



Scanning Electron Microscopy Scheme

BACKGROUND

This report covers Round 11B of the SEMS asbestos fibre counting PT scheme. The scheme is operated by HSE, in collaboration with APC, Germany and TNO, Netherlands.

SAMPLES

Four samples were circulated representing a range of different fibre densities and fibre types. All samples were produced at HSE using the modified sputnik multi-port sampling instrument.

INTRODUCTION

A total of 39 laboratories participated in this round (including the validating laboratories). Laboratories were able to submit up to three results per sample and many laboratories took advantage of this with a total of 278 results submitted.

The samples were as follows:

11BSEM1 – High density (67.0 fibres/mm²) - amosite fibres

11BSEM2 – Medium density (50.0 fibres/mm²) - amosite fibres

11BSEM3 – No asbestos added (0.0 fibres/mm²) - MMMF fibres present

11BSEM4 – Medium density (17.9 fibres/mm²) - chrysotile fibres

INFORMATION SUBMITTED BY LABORATORIES

Laboratories were asked to supply the following information:

- Number of fibres >5µm in length counted (amphibole, chrysotile & other inorganic)
- The number of fields of view searched
- The area of the field of view
- The magnification and the method used

Laboratories were asked to calculate the fibre density (in fibres/mm²) for each fibre type identified.

LABORATORY ASSESSMENT

RESULTS

Calculations – No errors were identified in this round.

Screen area – The fibre densities submitted by laboratories have not been recalculated and the density calculation and therefore screen area has not been verified.

Magnification – As was the case in earlier rounds, some laboratories used an operating magnification outside the range defined in ISO 14966 (or VDI 3492).

Magnifications ranging from 1000x to 4000x were recorded.

Results for total asbestos fibre densities for each laboratory are summarised in Appendix 1.

Data Analysis

Data analysis is based upon the total asbestos fibre densities (amphibole & chrysotile) derived from fibre numbers counted and the area of the filter searched. The distribution of fibres on a filter derived from airborne sampling is normally described as being Poisson-distributed. For Poisson-distributed counts, the variance (standard deviation squared) is equal to the mean. However, in practice the variation may be larger due to differences in sample production, laboratories and individual microscopists.

A comparison of the observed standard deviations with the expected standard deviations (expected under Poisson distribution) show that the observed variation is larger than that expected, and it is difficult to quantify how much of this may be due to differences in sample production, and how much is due to differences between labs/microscopists.

For this report, the data have been compared against the criteria used in the UK phase contrast fibre counting proficiency testing scheme RICE. Details of the analysis used can be found in Appendix 2.

Round 11B Overview

Summary statistics from this round of results are displayed in Table 1. Below this, Figure 1 displays the percentage of participants in each scoring band (as per the RICE scoring system). Figures 2 and 3 show the band scored by participants divided according to magnification and method used respectively.

Table 1: Summary statistics for results received in SEMS Round 11B

	Sample 1	Sample 2	Sample 3	Sample 4
Number of results	69	69	69	71
Median (fibres/mm²)	67.0	50.0	0.0	17.9
25th percentile (fibres/mm²)	51.0	42.9	0.0	11.6
75th percentile (fibres/mm²)	83.0	65.0	0.0	28.8
Interquartile range (fibres/mm²)	32.0	22.1	0.0	17.3
Mean (fibres/mm²)	67.6	52.7	1.4	20.0
Standard deviation (fibres/mm²)	21.6	16.3	8.7	11.9
Relative standard deviation (%)	31.9	30.8	615	59.6

*Note: The relative standard deviation (RSD) is calculated by (standard deviation/mean)*100%. This statistic illustrates the variation relative to the size of the mean value. For very low values of the mean, the value of the RSD can be considered largely meaningless.*

