Minutes of Air Filtration Meeting

11-12 April 2016, GE Florence Learning Center, Florence, IT

ETN Attendees:

Luke Thompson	AAF
Scott Taylor	AAF
Marco Tappani	Ansaldo Energia
Giovanni Barbieri	Boldrocchi Group
Richard Ringström	Camfil
Ulf Johansson	Camfil
Alf-Erik Jakobsen	Dresser Rand
Marco Costarelli	Enel
Ugo Simeoni	ETN
Mike Garnett	Freudenberg
Giorgio Marchetti	GE Oil & Gas
Carlo Coltri	Mann Hummel Vokes Air
Alex Straver	Shell
Martin Oestemar	Siemens
Olaf Brekke	Statoil
Dominique Orhon	Total
Wilson Poon	W.L. Gore & Associates

Testing Companies Attendees

Heinz Bittermann	Fiatec
Al Vatine	LMS Technologies
Massimo Ellena	TEXA Engineering
Pier Giorgio Tronville	TEXA Engineering
Tapio Kalliohaka	VTT

1. Introduction by ETN Officer

U. Simeoni opened the meeting and welcomed the participants. He relayed the apologies of Donaldson, E.ON, Iberdrola, MTU, Solar Turbines and SSE, who unfortunately could not attend due to business reasons.

U. Simeoni presented the agenda and the objectives of the current meeting, which were to discuss the "Water/Salt test procedure" included in the part 5 of the ISO-29461 standard and the comments submitted by the WG's members.

2. Discussion on testing activities to be performed with external companies

A. Straver, as representative of all the GT Users in the WG, reported the main objectives the air filtration should achieve and what should be considered in the filter tests. He focused mainly on EPA and HEPA filter; nevertheless the same considerations are applicable to all type of filters.

A. Straver stated that the endurance test should replicate the operation of the filters installed. Furthermore filters should be tested in presence of humid air, salt, aerosol (i.e. bush fires) and dust. It is crucial for GT users to define the characteristics of the test rig that can be a reference case for testing activities and would allow the comparison of the filters based on the performance in a real environment. Further GT users' requirements are shared in the presentation "Filter element and filtration system testing" uploaded on the ETN Air Filtration webpage.

M. Garnett proposed to agree on the questions to be asked to the independent testing companies, based on the ETN members' comments on the first draft. It was also taken into consideration the "Air Filtration Survey Report" issued in 2014, in which the most important filter element characteristics for the ETN members are listed.

It was agreed to discuss the following requirements:

1. **Spray**
   There is a need to define how to generate the spray and make it repeatable. Size and presence of potassium chloride (KCl) and sodium chloride (NaCl) should be specified in the standard.
2. **Dust**
   The standard should define the dust distribution, the oil content in the dust and the type of loading dust, including but not limited to soot, ASHRAE dust and ISO dust. It was proposed to find a new test dust that would suit the scope.
3. **Mass flow**
   GT Users proposed that the test should be suitable for all the designed filters' mass flow. It was stated that there are two reference mass flows in the market: 4250 m^3/hr and 3400m^3/hr. It was pointed out that the tests performed on the filters should represent a reference case to which the GT Users can use to compare the performance. If high mass flows are not tested, it will never be possible to represent real conditions.
   It was agreed that the range to take into consideration is 900 m^3/hr ÷ 8000 m^3/hr (low, medium and high velocity).
4. **Duration**
   It was agreed that the test should last minimum 72 hours; however the duration should be determined based on what is needed to generate representative and sufficient test results.
5. **Salt Particles/Measurement**
   It was agreed to consider different lab methods regarding the salt measurement. It shouldn't be considered only the photometer since it present a gap in large particle measurement.
6. **Relative Humidity**
   The relative humidity (RH) should be higher than 90%.
7. **Temperature**
   The temperature should be a function of the relative humidity. R. Ringström underlined that it's not necessary a strict correlation between RH and T.
8. **Cycle**
   It was highlighted that the duration of the test should be related to the cycle number and the duration of the cycle. With regards to the cycles, a switch of dry and wet cycles should be considered to reproduce the aging effect, as well as dust load and salt changing phase.
9. **Element vs System**
   It was discussed the possibility to test also pulse-jet filters. U. Johansson suggested starting the test on static filters and in a later stage to include also pulse-jet. Also, the test should first be performed on the element and then put into a system, considering also that the system test would influence the duration. The filter elements to be considered are: pre-filter, coalescer, HEPA filter, vane separator.
10. **Burst test**

