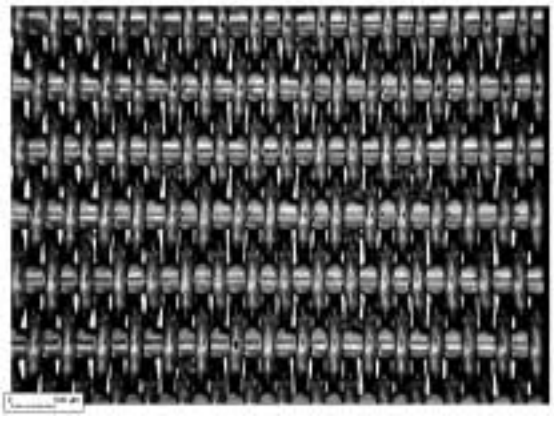
Measuring the Filter Cut Points

of Sand Screens

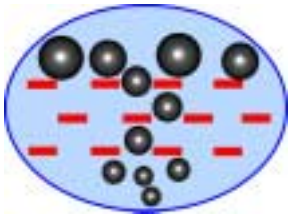
Dr Graham Rideal and Jamie Storey



Summary of the Sonic Challenge test method

1. Scope of the method

The filter cut point of a sand screen is measured by challenging the mesh with accurately measured glass microspheres using a Sonic filter tester, figure 1. From the percentage of the glass beads passing, the cut point is determined using a calibration graph accompanying the filter standard, figure 2.
20 narrow particle size distribution standards enable cut points from 16 – 700 microns to be measured with micron precision and repeatability, table 1.



Challenge test principle

Table 1. Band Widths of Filter Standards (µm)

16-25	20-34	26-36	31-46	36-55
45-62	53-73	63-86	75-103	80-123
106-147	127-175	151-209	180-248	214-295
252-346	304-417	360-498	383-591	484-700

Figure 1. Sonic filter tester and sample holders

2. Certifying the glass microspheres

High precision Electroformed sieves were used to measure the particle size distributions of the glass microspheres. The measurements were traceable to the National Institute of Standards and Technology (NIST).

A calibration graph was then constructed where the weight percent passing an unknown mesh could be used to determine its cut point, figure 2. Because the size distributions were so narrow, resolutions down to 1 micron are possible.

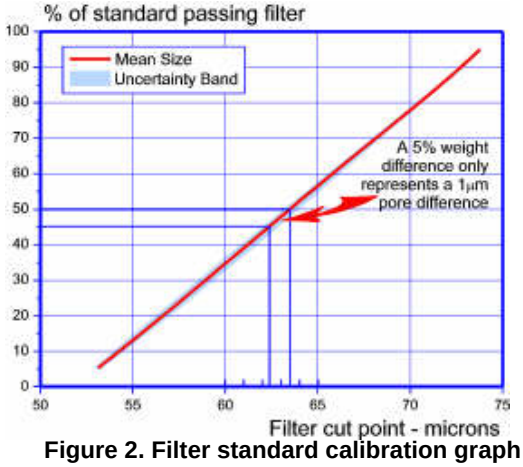


Figure 2. Filter standard calibration graph

3. Challenge Test Apparatus

The Sonic filter tester generates a high velocity air current, which oscillates at 50Hz backwards and forwards through the filter under test. The process fluidizes the glass beads on the surface of the mesh and takes about 1 minute to reach the end point - the time at which there is no further change in the cut point.

4. Filter cut point and maximum pore size

Analysis of the microspheres passing a mesh, figure 3 shows that the cut point is very close to the 97th percentile of the maximum pore size.

The 100% (maximum particle size passing) has been shown to contain beads up to 10% bigger than the D97% (cut point). However, the maximum pore size is statistically difficult to measure because there are so few pores available for penetration by the beads. A good approximation has been found to be:

Maximum pore size = filter cut point + 10%

This relationship has been confirmed using single size glass beads. Beads 10% greater than the cut point do not pass the mesh.

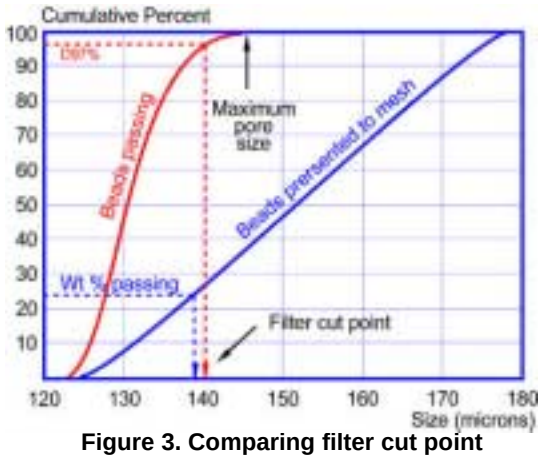


Figure 3. Comparing filter cut point with the beads passing a mesh

Repeatability measurements in sand screen testing

1. Sample repeatability

Provided the beads from the previous test have been removed, usually by tapping the inverted sieve in its holder, repeated analysis of the same mesh should give results within a few percent.

