



Scanning Electron Microscopy Scheme

BACKGROUND

This report covers Round 13A 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 37 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 233 results submitted.

The samples were as follows:

13ASEM1 – Low density (0 fibres/mm²) – no asbestos (MMMMF fibres present)

13ASEM2 – High density (58.9 fibres/mm²) - amosite fibres

13ASEM3 – Medium density (23.1 fibres/mm²) – amosite fibres

13ASEM4 – High density (94.6 fibres/mm²) – 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/mm²) for each fibre type identified. There was also an option to include the number of fibres ≤5µm in length.

LABORATORY ASSESSMENT

RESULTS

Calculations – Participants are responsible for carrying out and submitting the results of their own calculations of fibre density. These density calculations are not verified by HSE when the round results are calculated. However, it seems likely from inspection of the data that fibre density calculation errors have occurred on multiple occasions in this round.

Screen area – Although the submitted screen area is not used by HSE to verify density calculations (and therefore this will not necessarily affect participant results), we have noted that several participants have erroneously been recording the “screen area” as the total area counted (i.e. 1mm²). We would like to remind participants that this value should be the area of a single field of view (then multiplied by the number of fields counted to give the total area counted).

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 900x to 4500x were used by participants.

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 13A 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 13A.

	Sample 1	Sample 2	Sample 3	Sample 4
Number of results	59	58	58	58
Median (fibres/mm²)	0	58.9	23.1	94.6
25th percentile (fibres/mm²)	0	48.6	15.8	80.0
75th percentile (fibres/mm²)	0	76.8	28.2	110.7
Interquartile range (fibres/mm²)	0	28.2	12.4	30.7
Mean (fibres/mm²)	1.4	61.9	23.6	89.4
Standard deviation (fibres/mm²)	10.3	25.8	12.1	33.6
Relative standard deviation (%)	749.1	41.6	51.2	37.6

*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 (e.g. Sample 1), the value of the RSD can be considered largely meaningless.*

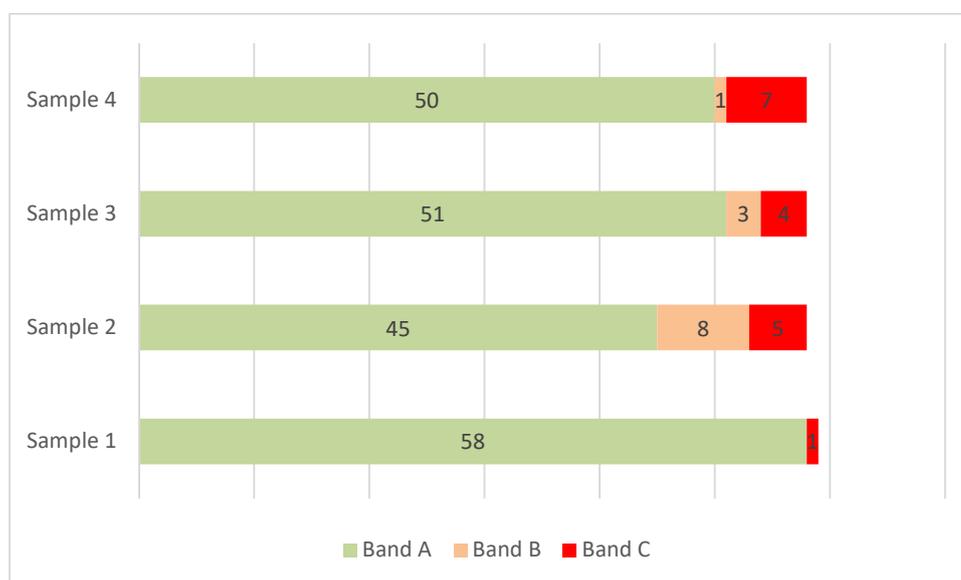


Figure 1: Banded scores for participants in SEMS Round 13A (categorised as per RICE scoring system - see Appendix 2)

