



Scanning Electron Microscopy Scheme

BACKGROUND

This report covers Round 11A 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 38 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:

11ASEM1 – High density (72.7 fibres/mm²) - amosite fibres

11ASEM2 – Medium density (43.2 fibres/mm²) - amosite fibres

11ASEM3 – No asbestos added (0.0 fibres/mm²) – MMMF fibres present

11ASEM4 – Medium density (19.5 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 1100x to 6000x 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 11A 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 11A

	Sample 1	Sample 2	Sample 3	Sample 4
Number of results	70	70	69	69
Median (fibres/mm²)	72.7	43.2	0.0	19.5
25th percentile (fibres/mm²)	59.5	31.6	0.0	12.7
75th percentile (fibres/mm²)	89.3	50.1	1.0	27.0
Interquartile range (fibres/mm²)	30.1	18.5	1.0	14.3
Mean (fibres/mm²)	75.7	41.2	2.2	21.6
Standard deviation (fibres/mm²)	27.0	16.1	7.5	12.4
Relative standard deviation (%)	35.7	39.2	340.6	57.2

*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.*

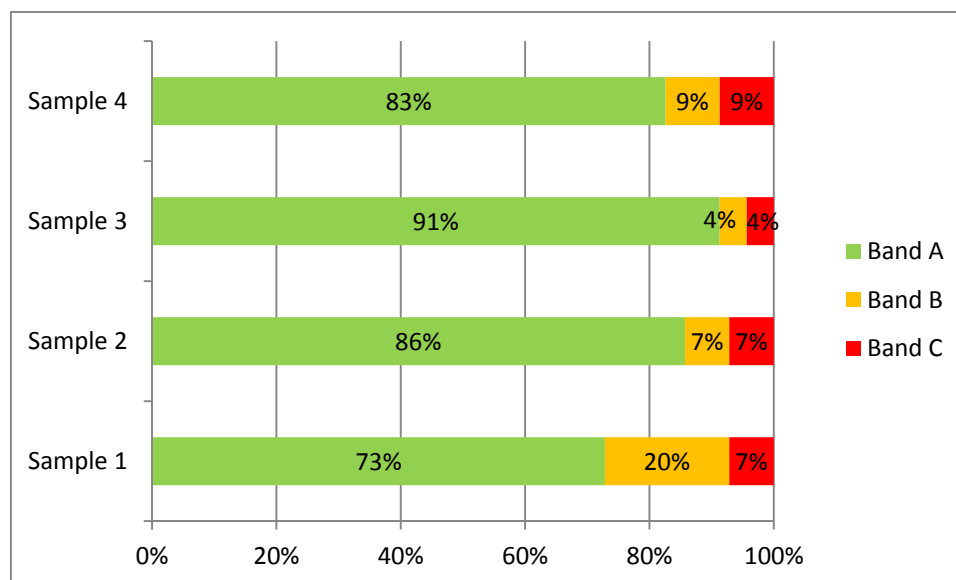


Figure 1: Banded scores for participants in SEMS Round 11A (categorised as per RICE scoring system - see Appendix 2)

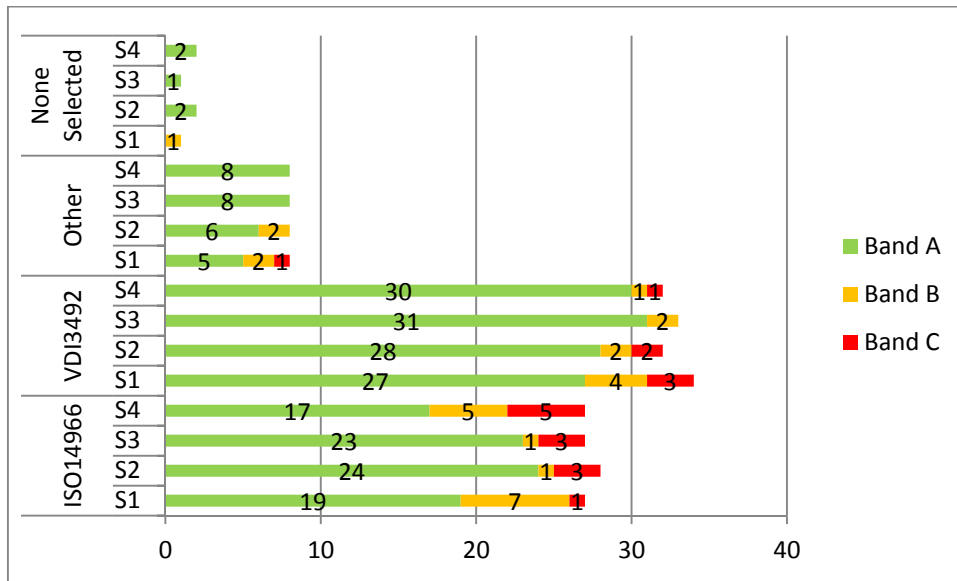


Figure 2: Banded scores for participants in SEMS Round 11A divided according to method used

