Group Report
Round 9A

November 2019

Scanning Electron Microscopy Scheme

BACKGROUND

This report covers Round 9A 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 51 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 366 results submitted.

The samples were as follows:

9ASEM1 – Low density (12.0 fibres/mm^2) - amosite fibres

9ASEM2 – Medium density (49.0 fibres/mm^2) - amosite fibres

9ASEM3 – Medium density (26.5 fibres/mm^2) – amosite fibres

9ASEM4 – Medium density (65.3 fibres/mm^2) – amosite 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/mm^2) 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 of 4000x, 3000x, 2000x and 1000x 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 9A 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 9A

	Sample 1	Sample 2	Sample 3	Sample 4
Number of results	89	87	88	90
Median (fibres/mm^2)	12.0	49.0	26.5	65.3
25th percentile (fibres/mm^2)	7.5	40.0	21.0	51.3
75th percentile (fibres/mm^2)	15.0	61.0	35.2	82.1
Interquartile range (fibres/mm^2)	7.5	21.0	14.2	30.8
Mean (fibres/mm^2)	12.1	50.0	28.1	66.3
Standard deviation (fibres/mm^2)	6.5	18.6	11.4	28.1
Relative standard deviation (%)	53.6	37.3	40.4	42.4

*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.*

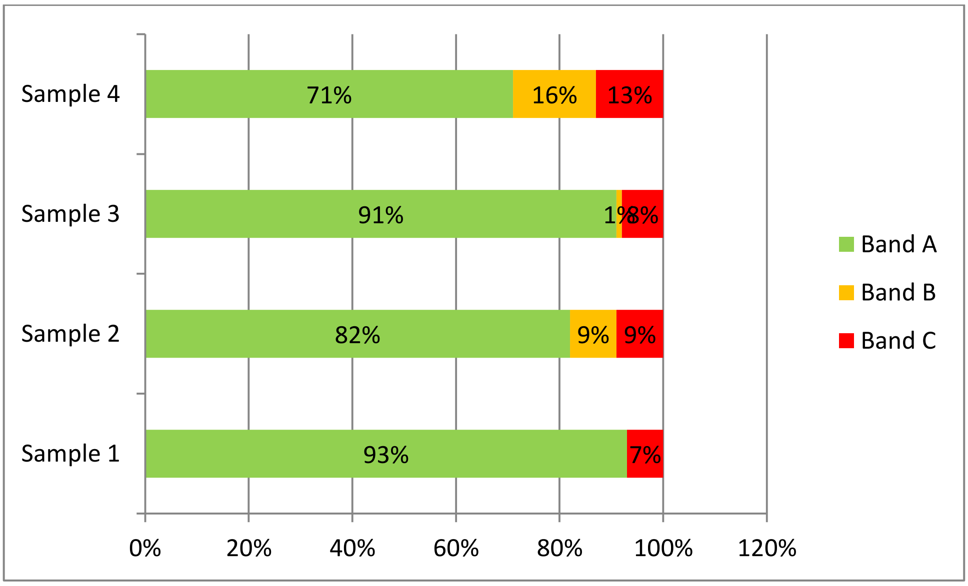


Figure 1: Banded scores for participants in SEMS Round 9A (categorised as per RICE scoring system - see Appendix 2)

Figure 2: Banded scores for participants in SEMS Round 9A divided according to method used