Figure 4. Close proximity testing

3. Close proximity testing

The next stage in the repeatability analysis is to examine meshes in close proximity, figure 4. This determines the uniformity of the weaving in a confined area. In a good weaving process, the cut points again should not vary by more than a few percent.

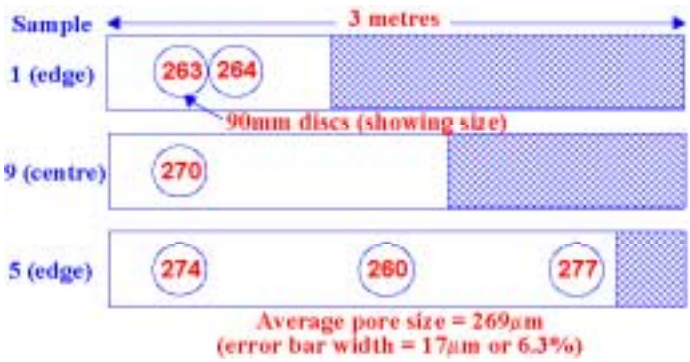


Figure 5. Measuring the uniformity of weaving

4. Checking the consistency of weaving

Having established the repeatability of the method, variations in the pore size across and down the length of a roll of mesh can be determined, figure 5. The maximum variation on the roll examined was found to be approximately 6%.

5. Measuring roll-to-roll variations in cut points

Once the confidence levels have been established for both the sonic tester and the weaving process, roll-to-roll comparisons can be made with confidence. Table 2 shows an overall uncertainty of less than 5% in the analysis of 25 rolls of mesh of three different nominal sizes.

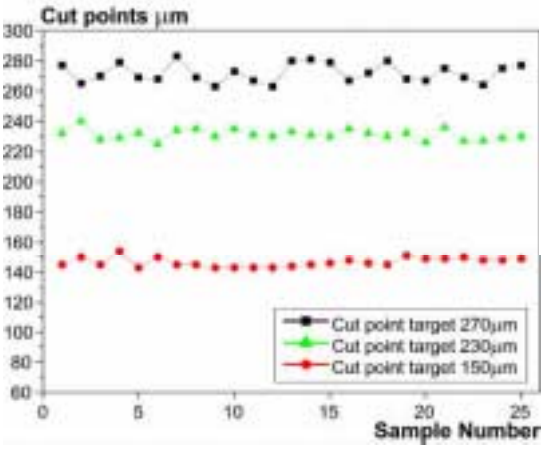


Figure 6. Measuring roll-to-roll variations

Table 2. Analysis of 25 rolls of sand screen		
Target Cut point µm	**Range µm**	**Final Size µm**
270	263 – 283	272 +/-4.6%
230	225 – 240	231 +/-2.9%
150	143 – 154	147 +/-4.1%

6. Testing the final sand screen

In the final analysis, the sand screen must perform underground.

The last test involves taking and analyzing 90mm discs from the sand screen element, figure 7. The results in table 3 show remarkable consistency.

Table 3. Testing a sand screen element

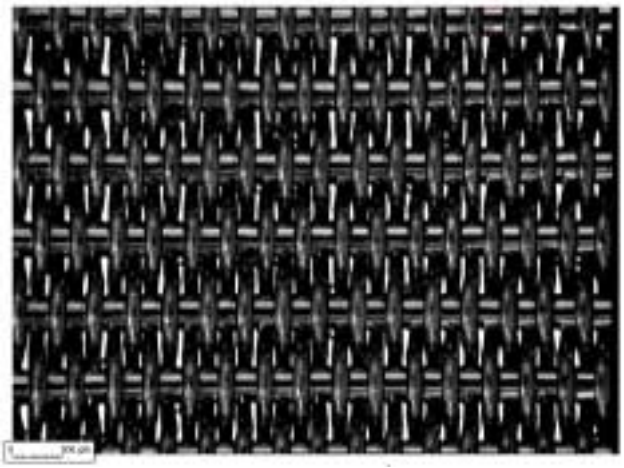
Sample #	1	2	3	4	5	6
% passing	127	128	127	131	126	128
Cut point	138	139	138	140	138	139
Filter standard used 127-175 microns						

