



**Group Report**

Round 10A

Issue 3

May 2021



# Scanning Electron Microscopy Scheme

This is a re-issued report and supersedes the SEMS Group Reports issued in March and April 2021. Reason for Re-Issue: Minor errors found in summary statistics and incorrect dataset included in Appendix 1 of April 2021 reissue. These problems have now been resolved.

## BACKGROUND

This report covers Round 10A of the SEMS asbestos fibre counting PT scheme. The scheme is operated by HSL, 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 HSL using the modified sputnik multi-port sampling instrument.

## INTRODUCTION

A total of 49 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 373 results submitted.

The samples were as follows:

10ASEM1 – Medium density (40.8 fibres/mm<sup>2</sup>) - amosite fibres

10ASEM2 – Medium density (28.0 fibres/mm<sup>2</sup>) - amosite fibres

10ASEM3 – High density (74.7 fibres/mm<sup>2</sup>) - amosite fibres

10ASEM4 – Medium density (30.0 fibres/mm<sup>2</sup>) - 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<sup>2</sup>) for each fibre type identified. There was also an option to include the number of fibres ≤5µm in length.

## 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 10A 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 10A.

	Sample 1	Sample 2	Sample 3	Sample 4
<b>Number of results</b>	94	93	93	93
<b>Median (fibres/mm<sup>2</sup>)</b>	40.8	28.0	74.7	30.0
<b>25th percentile (fibres/mm<sup>2</sup>)</b>	33.6	21.0	58.4	24.0
<b>75th percentile (fibres/mm<sup>2</sup>)</b>	53.0	34.0	89.0	37.0
<b>Interquartile range (fibres/mm<sup>2</sup>)</b>	19.4	13.0	30.6	13.0
<b>Mean (fibres/mm<sup>2</sup>)</b>	42.8	27.8	73.1	31.1
<b>Standard deviation (fibres/mm<sup>2</sup>)</b>	16.7	10.5	27.9	12.0
<b>Relative standard deviation (%)</b>	38.9	37.8	38.2	38.4

Note: The relative standard deviation (RSD) is calculated by  $(\text{standard deviation}/\text{mean}) \times 100\%$ . 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.

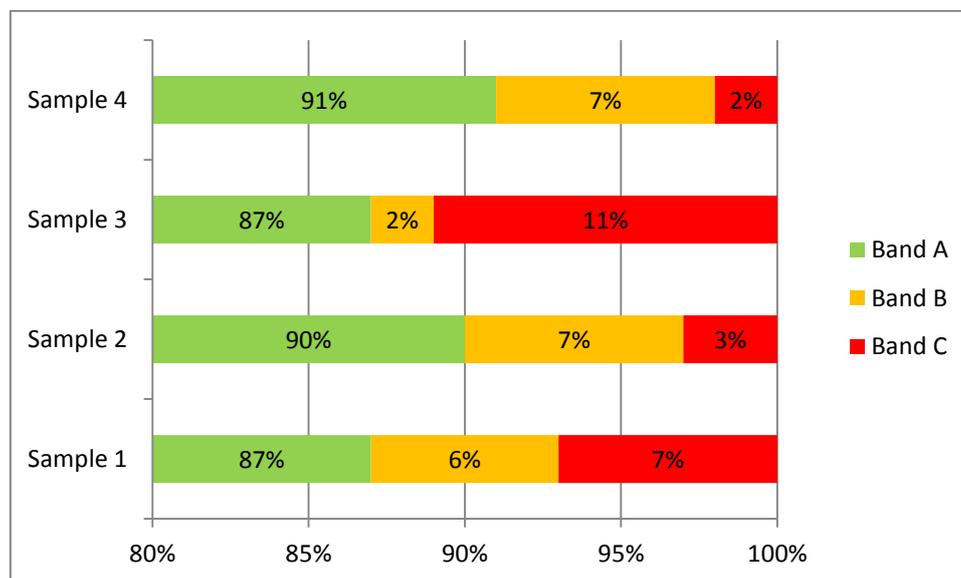


Figure 1: Banded scores for participants in SEMS Round 10A (categorised as per RICE scoring system - see Appendix 2)

Figure 2: Banded scores for participants in SEMS Round 10A divided according to method used