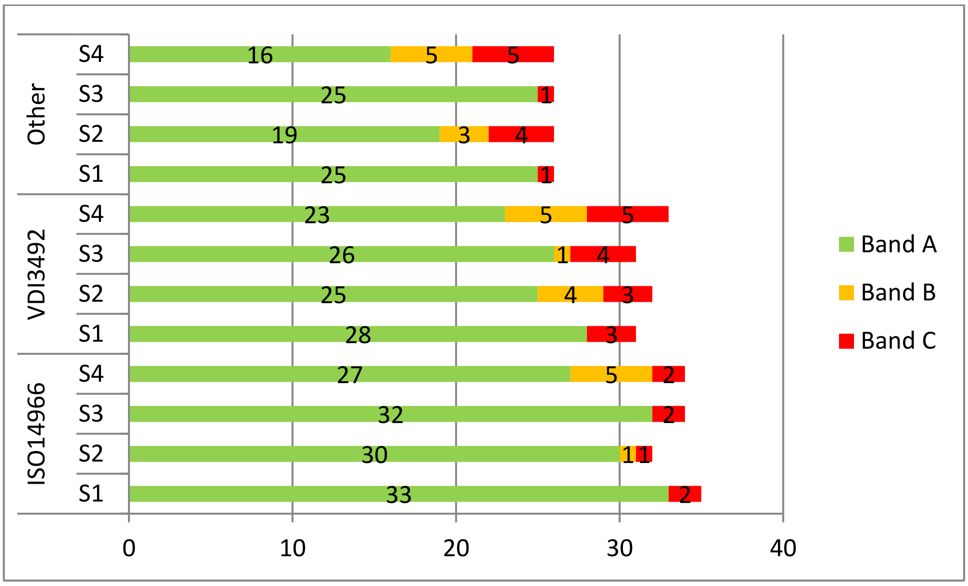
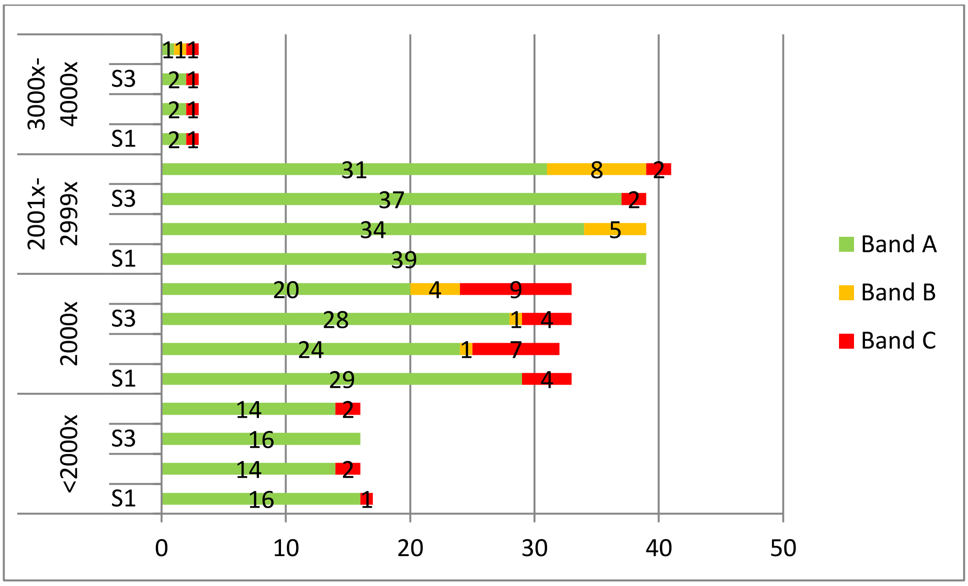


Figure 3: Banded scores for participants in SEMS Round 9A divided according to magnification use



APPENDIX 1

Sample 1 (9ASEM1) - Low density (12.0 fibres/mm^2) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
1277	6.7	A
1277	12.5	A
1620	12.5	A
1620	8.0	A
1620	28.5	A
1836	7.0	A
1848	16.7	A
1848	10.4	A
1860	0.0	C
1866	14.5	A
1866	8.9	A
1868	13.6	A
1868	10.0	A
1877	7.0	A
1879	6.1	A
1879	7.2	A
1884	4442.0	C
1884	4810.0	C
1884	2627.0	C
1885	10.0	A
1885	12.0	A
1885	14.0	A
1889	13.9	A
1889	9.0	A
1903	10.0	A
1903	19.5	A
1922	12.3	A
1922	12.8	A
1922	19.6	A
1923	16.0	A
1923	19.2	A
1928	7.4	A
1928	6.0	A
1928	6.7	A
1936	9.0	A
1936	8.0	A
1937	10.5	A
1937	7.6	A
1937	4.8	A
1938	13.0	A
1939	8.5	A
1939	12.0	A