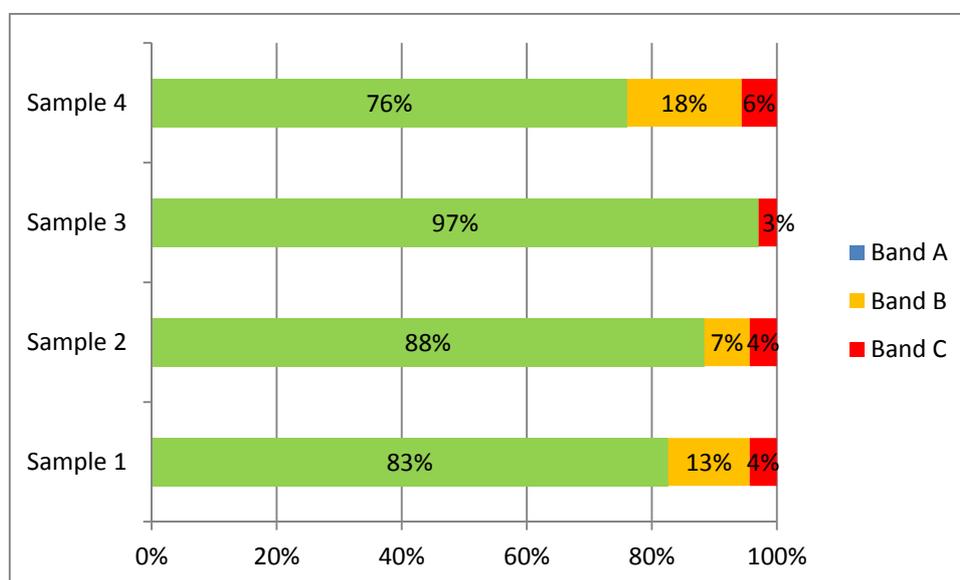


Figure 1: Banded scores for participants in SEMS Round 11B (categorised as per RICE scoring system - see Appendix 2)

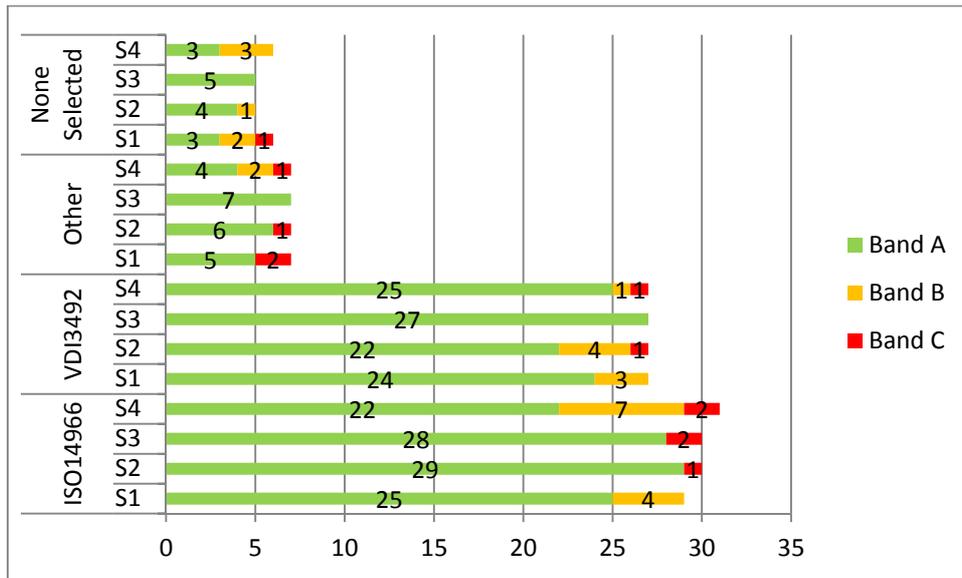


Figure 2: Banded scores for participants in SEMS Round 11B divided according to method used