Figure 7. Sand screens – the final analysis

Whitehouse Scientific

Dr G Rideal and J Storey 1st December 2007

Sample 1



Filter cut point = 102µm

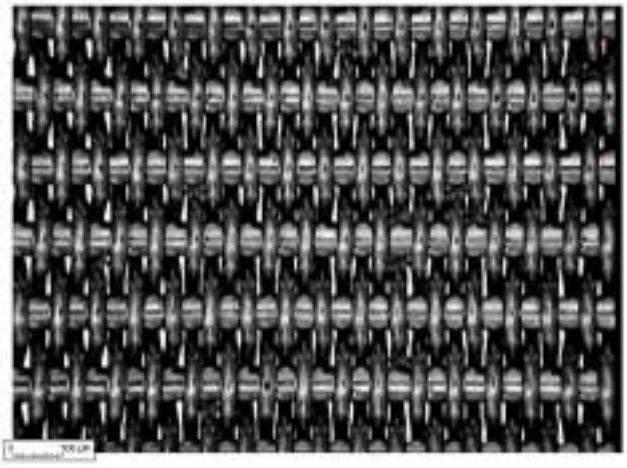
Sample 2

Filter cut point = 164µm

Sample 3

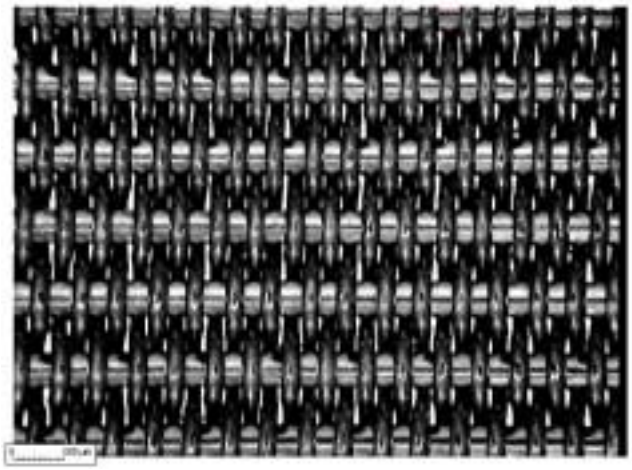
Filter cut point = 138µm

Sample 4



Filter cut point = 105µm

Sample 5



Filter cut point = 105µm

Example of a Test Certificate

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Certificate of Analysis

SAND SCREEN PORE SIZE MEASUREMENT

1. Filter Reference: Sample 1

2. Client: [redacted]

Calibration Method:

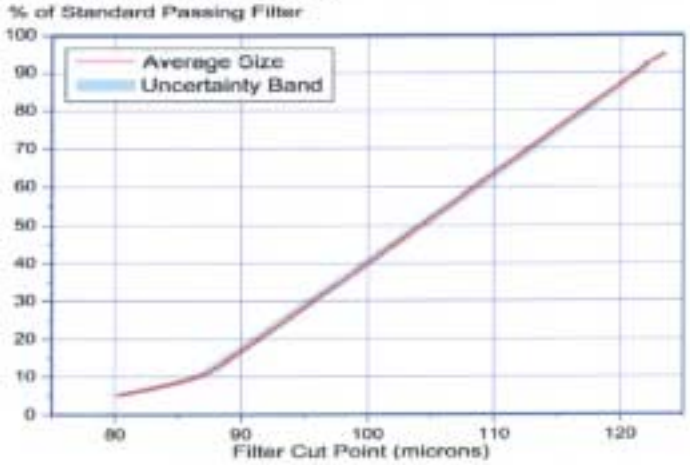
Clamp a disc of the filter to be tested in the Perspex filter holder of the Automatic Sonic Filter Tester. Tare and add approximately 0.3g of the calibrating microspheres. Record the weight of microspheres before transferring to the test machine. Run under the conditions specified below and reweigh to calculate the percentage of microspheres passing the filter. From the percentage passing, use the graph or equation below to determine the cut point (pore size[1]) of the filter under test.

3. Test Conditions

a) Microsphere Size Range: 80 – 123 µm

b) Filter Tester Settings: ramp up time 0.1 minute, amplitude 30, run time 1 minute, ramp down 0.1min

4. Microsphere Calibration Graph:



5. Microsphere Calibration Equation:

Filter Cut Point = $82.82 + 0.431\ X - 0.000277\ X^2 + 0.0000279\ X^3$ where X = % passing

6. Analysis Results:

Initial Wt: 0.293g, Wt Passing: 0.127g, Percent Passing: 43%, **Filter Cut Point[1]: 102µm**

Issued by: Dr G R Rideal – Senior Analyst

Notes:
1. Filter cut point is defined as the size above which there is a better than 97% chance of particle capture.
2. Fleabrum pore size. For Dutch weave sand screens this has been shown to be about 10% above the cut point. See web site www.whitehousescientific.com.
3. The electroformed sieves used to measure the particle size of the microspheres were calibrated by optical microscopy using reference graticules from NIST (825/263573-00) and NPL (DBA08/870127/S06-66). For full details of see web site www.whitehousescientific.com.
4. Whitehouse Scientific Ltd does not accept responsibility for losses, financial or otherwise which may occur as a result of the interpretation or use of the information contained within the certificate.
5. Whitehouse Scientific is the leading European particle size certification laboratory for the Community Bureau of Reference (BCR), Brussels (Laboratory Reref. – August 1995).

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