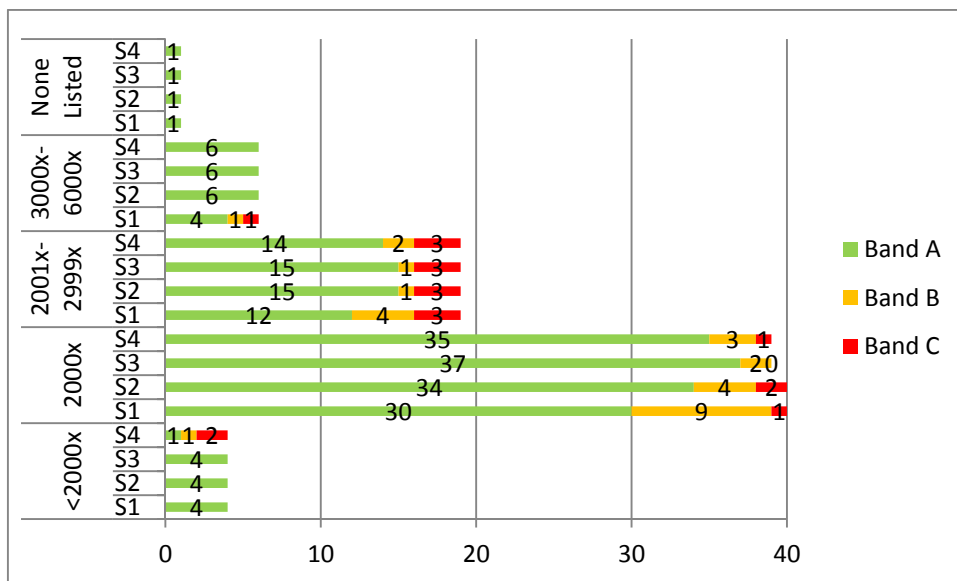


Figure 3: Banded scores for participants in SEMS Round 11A divided according to magnification use

APPENDIX 1

Sample 1 (11ASEM1) - High density (72.7 fibres/mm²) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
7	137.3	B
7	113.4	B
139	68.3	A
139	68.8	A
139	39.5	B
300	53	A
709	89	A
807	85.38	A
807	82.82	A
818	154.86	C
1181	89.37	A
1187	62.06	A
1187	59.81	A
1267	96	A
1267	98	A
1456	63.1	A
1477	72.193	A
1477	83.878	A
1477	85.238	A
1507	79.7	A
1510	72	A
1510	24	C
1546	92.52	A
1562	106.6	A
1562	103.6	A
1562	115.8	B
1569	73	A
1575	38.4	B
1575	21.02	C
1575	32	C
1576	52.38	A
1576	73.33	A
1579	75	A
1579	79.5	A
1579	73.5	A
1582	92.5	A
1592	116	B
1640	71	A
1658	62	A
1658	68	A
1675	75.3	A

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1680	69.1	A
1680	42.3	B
1680	41.5	B
1684	115	B
1708	72.4	A
1708	72.4	A
1708	77.5	A
1715	45.54	B
1716	109	A
1717	54.2	A
1717	56.1	A
1717	34.5	C
1718	79	A
1718	69.5	A
1718	52.5	A
1727	86.22	A
1727	82.24	A
1734	59	A
1734	63	A
1734	43	B
1910	41	B
2023	66.4	A
2023	70.69	A
2023	56.48	A
2207	137.5	B
2215	119	B
2230	94.27	A
2230	106.41	A
2230	80.66	A

Mean	75.7
Median (Ref)	72.7
STDev	27.0
Min	21.0
Max	154.9

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
47.26	112.69	36.35	145.4	<36.35	>145.4