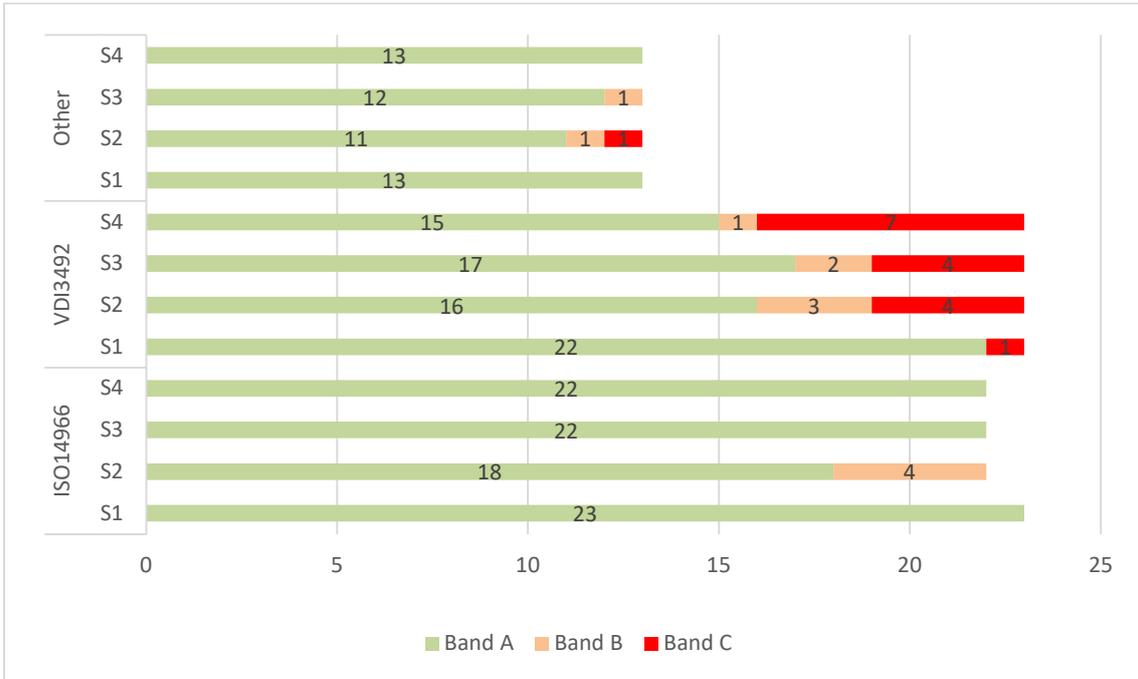


Figure 2: Banded scores for participants in SEMS Round 13A divided according to method used

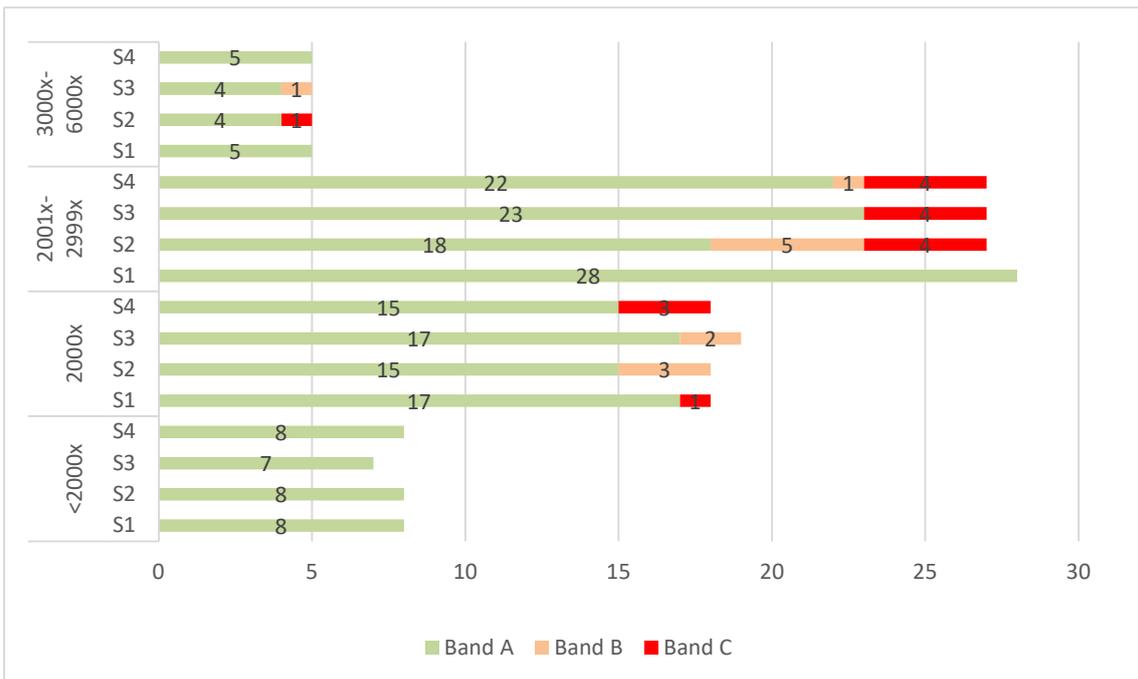


Figure 3: Banded scores for participants in SEMS Round 13A divided according to magnification used

APPENDIX 1

Sample 1 (13ASEM1) - low density (0 fibres/mm²) – no asbestos (MMMMF fibres present)

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
818	0	A
818	0	A
1277	0	A
1445	0	A
1546	0	A
1579	0	A
1579	0	A
1579	0	A
1592	0	A
1620	0	A
1620	0	A
1620	0	A
1658	0	A
1658	0	A
1680	0	A
1680	0	A
1680	0	A
1720	0	A
1738	0	A
1745	0	A
1764	0	A
1764	0	A
1764	0	A
1768	0	A
1768	0	A
1768	0	A
1774	0	A
1831	0	A
1831	0	A
1831	0	A
1860	0	A
1866	0	A
1866	0	A
1866	0	A
1868	0	A
1876	79	C
1877	0	A
1885	0	A
1885	0	A
1938	0	A