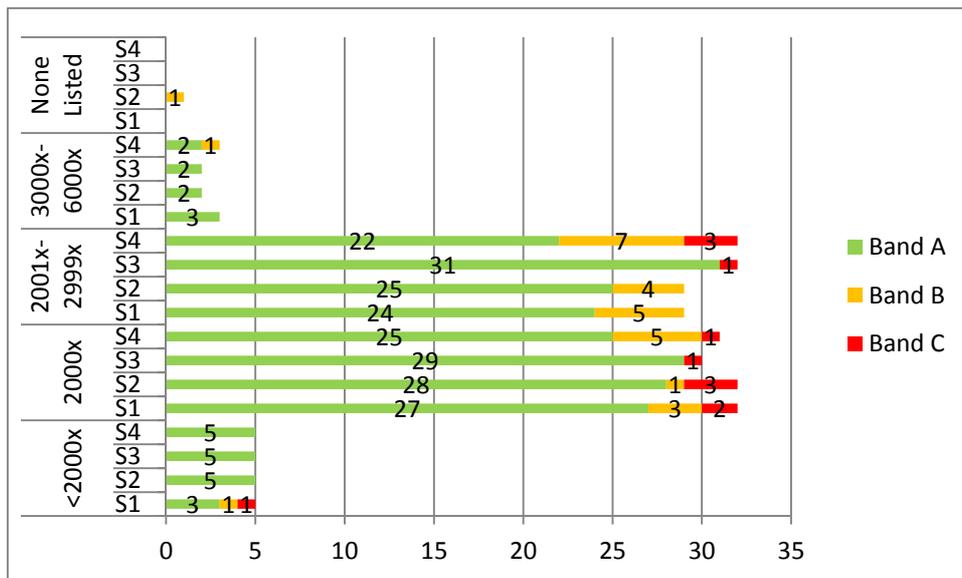


Figure 3: Banded scores for participants in SEMS Round 11B divided according to magnification use

APPENDIX 1

Sample 1 (11BSEM1) - High density (67.0 fibres/mm²) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
1277	85.2	A
1445	66	A
1445	68	A
1458	56.3	A
1458	49.5	A
1458	45.2	A
1737	19.1	C
1738	67.28	A
1745	45.8	A
1759	64.69	A
1759	73.11	A
1759	76.07	A
1761	70	A
1761	45	A
1761	65	A
1764	50.5	A
1764	50.5	A
1767	68.78	A
1767	47.27	A
1767	112.55	B
1768	76.75	A
1768	72.81	A
1768	65.35	A
1774	72	A
1784	74	A
1812	51	A
1812	51.5	A
1812	48.5	A
1813	89	A
1813	92.3	A
1813	72.5	A
1814	93.9	A
1827	34	B
1831	63.3	A
1831	42.8	B
1831	39.7	B
1832	52	A
1836	114.64	B
1838	67	A
1838	58	A
1838	57	A
1848	86.3	A

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1848	110.3	B
1852	74	A
1860	108.5	B
1866	85.8	A
1866	94.1	A
1877	31	C
1885	83	A
1885	90	A
1885	83	A
1888	29	C
1889	56.2	A
1889	52.2	A
1889	41.8	B
1892	97	A
1892	101	A
1894	89.1089	A
1903	56	A
1903	61	A
1922	76.6	A
1922	101.6	A
2085	42	B
2251	78.5	A
2254	82.96	A
2259	50.53	A
2259	51.02	A
2269	52.7	A
2272	86.4	A

Mean 67.6
 Median (Ref) 67.0
 STDev 21.6
 Min 19.1
 Max 114.6

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
43.6	103.9	33.5	134	<33.5	>134

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Sample 2 (11BSEM2) - Medium density (50.0 fibres/mm²) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
1277	33.3	A
1445	65	A
1445	54	A
1458	39.9	A
1458	66.8	A
1458	48.6	A
1737	8.9	C
1738	60.04	A
1745	39.6	A
1759	58.97	A
1759	52.99	A
1759	50	A
1761	49	A
1761	47	A
1761	21	C
1764	66	A
1764	71.5	A
1767	42.93	A
1767	44.55	A
1767	48.24	A
1768	34.21	A
1768	37.5	A
1768	31.14	A
1774	45	A
1784	42	A
1812	50	A
1812	51.5	A
1812	48.5	A
1813	71.7	A
1813	74.2	A
1813	58.1	A
1814	57.1	A
1827	20	C
1831	47.5	A
1831	45.5	A
1831	35.9	A
1832	47	A
1836	83.74	B
1838	67	A
1838	70	A
1838	76	A
1848	57.4	A

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1848	58.8	A
1852	62	A
1860	53.8	A
1866	50.8	A
1866	56.9	A
1877	43.9	A
1885	87	B
1885	87	B
1885	93	B
1888	27	B
1889	70.7	A
1889	71.2	A
1889	65.7	A
1892	41.5	A
1892	40	A
1894	43.5644	A
1903	49	A
1903	46.5	A
1922	58.9	A
1922	51.5	A
2085	35.5	A
2251	68.3	A
2254	75.55	A
2259	42.27	A
2259	47.13	A
2269	41.7	A
2272	48.2	A

Mean 52.7
 Median (Ref) 50.0
 STDev 16.3
 Min 8.9
 Max 93.0

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
30.3	81.6	22.4	107.6	<22.4	>107.6

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Sample 3 (11BSEM3) – No asbestos added (0.0 fibres/mm²) – MMMF fibres present

