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Air intake filter systems for rotary machinery — Test methods —

Part 3: Mechanical integrity of filter elements

Systèmes de filtration d'air d'admission pour machines tournantes — Méthodes d'essai —

Partie 3: Intégrité mécanique des éléments filtrants

FDIS stage

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Contents

Foreword

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Field Code Changed

This document was prepared by Technical Committee ISO/TC 142, *Cleaning equipment for air and other gases,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 195, *Cleaning equipment for air and other gases*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 29461 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

In rotating machinery applications, the filtering system, typically a set of filter elements arranged in a suitable manner, is an important part of the whole turbine/compressor system. The development of turbine machinery used for energy production or others has led to more sophisticated equipment and therefore, the importance of effective protection of these systems has become more important in the recent years. It is known that particulate contamination can deteriorate a turbine power system quite substantially if not taken care of.

This process is often described as “erosion”, “fouling” and “hot corrosion” where salt and other corrosive particles are known as potential problems. Other particulate matters can also cause significant reduction of efficiency of the systems. It is important to understand that air filter devices in such systems are located in various environmental conditions. The range of climate and particulate contamination is very wide, ranging from deserts to humid rain forests to arctic environments. The requirements on these filter systems are obviously different depending on where they are operated.

This document has based the performance of the air intake filter systems not only upon heavy dust collection but also particulate efficiency in a size range that is considered to be the problematic field for these applications. Both ultra-fine and fine particles, as well as larger particles should be considered when evaluating turbine fouling. In typical outdoor air, ultra-fine and fine particles in the size range from 0,01- µm to 1 µm are contributing to > 99 % of the number concentration and to > 90 % of the surface contamination. The majority of the mass normally results from larger particles (> 1,0 µm).

Turbo-machinery filters comprise a wide range of products, ranging from filters preventing from coarse particles to filters for very fine and even sub-micrometermicrometre particles. The range of products varies from self-cleaning to depth and surface loading systems. The filters and the systems have to withstand a wide temperature and humidity range, very low to very high dust concentration and mechanical stress. The shape of products existing today can be of many different types and have different functions such as droplet separators, coalescing products, filter pads, metal filters, inertial filters, filter cells, bag filters, panel filters, self-cleanable and depth loading filter cartridges or pleated media surface filter elements.

The ISO 29641 series provides a way to compare these products in a standardized way and defines the criteria important for air filter intake systems for rotary machinery performance protection. The performance of products in this broad range needs to be compared according to a standardized procedure. Comparing different filters and filter types needs to be done with respect to the overall conditions they finally operate in.

If a filter or a filter system is meant to operate in an extreme, very dusty environment, the real particulate efficiency of this filter cannot be predicted since the dust loading of the filter becomes important.

In an ideal filtration process, each particle would be permanently arrested at its first contact with a media fibre, but incoming particles can impact on a captured particle and detach it into the air stream. Fibres or particles from the filter itself can also be released, due to mechanical forces.

Another worst-case scenario in abnormal operating environments which leads to unusual high-pressure drops is the burst or damage of the filter element accompanied with a sudden release of parts of the filter element or high amounts of dust captured.

This document specifies a method and procedure to test the mechanical integrity (“burst test”) of individual filter elements up to an abnormal final test pressure drop of maximum 6 250 Pa. Any other customer defined final pressure drop up to a higher pressure drop shall be reported as variation from the standard. Nevertheless, it is within the ability of the user to define the maximum possible value (lower or higher) for a certain application and to define the burst strength requirements for this test procedure. As the pressure drops under typical operating conditions are on a much lower level, it is not intended to specify a final pressure drop for any application within this procedure.

For multi-stage systems which use a number of components (e.g. equipment for cleaning, filters), each filter element needs to be tested separately.

In general, it is possible to use this procedure also after any previous ageing procedure if it is clearly described as a variation from the standard test procedure. An ageing procedure is defined as an appropriate customer defined durability test which can affect the stability of media, adhesives, construction etc.and the like, and is important for the evaluation at its real application. Test results of filter elements after different ageing procedures cannot be quantitively compared.

Examples of conditioning are:

— ——climatic conditioning at high or low temperatures and/or defined relative humidity levels;

— ——wet conditions with water droplets or condensing water over a defined time period;

— ——any kind of dust loading and pulsing procedure over a certain duration or number of pulses;

— ——operation at real conditions, etc.

The “Burst Testburst test” itself is considered as an independent procedure to evaluate the integrity of a filter element to resist a defined high pressure drop without collapsing, losing or releasing any parts of its construction into the downstream while keeping its filtration efficiency.

The test procedure does not include methods for the direct measurement of the performance of entire systems as installed, (e.g. systems with use of multiple stages of coarse and fine filter elements.).

Note: For example, can a damaged, vertically installed pulse-jet filter perform differently in real operation conditions compared to what can be detected by a horizontal, non-pulsing test as described in this document.