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1966	0	A
1977	0	A
2023	0	A
2023	0	A
2023	0	A
2037	0	A
2037	0	A
2037	0	A
2069	2	A
2079	0	A
2085	0	A
2125	0	A
2141	0	A
2174	0	A
2191	0	A
2215	0	A
2289	0	A
2306	0	A
2306	0	A

Mean 1.4
Median (Ref) 0
 STDev 10.3
 Min 0
 Max 79

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 2 (13ASEM2) - High density (58.9 fibres/mm²) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
818	67.41	A
818	125.27	C
1277	90.2	A
1445	69	A
1546	114.5	B
1579	72	A
1579	73	A
1579	74	A
1592	86	A
1620	58.5	A
1620	61	A
1620	94.5	B
1658	41	A
1658	44	A
1680	50	A
1680	59.3	A
1680	60.7	A
1720	67.5	A
1738	57.5	A
1745	74.2	A
1764	1.3	C
1764	1.77	C
1764	1.86	C
1768	44.52	A
1768	45.18	A
1768	56.14	A
1774	93	B
1831	56.8	A
1831	60.7	A
1860	79.29	A
1866	94.8	B
1866	103.2	B
1866	103.2	B
1868	80.2	A
1876	32	B
1877	52.93	A
1885	57	A
1885	58	A
1938	67	A
1966	54.73	A
1977	43.53741	A

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2023	52.79	A
2023	56.37	A
2023	77.78	A
2037	36	B
2037	49	A
2037	77	A
2069	2	C
2079	50	A
2085	48.481	A
2125	90.3	A
2141	56.5	A
2174	65.99	A
2191	44.4	A
2215	90.54	A
2289	76.3	A
2306	44	A
2306	47.5	A

Mean 61.9
Median (Ref) 58.9
 STDev 25.8
 Min 1.3
 Max 125.3

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
37.3	92.8	28.5	120.4	<28.5	>120.4

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Sample 3 (13ASEM3) - Medium density (23.1 fibres/mm²) – amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
818	21.97	A
818	52.69	B
1277	29.2	A
1445	27	A
1546	57.6	B
1579	30	A
1579	32	A
1579	32	A
1592	23	A
1620	20	A
1620	25.5	A
1620	41	A
1658	12	A
1658	13	A
1680	22.3	A
1680	23.3	A
1680	27	A
1720	26	A
1738	28.2	A
1745	14.3	A
1764	0.61	C
1764	0.62	C
1764	0.64	C
1768	18.42	A
1768	24.56	A
1768	27.41	A
1774	33	A
1831	22.9	A
1831	26.2	A
1860	10.85	A
1866	16.7	A
1866	20.5	A
1866	23.2	A
1868	34.5	A
1876	65	B
1877	30.96	A
1885	12	A
1885	15	A
1938	28	A
1966	26.34	A
1977	20.06803	A

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2023	14.32	A
2023	17.9	A
2023	21.91	A
2037	17	A
2037	27	A
2037	34	A
2069	2	C
2079	24	A
2085	20.992	A
2125	39.2	A
2141	15.25	A
2174	26.1	A
2191	21.2	A
2215	30.01	A
2289	15.06	A
2306	14	A
2306	15.5	A

Mean 23.6
Median (Ref) 23.1
 STDev 12.1
 Min 0.61
 Max 65.0

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
10.5	45.8	6.1	65.7	<6.1	>65.7

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Sample 4 (13ASEM4) - High density (94.6 fibres/mm²) – amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
818	91.38	A
818	128.25	A
1277	100	A
1445	108.5	A
1546	124.4	A
1579	115	A
1579	115.5	A
1579	116	A
1592	110	A
1620	89	A
1620	102	A
1620	116	A
1658	45	C
1658	46	C
1680	99.5	A
1680	103.3	A
1680	115.6	A
1720	109	A
1738	95.2	A
1745	63.7	A
1764	1.73	C
1764	2.45	C
1764	2.53	C
1768	82.89	A
1768	110.96	A
1768	111.84	A
1774	109.5	A
1831	76	A
1831	87.3	A
1860	122.23	A
1866	73.5	A
1866	75.3	A
1866	80	A
1868	121.8	A
1876	0	C
1877	112.85	A
1885	80	A
1885	84	A
1938	129	A
1966	108.64	A
1977	100.6803	A

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2023	83.21	A
2023	92.86	A
2023	93.95	A
2037	69	A
2037	100	A
2037	130	A
2069	2	C
2079	75	A
2085	91.398	A
2125	148	B
2141	85.31	A
2174	101.32	A
2191	77.9	A
2215	108.74	A
2289	88.35	A
2306	86	A
2306	88.5	A

Mean 89.4
Median (Ref) 94.6
 STDev 33.6
 Min 0
 Max 148.0

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
61.5	146.6	47.3	189.2	<47.3	>189.2

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 per mm^2 .