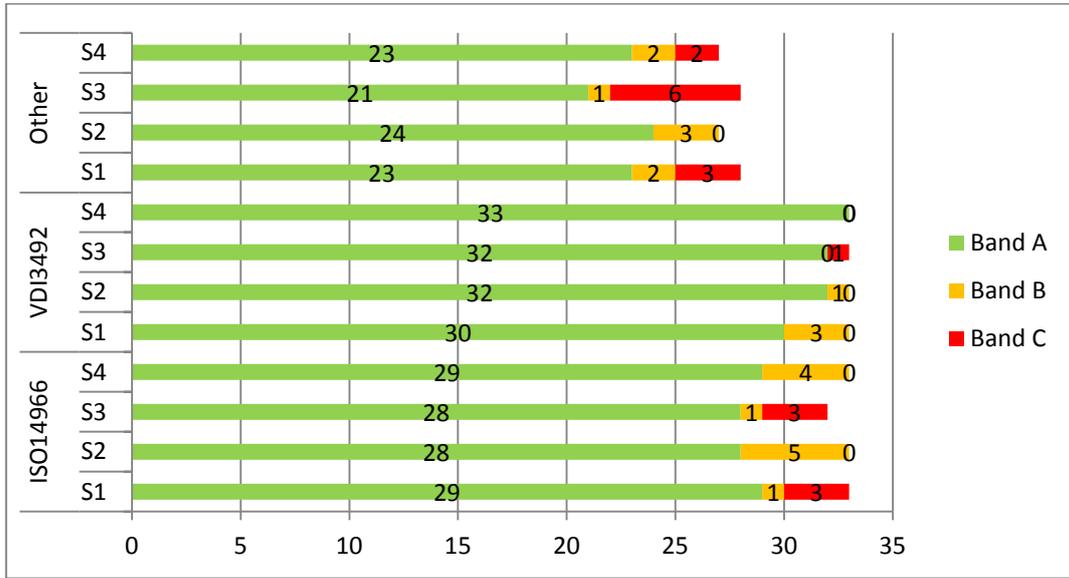
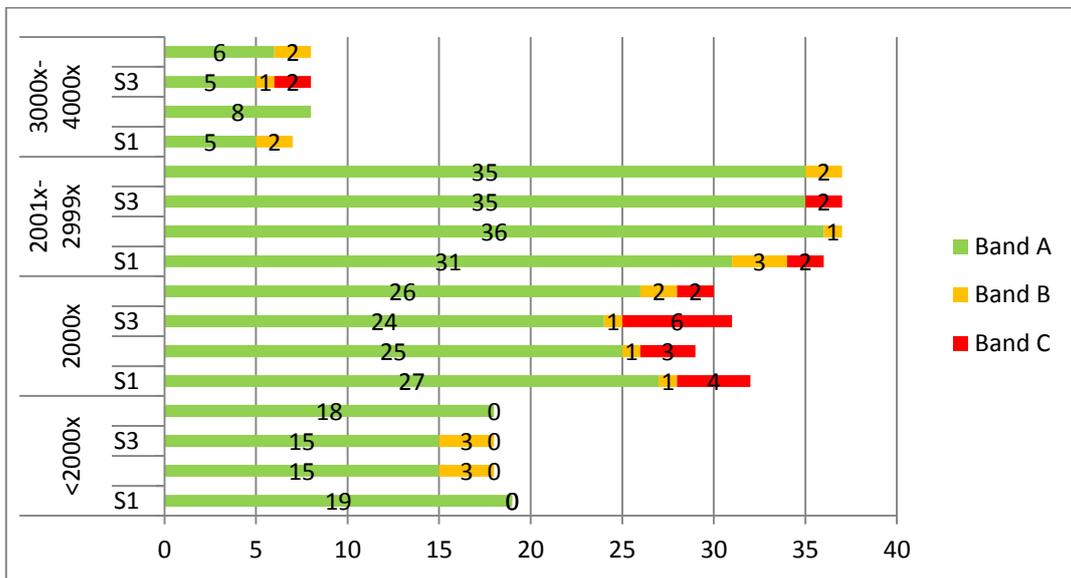


Figure 3: Banded scores for participants in SEMS Round 10A divided according to magnification use



# APPENDIX 1

## Sample 1 (10ASEM1) - Medium (40.8 fibres/mm<sup>2</sup>) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
1458	49	A
1458	51.9	A
1458	53.8	A
1620	46	A
1620	52	A
1620	62	A
1628	28.6	A
1628	34.1	A
1828	50	A
1889	25.4	A
1889	28.4	A
1889	40.8	A
1903	41.5	A
1903	51	A
1922	36.8	A
1922	40.3	A
1922	48.1	A
1923	38.7	A
1928	27.1	A
1928	29.8	A
1928	30.2	A
1937	28.1	A
1937	32.4	A
1938	31	A
1939	39.96	A
1939	47.96	A
1941	36	A
1941	57	A
1958	53.02	A
1966	42.5	A
1966	45.4	A
1966	46.4	A
1968	74	B
1976	29	A
1976	38	A
1976	38	A
1977	57.49	A
1984	0.1091	C
1984	0.1169	C
1984	0.1403	C
1992	55.22	A