3. Air Filtration testing companies presentations

U. Simeoni welcomed the representatives of the air filtration independent testing companies who joined the meeting:

- LMS Technologies

- VTT
- Fiatec
- TEXA Engineering

He also relayed the apologies of Blue Heaven Technologies, who couldn't join the meeting due to business reasons but have expressed an interested in the project.
The independent testing companies presented their testing capabilities and methods based on the requirements in the "Water/Salt test procedure". The presentations have been uploaded on the restricted area of the ETN Air Filtration webpage.

It was highlighted that the testing companies have different capabilities, using different methods, each one with some pros and cons to be considered for the new method to be developed. Nevertheless none of the companies have been evaluating the aging effect on the filters nor reproducing the same environment requirements discussed within our WG.

Since different test rigs were presented, A. Straver asked if the test loop must be an agreed standard test loop.

In order to do this it was underlined that the WG should agree on the elements to be contained in the test loop and the environment conditions to be reproduced. With regards to the shape, it would be important to reproduce the V shape considered in the GE test method, if it is not proprietary information.

The testing companies expressed their interest cooperating in the draft of the new testing method.

It was agreed that the ETN Working Group should first define the requirements of the testing method and in a later stage maybe do a consultation with the testing companies.

4. Discussion on Water/Salt test procedure

On 12th of April the outcome of the previous days meeting, with the testing companies, was discussed among the ETN WG members.

U. Johansson explained the approaches currently used by the ISO committee when drafting a new standard:

1. To specify all the components of test rig, at screw level.
2. To specify the test procedure which would allow to generate more operational data.

S. Taylor proposed to specify in the standard only the critical portion of the test rig and focus on the test procedure.

U. Johansson suggested starting the discussion on the Water/Salt procedure from the qualification of the spray. M. Tappani stated that also the cycle is a critical element to be considered. D. Orhon added that the measurement methods should be all equal; otherwise the results wouldn't be comparable. He also proposed to create dedicated WGs with maximum 4-5 people on the qualification of the spray, on the measurements methodology and on the cycle.

R. Ringström highlighted that the measurements of the mass is important from the performance perspective particle counting.
G. Marchetti stated that the maximum average mass of salt and the maximum mass of salt should be defined. He proposed the following alternatives to qualify the spray:

- To define and control the aerosol downstream
- To fix the distribution range
- To define the aerosol to be used
- To couple the definition of aerosol with measurement of mass salt with instrumentation such as a photometer

Two different approaches could be taken:

1. Start from acceptance criteria and go backward.
2. Start from the results.

U. Johansson proposed to generate a synthetic aerosol (DEHS) to measure the efficiency by particle size of the filter, as presented by TEXA Engineering. He also added that in ISO TC142/WG9 a WG has been formed to work on spray and ETN representatives could join it.

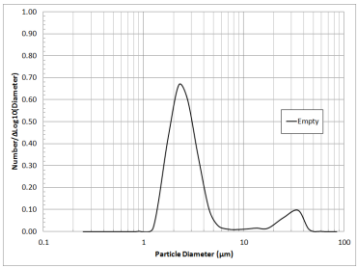
It was also discussed and agreed that the procedure will focus on F7, E12 and E13 filters whatever square, cylindrical or conical. Nevertheless it should be applicable also to other types of filters.

To summarise the discussion, R. Ringström stated that three staring points should be taken into consideration:

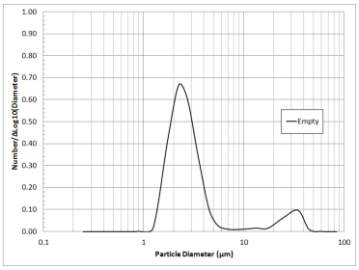
1. Upstream conditions
2. Filters/Measuring
3. Criteria or Grades

The WG should agree from which block to start. G. Marchetti underlined that if the tests are done considering the upstream conditions without the criteria or grades, the outcomes could be not comparable. M. Tappani remarked that the methodology we choose should also work when compared with a baseline.
G. Marchetti explained that a reference measures are needed for the acceptance criteria, expressed in [kg/m^3], for the worst case and for an average case.