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1948	6.9	A
1958	16.5	A
1968	15.0	A
1976	17.0	A
1976	15.0	A
1977	8.2	A
1984	13.3	A
1992	18.0	A
1992	18.0	A
1993	8.0	A
1993	19.0	A
1993	13.0	A
2020	5.3	A
2020	4.7	A
2020	6.0	A
2022	24.0	A
2023	19.0	A
2023	12.6	A
2023	47.5	C
2026	23.2	A
2032	4.0	A
2037	6.3	A
2037	10.0	A
2037	8.9	A
2044	14.9	A
2044	7.5	A
2051	14.3	A
2061	6.4	A
2061	6.4	A
2061	6.4	A
2069	16.0	A
2076	19.0	A
2076	16.0	A
2098	18.5	A
2107	8.0	A
2107	7.0	A
2107	9.0	A
2116	20.0	A
2135	12.0	A
2135	16.0	A
2135	16.0	A
2158	0.0	C
2174	12.0	A
2188	13.0	A
2189	9.7	A
2190	12.5	A

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2192	12.3	A
2192	11.4	A
2195	14.9	A
2196	5.0	A

Mean	12.1
Median (Ref)	12.0
STDev	6.5
Min	0.0
Max	47.5

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
3.6	29.4	1.3	45.8	<1.3	>45.8

Sample 2 (9ASEM2) - Medium density (49.0 fibres/mm^2) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
1277	66.7	A
1277	71.4	A
1620	80.0	A
1620	50.5	A
1620	98.5	B
1836	25.4	B
1848	65.5	A
1848	47.5	A
1860	2.8	C
1866	70.2	A
1866	60.8	A
1868	59.3	A
1868	44.7	A
1877	44.9	A
1879	39.0	A
1879	40.7	A
1884	12216.0	C
1884	9250.0	C
1884	9757.0	C
1885	64.0	A
1885	67.0	A
1885	80.0	A
1889	78.6	A
1889	53.7	A
1903	50.0	A
1903	44.0	A
1922	58.9	A

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1922	51.1	A
1922	82.5	B
1923	81.9	B
1923	79.8	A
1928	38.2	A
1928	40.2	A
1928	39.6	A
1936	50.9	A
1936	52.9	A
1937	41.9	A
1937	46.2	A
1937	45.7	A
1938	68.0	A
1938	30.0	A
1939	49.0	A
1939	38.0	A
1948	35.4	A
1958	66.7	A
1968	85.0	B
1976	51.0	A
1976	50.0	A
1977	44.9	A
1984	35.4	A
1992	46.0	A
1992	49.0	A
1993	54.0	A
1993	78.0	A
1993	38.0	A
2020	13.9	C
2020	13.9	C
2020	10.4	C
2022	67.0	A
2023	50.3	A
2026	61.1	A
2032	28.0	B
2037	28.1	B
2037	52.1	A
2037	41.1	A
2044	40.0	A
2044	40.0	A
2051	48.2	A
2061	47.9	A
2061	52.4	A
2061	50.4	A
2069	44.0	A
2076	75.0	A

2098	53.0	A
2107	37.0	A
2107	40.0	A
2107	32.0	A
2116	60.0	A
2135	39.0	A
2135	47.0	A
2135	45.0	A
2158	0.1	C
2174	80.0	A
2188	33.0	A
2189	24.2	B
2190	73.8	A
2192	50.2	A
2192	45.5	A
2195	41.8	A
2196	51.6	A

Mean	50.0
Median (Ref)	49.0
STDev	18.6
Min	0.1
Max	98.5

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
29.5	**80.3**	**21.7**	**106.1**	**<21.7**	**>106.1**

Sample 3 (9ASEM3) - Medium density (26.5 fibres/mm^2) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
1277	25.0	A
1277	26.7	A
1620	21.0	A
1620	31.0	A
1620	38.5	A
1836	7.5	C
1848	39.8	A
1848	30.7	A
1860	1.9	C
1866	26.2	A