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1992	56.45	A
1993	7	C
1993	7	C
1993	32	A
2020	30	A
2020	33.83	A
2020	34.38	A
2022	72	B
2023	38.61	A
2023	43.82	A
2023	50.3	A
2024	36.5	A
2024	40	A
2024	44	A
2026	57.2	A
2032	45	A
2037	30.6	A
2037	34.4	A
2037	38.3	A
2044	42.22	A
2044	54.16	A
2051	103.7	C
2061	37.539	A
2061	41.984	A
2061	48.405	A
2062	49	A
2062	73	B
2062	74	B
2069	54	A
2071	45.7	A
2076	32	A
2076	35	A
2098	59.5	A
2107	31	A
2107	37	A
2107	40	A
2135	57	A
2135	69	A
2135	72	B
2141	31.07	A
2159	63.7	A
2168	61	A
2168	63	A
2182	58	A
2195	38.98	A
2202	53.82	A

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2211	33.5	A
2216	38	A
2226	17.7	B
2226	30	A
2229	39.3	A
2229	40.7	A
2233	52.96	A

Mean	42.8
<b>Median (Ref)</b>	40.8
STDev	16.7
Min	0.1
Max	103.7

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
23.2	69.7	16.4	93.8	<16.4	>93.8

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## Sample 2 (10ASEM2) - Medium density (28.0 fibres/mm<sup>2</sup>) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
1458	26	A
1458	23.1	A
1458	26.9	A
1620	28.5	A
1620	28	A
1620	26.5	A
1628	24.5	A
1628	25.3	A
1828	18.5	A
1889	29.9	A
1889	30.8	A
1889	37.3	A
1903	15	A
1903	20	A
1922	32.4	A
1922	39.3	A
1922	41.7	A
1923	19.3	A
1928	23.8	A
1928	20.8	A
1928	22.8	A
1937	21.9	A
1937	15.2	A
1938	30	A
1939	25.48	A
1939	15.48	A
1941	32	A
1941	29	A
1958	44.79	A
1966	25.5	A
1966	31.6	A
1966	33.6	A
1968	33	A
1976	39	A
1976	31	A
1976	33	A
1977	15.68	A
1984	0.174	C
1984	0.1688	C
1992	10.04	B
1992	9.84	B

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1993	21	A
1993	37	A
1993	21	A
2020	33.33	A
2020	32.29	A
2020	28.86	A
2022	34	A
2023	19.82	A
2023	13.56	B
2023	28.6	A
2024	37.5	A
2024	42	A
2024	36	A
2026	36.5	A
2032	26	A
2037	8.3	C
2037	23.4	A
2037	18.3	A
2044	33.96	A
2044	34.88	A
2051	51.85	A
2061	32.105	A
2061	29.142	A
2061	27.66	A
2062	47.5	A
2062	46.5	A
2062	37.5	A
2069	34	A
2071	21	A
2076	19	A
2076	22	A
2098	42	A
2107	34	A
2107	26	A
2107	24	A
2135	49	A
2135	25	A
2135	51	A
2141	10.17	B
2159	30.4	A
2168	48	A
2168	35	A
2182	39	A
2195	25.98	A
2202	32.29	A
2211	27	A

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2216	13	B
2226	11.8	B
2226	15.6	A
2229	29.3	A
2229	26.3	A
2233	23.12	A

Mean	27.8
<b>Median (Ref)</b>	28
STDev	10.5
Min	0.2
Max	51.9

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
13.8	52.6	8.7	73.8	<8.7	>73.8

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## Sample 3 (10ASEM3) - High density (74.7 fibres/mm<sup>2</sup>) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
1458	61.5	A
1458	78.4	A
1458	88	A
1620	62.5	A
1620	71	A
1620	90	A
1628	44.3	A
1628	51.1	A
1828	66.5	A
1889	70.2	A
1889	78.6	A
1889	91.1	A
1903	60	A
1903	74.5	A
1922	83	A
1922	86.4	A
1922	109	A
1923	96.7	A
1928	73.1	A
1928	76.8	A
1928	80.4	A
1937	36.7	C
1937	43.8	A
1938	78	A
1939	62.96	A
1939	66.45	A
1941	90	A
1941	104	A
1958	74.04	A
1966	73.08	A
1966	86.5	A
1966	94.8	A
1968	92	A
1976	91	A
1976	96	A
1976	101	A
1977	36.59	C
1984	0.2623	C
1984	0.2701	C
1984	0.3273	C

