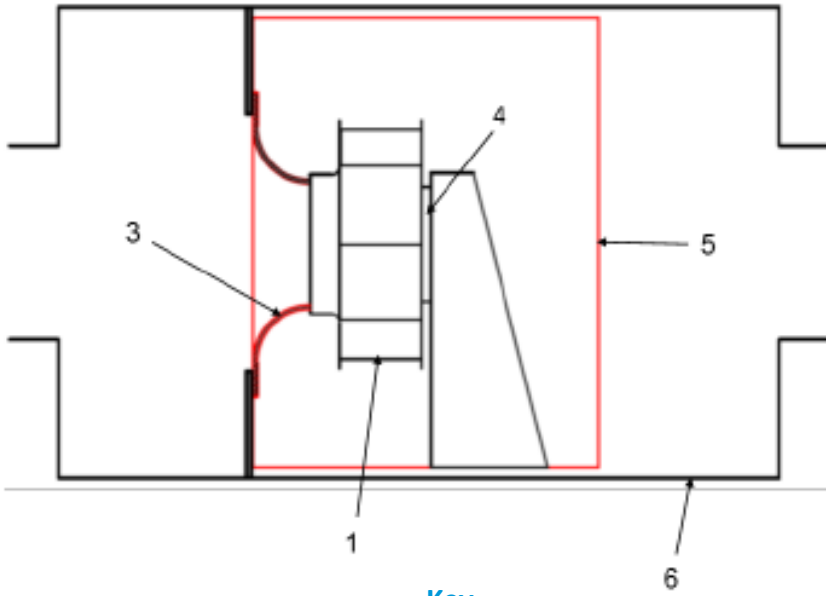
EU 1253

- Technical Report by the ‘Danish Technical Institute’.
- ISBN: 978-87-998971-0-0.

Transitional method for determination of internal specific fan power of ventilation units, SFP_{int}

EU 1253

- NRVU-UVU with an impeller (boxfan).



Key

1. Impeller
2. Stator
3. Motor
4. Boundary
5. Casing

EU 1253 Annex III

- Specific ecodesign requirements for NRVUs, as referred to in Article 3(2) and 3(4).

2. From 1 January 2018:

— All ventilation units, except dual use units, shall be equipped with a multi-speed drive or a variable speed drive.

All BVUs shall have a HRS.

The HRS shall have a thermal by-pass facility.

— The minimum thermal efficiency η_{t_nrvu} of all HRS except run-around HRS in BVUs shall be 73 % and the efficiency bonus E = $(\eta_{t\_nrvu} - 0{,}73) * 3\ 000$ if the thermal efficiency η_{t_nrvu} is at least 73 %, otherwise E = 0.

— The minimum thermal efficiency η_{t_nrvu} of run-around HRS in BVUs shall be 68 % and the efficiency bonus E = $(\eta_{t\_nrvu} - 0{,}68) * 3\ 000$ if the thermal efficiency η_{t_nrvu} is at least 68 %, otherwise E = 0.

— 6,2 % * ln(P) + 42,0 % if P ≤ 30 kW and

— 63,1 % if P > 30 kW.

— The maximum internal specific fan power of ventilation components (SFP_{int_limit}) in W/(m³/s) is

— for a BVU with run-around HRS

$1\ 600 + E - 300 * q_{nom}/2 - F$ if $q_{nom} < 2$ m³/s and

$1\ 300 + E - F$ if $q_{nom} \geq 2$ m³/s;

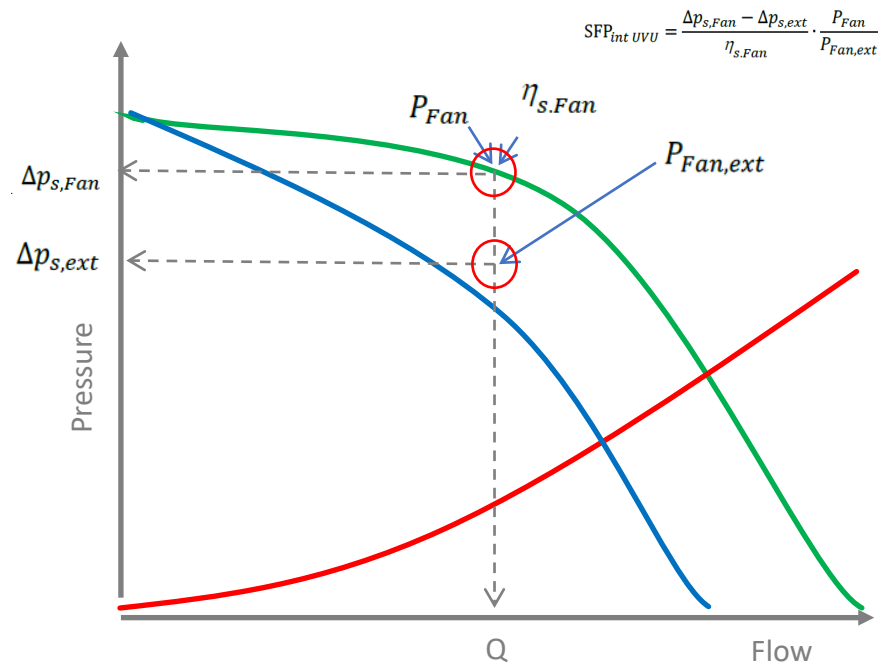
— 230 for an UVU intended to be used with a filter.

— If a filter unit is part of the configuration the product shall be equipped with a visual signalling or an alarm in the control system which shall be activated if the filter pressure drop exceeds the maximum allowable final pressure drop.

EU 1253

Internal Specific Fan Power- SFP_{int}

is the ratio between the internal pressure drop of the ventilation components and the fan (blower) efficiency for the reference configuration. Multiplied by the power ratio of the fan and unit.



Thank you

Contact Details:

Tony Breen, Nuaire | tony.breen@nuaire.co.uk