Air intake filter systems for rotary machinery — Test methods ~~— Part 3: Mechanical integrity of filter elements~~ —

Part 3: Mechanical integrity of filter elements

1 Scope

This document ~~provides~~specifies methods to determine the mechanical integrity of filters under defined conditions that can be encountered in abnormal operating environments. It describes the test methods for filter elements, independent of any ageing procedures like pulsing, loading, temperature cycles, wet conditions or others.

The test procedure is intended for filters operating in the range of 0,24 m^3/s (850 m^3/h) up to 2,36 m^3/s (8 500 m^3/h). Filter elements with a lower efficiency than ISO T5 (ePM_{10}) according to ISO 29461-1 are excluded.

~~As a standard to~~To ensure the comparability of the test results, only new filter elements or those loaded up to 625 Pa or maximum 800 Pa according to ISO 29461-1 are tested.

This document does not describe a standardized method to measure the fractional or gravimetric efficiency. The efficiency of the filter element can be tested according to ISO 29461-1.

The performance results obtained according to this document cannot be quantitatively applied (by themselves) to predict performance in real use.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5167 (all parts), *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduit running full*

ISO 12103-1, *Road vehicles — Test dust for filter evaluation — Part 1: Arizona test dust*

ISO 16890-2:2022, *Air filters for general ventilation — Part 2: Measurement of fractional efficiency and air flow resistance*

ISO 29461-1, *Air intake filter systems for rotary machinery — Test methods — Part 1: Static filter elements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 29461-1 and the following apply.

ISO and IEC maintain ~~terminological~~terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Test parameter

3.1.1
air flow rate
volume of air flowing through the filter per unit time

[SOURCE: ISO 29464:2017, 3.1.24]

3.1.32
test airflow rate
volumetric air flow rate used for testing

[SOURCE: ISO 29464:2017, 3.3.2]

3.1.43
pressure drop
difference in absolute (static) pressure between two points in a system

Note 1 to entry: Resistance to air flow is measured in Pa.

[SOURCE: ISO 29464:2017, 3.1.36]

3.1.54
initial pressure drop
pressure drop of the clean filter operating at the test airflow rate

[SOURCE: ISO 29464:2017, 3.3.17]

3.1.65
initial test pressure drop
pressure drop of the filter element operating at the test airflow rate at start of the test

3.1.76
final pressure drop
maximum test pressure drop of the filter specified by the requestor of the test

3.1.87
final test pressure drop
maximum operating pressure drop of the filter to terminate the test as recommended at rated airflow

3.1.98
leakage
~~describes the~~ damage of the structure of a filter element, which allows particles to pass through the filter element without passing through the filter medium

3.2 Filter to be tested

3.2.1
test device
filter element ~~(3.2.2)~~(3.2.2) being subjected to performance testing

[SOURCE: ISO 29464:2017, 3.1.38]

3.2.2
filter element
structure made of the filtering material, its supports and its interfaces with the filter housing

[SOURCE: ISO 29464:2017, 3.2.77]

3.2.~~5~~3
static filter
air filter that will be removed (exchanged) after it has reached its final test pressure drop and that is not cleaned with jet pulses or other means in order to fully, or partially, retrieve its initial performance (pressure drop and efficiency)

[SOURCE: ISO 29464:2017, 3.3.12]

3.3 Test duration

3.3.1
test duration
time between starting a test and achieving a terminal condition~~,~~ (e.g. pressure drop)

3.4 Test materials

3.4.1
water fog
water droplets and fog generated by water spray device

3.4.2
test dust
synthetic dust used for the loading up to the final pressure drop ~~as defined in 6.1~~

4 Test rig, conditions and equipment

4.1 Test conditions

Room air or outdoor air can be used as a test air source. Relative humidity of supply air (before water spraying nozzles) shall be in the range of > 30 % during the tests. The air temperature shall be in the range of 25 °C ~~±~~ ± 10 °C. Other conditions may be used upon customer request.

4.2 Test rig – General requirements

The test rig shall be operated in negative pressure airflow ~~arrangement.~~configuration. The duct material shall be electrically conductive and electrically grounded and shall have a smooth interior finish and be sufficiently rigid to maintain its shape at the operating pressure (designed to withstand the negative pressure of at least 6 500 Pa). Parts of the test duct can be made in glass or plastic material to see the filter and equipment. Provision of windows to allow monitor of test progress is desirable. At least the upstream side of the filter element under test shall be observable from outside the test rig through a window as a camera is polluted very fast by the high dust/water concentration.

Test rigs according to ISO 16890-2 can be used for static filter elements~~ for example~~, but it is recommended to use a larger test rig designed for pulse cleaning tests~~ for example~~, because of its optimized construction for higher pressure drop, more powerful ventilators, higher dust feeding possibilities and the option to simulate ageing procedures like pulsing and/or wet conditioning prior to the burst test procedure.