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1992	76.81	A
1992	77.31	A
1993	58	A
1993	65	A
1993	80	A
2020	74.63	A
2020	82.29	A
2020	86.46	A
2022	0.75	C
2023	43.82	A
2023	50.08	A
2023	63.12	A
2024	82	A
2024	84.5	A
2024	89	A
2026	97.1	A
2032	66	A
2037	39.6	A
2037	56.2	A
2037	67.8	A
2044	101.89	A
2051	31.48	C
2061	81.004	A
2061	83.474	A
2061	83.968	A
2062	139.5	B
2062	154	C
2062	158.5	C
2069	97	A
2071	74.7	A
2076	32	C
2076	48	A
2098	73.5	A
2107	56	A
2107	58	A
2107	59	A
2135	83	A
2135	95	A
2135	95	A
2141	42.94	A
2159	95.1	A
2168	109	A
2168	122	B
2182	68.5	A
2195	53.76	A
2202	81.21	A

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2211	62	A
2216	68	A
2226	43.1	A
2226	56.2	A
2229	58.4	A
2229	76.5	A
2233	97.5	A

Mean	73.1
<b>Median (Ref)</b>	74.7
STDev	27.9
Min	0.3
Max	158.5

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
48.6	115.8	37.4	149.4	<37.4	>149.4

Sample 4 (10ASEM4) - Medium density (30.0 fibres/mm<sup>2</sup>) - amosite fibres

LAB NUMBER	TOTAL ASBESTOS	BAND (RICE)
1458	38.5	A
1458	33.2	A
1458	28.8	A
1620	35	A
1620	38	A
1620	31.5	A
1628	29.5	A
1628	20.5	A
1828	24	A
1889	55.7	B
1889	30.4	A
1889	34.8	A
1903	23.5	A
1903	33	A
1922	41.2	A
1922	39.3	A
1922	29.9	A
1923	29	A
1928	28.5	A
1928	32.2	A
1928	27.5	A
1937	21	A
1937	26.7	A
1938	40	A
1939	36.47	A
1939	29.97	A
1941	28	A
1941	26	A
1958	25.59	A
1966	43	A
1966	40.5	A
1966	34.6	A
1968	30	A
1976	27	A
1976	29	A
1976	30	A
1977	51.24	A
1984	0.1584	C
1984	0.1688	C
1992	20.08	A
1992	19.58	A

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1993	24	A
1993	14	B
1993	26	A
2020	32.81	A
2020	34.9	A
2020	31.84	A
2022	34	A
2023	17.74	A
2023	16.69	A
2023	30.57	A
2024	28	A
2024	32	A
2024	26	A
2026	47.3	A
2032	22	A
2037	26	A
2037	23.3	A
2037	19.4	A
2044	42.22	A
2044	35.8	A
2051	29.63	A
2061	40.008	A
2061	48.899	A
2061	41.49	A
2062	71.5	B
2062	68	B
2062	47.5	A
2069	41	A
2071	46.4	A
2076	11	B
2076	17	A
2098	52	A
2107	24	A
2107	21	A
2107	21	A
2135	39	A
2135	33	A
2135	21	A
2141	11.86	B
2159	54.4	A
2168	35	A
2168	37	A
2182	44.5	A
2195	24.19	A
2202	35.23	A
2211	25.5	A

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2216	23	A
2226	25.3	A
2226	18.5	A
2229	34.8	A
2229	17.4	A
2233	24.87	A

Mean	31.1
<b>Median (Ref)</b>	30.0
STDev	12.0
Min	0.2
Max	71.5

<b>RICE A (Lower)</b>	<b>RICE A (Upper)</b>	<b>RICE B (Lower)</b>	<b>RICE B (Upper)</b>	<b>RICE C (Lower)</b>	<b>RICE C (Upper)</b>
15.3	55.3	9.8	77	<9.8	>77

## 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.  $\text{mm}^{-2}$ )

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.  $\text{mm}^{-2}$ )\*

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. $\text{mm}^{-2}$  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  $\text{mm}^2$ .