$\left[\frac{Kg}{m^3}\right]$ Worst Case → Define → Worst Case Aerosol



$\left[\frac{Kg}{m^3}\right]$ Average Case → Define → Average Case Aerosol



Note: the examples shown here are for illustration purposes only.

Based on these measures the tests should generate an output to be compared with them in order to measure the efficiency.

R. Ringström underlined that it is difficult to measure water droplets and hence difficult to assure the repeatability of the test. For this reason he suggested to define 3 consequential steps:

1st step: Definition of the filter and upstream conditions

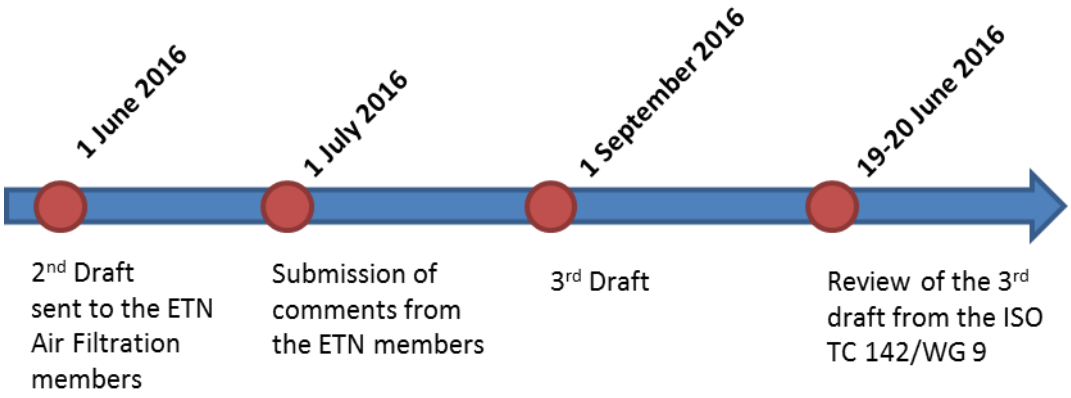
2nd step: Definition of the criteria

3rd step: Definition of the system approach for ≥ 2 stage filters

It was agreed to create a sub-WG that will work on a second draft of the "Water/Salt test procedure" following the above mentioned steps. The sub-WG is constituted by the following members:

- S. Taylor (AAF) – WG Leader
- W. Poon (W.L. Gore & Associates)
- R. Ringström (Camfil)
- M. Garnett (Freudenberg)
- D. Orhon (Total)

The sub-WG will follow the below timeline in order to submit a final draft to the attention of the ISO TC142/WG 9 for a first feedback.



5. Review of the comments submitted by the ETN members.

During the meeting, the present ETN Air Filtration members reviewed the summary of comments in the draft standard, item by item.

It was highlighted that pulse jet filters could be present for offshore applications; however they could also be removed from the procedure since cylindrical cartridges as static filters are still part of the scope.

With regards to the airflow limits, it was mentioned that the filters should be tested at the airflow designed and specified by the vendor. A. Straver underlined that the design of the filters should assure minimum 3 years operation (especially for LNG applications). R. Ringström stated that the draft should replicate the airflow range at which currently it is possible to test the filters. It was agreed that the test should be carried out at the recommended operating airflow ± an envelope range (±20%).

Due to lack of times it was agreed that the sub-WG will go through the ETN members' comments while drafting the 2nd draft by the 1st of June 2016.

6. Next meetings

U. Simeoni would send a doodle after the feedback from the ISO TC142/WG in order to set up a meeting to take place in November 2016.

Annex I: Action list

Action Owner	Description	Deadline date
sub-WG members	To send a second draft of the “Water/Salt test procedure”.	1 June 2016
ETN members	To review the second draft of the “Water/Salt test procedure”.	1 July 2016
sub-WG members	To send a third draft of the “Water/Salt test procedure”.	1 September 2016