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Sample 2 (11ASEM2) - Medium density (43.2 fibres/mm²) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
7	50.1	A
7	56.4	A
139	31.7	A
139	39	A
300	41	A
709	65	A
807	44.34	A
807	40.26	A
818	58.94	A
1181	50.64	A
1187	29.02	A
1187	49.75	A
1267	50	A
1267	45	A
1456	48.7	A
1477	38.489	A
1477	44.662	A
1477	21.794	B
1507	55.95	A
1510	26	A
1510	17	C
1546	3.57	C
1562	60.7	A
1562	66.6	A
1562	65.7	A
1569	41	A
1575	40.22	A
1575	34.73	A
1575	26.31	A
1576	28.57	A
1576	22.86	B
1579	44	A
1579	45.5	A
1579	49	A
1582	48	A
1592	61	A
1640	39.5	A
1658	32	A
1658	34	A
1675	40.4	A
1680	28.2	A

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1680	24.5	B
1680	23.5	B
1684	59	A
1708	49.66	A
1708	43.63	A
1708	48.27	A
1715	57.43	A
1716	57	A
1717	0.985	C
1717	0.985	C
1717	0.985	C
1718	31.5	A
1718	31	A
1718	34	A
1727	59.24	A
1727	57.15	A
1734	28.5	A
1734	47	A
1734	39	A
1910	33	A
2023	42.68	A
2023	44.74	A
2023	52.9	A
2207	26.5	A
2207	32	A
2215	81	B
2230	63.65	A
2230	48.59	A
2230	46.65	A

Mean 41.2
Median (Ref) 43.2
 STDev 16.1
 Min 1.0
 Max 81.0

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
25.0	72.8	17.9	97.5	<72.8	>97.5

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Sample 3 (11ASEM3) – No asbestos added (0.0 fibres/mm²) - MMMF fibres present

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
7	0	A
7	0	A
139	1	A
139	1	A
300	1	A
709	1	A
807	0	A
807	0	A
818	0	A
1181	3.97	B
1187	0	A
1187	0	A
1267	2	A
1456	0	A
1477	0	A
1477	0	A
1477	0	A
1507	0	A
1510	0	A
1510	0	A
1546	4.29	B
1562	0.5	A
1562	0	A
1562	0	A
1569	2	A
1575	0	A
1575	0	A
1575	0	A
1576	1.9	A
1576	0	A
1579	2	A
1579	2	A
1579	3	A
1582	0	A
1592	1	A
1640	1	A
1658	0	A
1658	0	A
1675	0.4	A
1680	0	A
1680	0	A

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1680	0	A
1684	0	A
1708	0	A
1708	1.86	A
1708	0	A
1715	0	A
1716	2	A
1717	38.4	C
1717	32.5	C
1717	38.4	C
1718	0	A
1718	0	A
1718	0	A
1727	0	A
1727	0	A
1734	0	A
1734	0	A
1734	0	A
1910	1	A
2023	0.95	A
2023	0	A
2023	1.79	A
2207	1	A
2207	4	B
2215	1	A
2230	0	A
2230	0	A
2230	0	A

Mean 2.2
Median (Ref) 0.0
 STDev 7.5
 Min 0.0
 Max 38.4

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 (11ASEM4) - Medium density (19.5 fibres/mm²) - chrysotile fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
7	29	A
7	27	A
139	8.8	A
139	15.6	A
300	26	A
709	12	A
807	12.84	A
807	11.67	A
818	33.47	A
1181	12.66	A
1187	10.66	A
1187	7.7	B
1267	19	A
1267	18	A
1456	19.2	A
1477	11.619	A
1477	23	A
1477	26.637	A
1507	19.46	A
1510	22	A
1510	18	A
1546	2.89	C
1562	33.4	A
1562	39.1	A
1562	46.4	B
1569	11	A
1575	9.14	A
1575	8.22	A
1575	7.68	B
1576	24.76	A
1576	26.66	A
1579	22	A
1579	19	A
1579	21.5	A
1582	20	A
1592	33	A
1640	24.5	A
1658	15.5	A
1658	18	A
1675	19.2	A
1680	34.2	A

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1680	31.5	A
1680	25.8	A
1684	25	A
1708	18.1	A
1708	15.32	A
1708	19.96	A
1715	4.95	B
1716	31	A
1717	0.98	C
1717	0	C
1717	0.98	C
1718	39	A
1718	38	A
1718	18.5	A
1727	31.36	A
1727	24.39	A
1734	19.5	A
1734	18	A
1734	27	A
1910	12	A
2023	62.6	C
2023	59.95	C
2023	41.24	B
2207	5	B
2215	25	A
2230	27.21	A
2230	32.07	A
2230	17.49	A

Mean	21.6
Median (Ref)	19.5
STDev	12.4
Min	0.0
Max	62.6

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
8.1	40.7	4.3	59.5	<4.3	>59.5

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.