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1866	30.0	A
1868	30.0	A
1868	32.1	A
1877	13.0	A
1879	16.7	A
1879	19.5	A
1884	4072.0	C
1884	4442.0	C
1884	7505.0	C
1885	37.0	A
1885	40.0	A
1885	39.0	A
1889	39.8	A
1889	19.9	A
1903	42.0	A
1903	32.0	A
1922	27.5	A
1922	29.0	A
1922	37.3	A
1923	31.9	A
1923	41.5	A
1928	22.8	A
1928	22.1	A
1928	21.5	A
1936	37.5	A
1936	40.0	A
1937	21.0	A
1937	26.2	A
1937	12.9	A
1938	42.0	A
1939	29.5	A
1939	26.0	A
1948	19.2	A
1958	30.6	A
1968	38.0	A
1976	34.0	A
1976	28.0	A
1977	81.6	C
1984	20.4	A
1992	17.0	A
1992	15.0	A
1993	20.0	A
1993	40.0	A
1993	24.0	A
2020	24.9	A
2020	35.3	A

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2020	25.8	A
2022	34.0	A
2023	35.1	A
2023	21.5	A
2026	46.8	A
2032	19.0	A
2037	23.3	A
2037	16.7	A
2037	20.8	A
2044	20.5	A
2044	18.6	A
2051	23.2	A
2061	23.7	A
2061	27.7	A
2061	22.2	A
2069	29.0	A
2076	25.0	A
2076	28.0	A
2098	38.0	A
2107	30.0	A
2107	21.0	A
2107	23.0	A
2116	29.0	A
2135	35.0	A
2135	24.0	A
2135	36.0	A
2158	0.1	C
2174	38.5	A
2188	25.0	A
2189	14.5	A
2190	59.0	B
2192	23.7	A
2192	21.8	A
2195	16.7	A
2196	44.0	A

Mean	28.1
Median (Ref)	26.5
STDev	11.4
Min	0.1
Max	81.6

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
12.8	50.5	7.9	71.4	<7.9	>71.4

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Sample 4 (9ASEM4) - Medium density (65.3 fibres/mm^2) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
1277	79.0	A
1277	74.6	A
1620	65.5	A
1620	128.5	B
1620	65.0	A
1836	33.4	B
1848	104.0	B
1848	82.3	A
1860	14.2	C
1866	91.7	A
1866	82.4	A
1868	66.5	A
1868	68.2	A
1877	59.9	A
1879	57.9	A
1879	61.8	A
1884	13326.0	C
1884	9250.0	C
1884	15385.0	C
1885	104.0	B
1885	88.0	A
1885	72.0	A
1889	87.6	A
1889	81.6	A
1903	61.0	A
1903	54.0	A
1903	51.0	A
1922	57.4	A
1922	72.2	A
1922	92.3	A
1923	109.6	B
1923	106.4	B
1928	51.6	A
1928	53.6	A
1928	50.3	A
1936	0.0	C
1936	0.0	C
1937	56.2	A
1937	43.3	A
1937	62.9	A
1938	62.0	A

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1938	27.0	C
1939	64.0	A
1939	40.5	B
1948	41.5	B
1958	85.9	A
1968	74.0	A
1976	70.0	A
1976	67.0	A
1977	93.9	A
1984	73.4	A
1992	62.0	A
1992	66.0	A
1993	55.0	A
1993	68.0	A
1993	46.0	A
2020	60.0	A
2020	65.0	A
2020	44.7	A
2022	74.0	A
2023	65.5	A
2023	59.2	A
2026	74.9	A
2032	51.0	A
2037	22.9	C
2037	38.9	B
2037	73.3	A
2044	51.2	A
2044	59.6	A
2051	42.9	A
2061	66.2	A
2061	69.6	A
2061	60.8	A
2069	88.0	A
2076	73.0	A
2076	86.0	A
2098	79.5	A
2107	39.0	B
2107	34.0	B
2107	44.0	A
2116	108.0	B
2135	118.0	B
2135	112.0	B
2135	87.0	A
2158	0.1	C
2174	88.0	A
2188	59.0	A

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2189	16.5	C
2190	175.2	C
2192	107.1	B
2192	93.8	A
2195	63.1	A
2196	31.7	C

Mean	66.3
Median (Ref)	65.3
STDev	28.1
Min	0.0
Max	175.2

RICE A (Lower)	**RICE A (Upper)**	**RICE B (Lower)**	**RICE B (Upper)**	**RICE C (Lower)**	**RICE C (Upper)**
42.4	**101.2**	**32.7**	**130.6**	**<32.7**	**>130.6**

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/mm^2)

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. mm^{-2})*

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/mm^2 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/mm^2.