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
1277	0	A
1445	0	A
1445	0	A
1458	0	A
1458	0	A
1458	0	A
1737	0	A
1738	0	A
1745	0	A
1759	0	A
1759	0	A
1759	0	A
1761	0	A
1761	0	A
1761	0	A
1764	0	A
1764	0	A
1767	0	A
1767	0	A
1767	0	A
1768	0	A
1768	0	A
1768	0	A
1774	0	A
1784	0	A
1812	0	A
1812	0	A
1812	0	A
1813	0	A
1813	0	A
1813	0	A
1814	0	A
1827	0	A
1831	0	A
1831	0	A
1831	0	A
1832	0	A
1836	0	A
1838	0	A
1838	0	A
1838	0	A
1848	0	A

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1848	0	A
1852	24	C
1860	0	A
1866	0	A
1866	0	A
1877	0	A
1885	1	A
1885	1	A
1885	3	A
1888	0	A
1889	0	A
1889	0	A
1889	0	A
1892	0	A
1892	0	A
1894	0	A
1903	0	A
1922	0	A
1922	0	A
2085	0	A
2251	68.3	C
2254	0	A
2259	0	A
2259	0	A
2259	0	A
2269	0	A
2272	0	A

Mean 1.4
 Median
 (Ref) 0.0
 STDev 8.7
 Min 0.0
 Max 68.3

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
0	3.8	0	10.9	<0	>10.9

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Sample 4 (11BSEM4) - Medium density (17.9 fibres/mm²) - chrysotile fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
1277	4.2	B
1445	30	A
1445	28	A
1458	7.7	A
1458	8.2	A
1458	9.6	A
1737	4.3	B
1738	12.53	A
1745	4.9	B
1759	21.79	A
1759	18.8	A
1759	17.52	A
1761	24	A
1761	23	A
1761	39	B
1764	33	A
1764	29	A
1767	35.45	A
1767	15.45	A
1767	5.19	B
1768	10.09	A
1768	10.09	A
1768	6.14	B
1774	29	A
1784	13	A
1812	12	A
1812	13	A
1812	16	A
1813	31	A
1813	38.7	B
1813	46.5	B
1814	33.2	A
1827	20	A
1831	14.4	A
1831	17.1	A
1831	11.8	A
1832	0	C
1836	17.94	A
1838	16	A
1838	16	A
1838	17	A
1848	15.4	A

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1848	18.1	A
1852	0	C
1860	11.3	A
1866	39.1	B
1866	40.1	B
1877	34	A
1885	16	A
1885	17	A
1885	15	A
1888	6	B
1889	18.9	A
1889	22.9	A
1889	25.4	A
1892	21.5	A
1892	27	A
1894	18.8119	A
1903	35	A
1903	42	B
1922	28	A
1922	22.6	A
2085	8	A
2251	47.2	B
2254	30.6173	A
2259	36.93	A
2259	28.66	A
2259	27.7	A
2269	8.1	A
2269	0	C
2272	0	C

Mean 20.0
 Median (Ref) 17.9
 STDev 11.9
 Min 0.0
 Max 47.2

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
7.1	38.3	3.6	56.7	<3.6	>56.7

APPENDIX 2

DATA ANALYSIS

Regular Inter-laboratory Counting Exchange (RICE) Criteria

Where R is the reference value – in this case the Median value.

High density samples ($R > 63.7$ fibres/mm²)

Target band A: $> 0.65R$ to $< 1.55R$

Target band B: $> 0.50R$ to $0.65R$ [band -B] and $> 1.55R$ to $2.00R$ [band +B]

Target band C: $< 0.50R$ [band -C] and $> 2.00R$ [band +C]

Low density samples ($R \leq 63.7$ fibres/mm²)*

Target band A: $(\sqrt{R-1.57})^2$ to $(\sqrt{R+1.96})^2$ [band A]

Target band B: $< (\sqrt{R-2.34})^2$ to $(\sqrt{R-1.57})^2$ [band -B]
 $> (\sqrt{R+1.96})^2$ to $(\sqrt{R+3.30})^2$ [band +B]

Target band C: $< (\sqrt{R-2.34})^2$ [band -C]
 $> (\sqrt{R+3.30})^2$ [band +C]

* For samples less than 5.5 fibres/mm² the lower limit is set to zero when the component within the brackets ($\sqrt{R-n}$) is less than zero.

The plot below shows the positions of the performance limits in relation to the reference counts up to reference density 500 fibres/mm².

