



Scanning Electron Microscopy Scheme

BACKGROUND

This Interim Report covers the 6A round 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 44 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 307 results submitted.

The samples were as follows:

6ASEM1 – Medium – high density (<50 fibres mm⁻²) - chrysotile asbestos fibres

6ASEM2 – Medium (<30 fibres mm⁻²) - amosite asbestos fibres

6ASEM3 – High density (<70 fibres mm⁻²) – crocidolite asbestos fibres

6ASEM4 – Very low density (<10 fibres mm⁻²) – no asbestos fibres

INFORMATION SUBMITTED BY LABORATORIES

Laboratories were asked to supply:

- The number of fibres >5µm long counted (amphibole, chrysotile and 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. 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 between 500x and 5000x were recorded. Four laboratories used a magnification of 1500x or lower. The majority of results for all of these laboratories were systematically lower than the assigned reference values (median), perhaps indicating that the finer fibres were not being detected. Seven laboratories used a magnification of 3000x or higher. The results for one of these were significantly higher than those of the respective assigned reference values.

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 Interim 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.

APPENDIX 1

Sample 1 (6ASEM1) - Total asbestos fibre density (fmm⁻²)

Lab Number	Total Asbestos	RICE
7	30.0	A
7	43.8	A
807	32.1	A
807	40.8	A
1181	49.0	A
1277	20.0	B
1277	23.3	B
1282	10.5	C
1445	21.0	B
1477	43.9	A
1477	91.9	B
1477	105.3	C
1507	26.6	A
1510	27.0	A
1510	66.0	A
1569	23.5	B
1575	16.5	C
1576	47.1	A
1576	87.1	B
1579	44.0	A
1579	57.0	A
1582	25.0	A
1620	39.0	A
1620	46.5	A
1620	56.0	A
1669	31.0	A
1669	41.0	A
1669	52.5	A
1738	20.0	B
1738	46.0	A
1738	47.0	A
1767	6.2	C
1767	9.8	C
1767	15.7	C
1774	34.5	A
1813	51.1	A
1813	55.8	A
1813	60.4	A
1814	38.8	A
1828	45.0	A
1828	62.0	A
1828	62.5	A
1832	40.0	A
1832	48.0	A
1848	44.4	A

APPENDIX 1

1852	78.5	B
1856	67.1	A
1871	31.5	A
1871	43.0	A
1871	53.5	A
1875	3.4	C
1922	19.6	B
1922	21.1	B
1922	22.9	B
1937	37.1	A
1937	38.1	A
1938	54.0	A
1939	24.0	B
1939	27.5	A
1939	33.5	A
1941	84.0	B
1973	75.0	B
1981	24.0	B
1981	81.4	B
1992	33.1	A
1999	12.8	C
2020	70.0	A
2020	76.0	B
2020	83.8	B
2022	81.0	B
2024	20.0	B
2024	22.0	B
2024	23.5	B
2025	46.0	A
2025	62.5	A
2027	10.8	C
2029	136.0	C
2029	154.0	C
2034	103.0	C

Mean	46.3
Median (Ref)	43.0
STDev	28.6
Min	3.4
Max	154.0

RICE A	RICE A	RICE B	RICE B	RICE C	RICE C
(Lower)	(Upper)	(Lower)	(Upper)	(Lower)	(Upper)
24.9	72.5	17.8	97.2	<17.8	>97.2

APPENDIX 1

Sample 2 (6ASEM2) - Total asbestos fibre density (fmm⁻²)

Lab Number	Total Asbestos	RICE
7	22.1	A
7	24.1	A
807	19.3	A
807	21.6	A
1181	35.3	A
1277	17.9	A
1277	20.0	A
1282	33.8	A
1445	69.0	B
1477	26.5	A
1477	29.0	A
1477	62.8	B
1507	14.0	A
1510	17.0	A
1510	41.5	A
1569	26.5	A
1575	65.8	B
1576	32.0	A
1576	41.4	A
1579	28.0	A
1579	33.0	A
1582	30.0	A
1620	23.5	A
1620	28.5	A
1620	53.0	B
1669	17.0	A
1669	24.5	A
1669	30.0	A
1738	23.5	A
1738	32.5	A
1738	48.0	A
1767	18.6	A
1767	26.2	A
1767	27.1	A
1774	27.0	A
1813	20.1	A
1813	21.3	A
1813	22.5	A
1814	23.0	A
1828	20.5	A
1828	25.5	A
1828	30.5	A
1832	22.5	A
1832	23.5	A
1848	29.6	A

APPENDIX 1

1852	62.0	B
1856	30.6	A
1871	39.0	A
1871	55.0	B
1871	57.5	B
1875	22.7	A
1922	9.8	B
1922	11.0	B
1922	12.9	B
1937	30.5	A
1937	35.8	A
1938	20.0	A
1938	20.0	A
1939	19.0	A
1939	27.0	A
1941	21.0	A
1973	116.7	C
1981	129.3	C
1981	179.6	C
1992	48.7	A
1999	17.2	A
2020	62.0	B
2020	72.0	B
2020	82.7	C
2022	40.0	A
2024	17.0	A
2024	19.5	A
2024	23.5	A
2025	21.0	A
2027	6.3	C
2029	46.0	A
2029	51.0	A
2034	33.0	A

Mean	35.7
Median (Ref)	27.0
STDev	27.2
Min	6.3
Max	179.6

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
13.1	51.2	8.2	72.2	<8.2	>72.2

APPENDIX 1

Sample 3 (6ASEM3) - Total asbestos fibre density (fmm⁻²)

Lab Number	Total Asbestos	RICE
7	125.0	A
7	179.9	B
807	83.0	A
807	105.6	A
1181	92.3	A
1277	98.0	A
1277	106.4	A
1282	65.1	B
1445	222.0	C
1477	119.8	A
1477	141.6	A
1507	56.0	B
1510	66.0	B
1510	101.0	A
1569	77.0	A
1575	21.0	C
1576	140.6	A
1576	150.0	A
1579	107.0	A
1579	138.0	A
1582	84.0	A
1620	51.5	B
1620	82.5	A
1620	88.5	A
1669	43.5	C
1669	87.0	A
1669	96.5	A
1738	117.0	A
1738	123.0	A
1738	136.5	A
1767	37.3	C
1767	111.0	A
1767	171.4	B
1774	103.0	A
1813	71.3	A
1813	74.4	A
1813	77.5	A
1814	53.5	B
1828	62.0	B
1828	84.0	A
1828	88.5	A
1832	75.5	A
1832	86.0	A
1848	96.5	A
1852	123.0	A

APPENDIX 1

1856	136.3	A
1871	110.0	A
1871	186.0	B
1871	198.0	B
1875	88.2	A
1922	30.4	C
1922	47.2	C
1922	59.8	B
1937	84.8	A
1937	88.1	A
1938	122.0	A
1939	73.9	A
1939	80.4	A
1941	129.5	A
1973	183.3	B
1981	545.0	C
1981	1037.7	C
1992	125.9	A
1999	32.2	C
2020	183.5	B
2020	285.9	C
2020	300.0	C
2022	75.0	A
2024	119.5	A
2024	134.0	A
2024	139.0	A
2025	132.0	A
2027	13.8	C
2029	190.0	B
2029	197.0	B
2034	120.0	A

Mean	127.2
Median (Ref)	102.0
STDev	128.7
Min	13.8
Max	1037.7

RICE A (Lower)	RICE A (Upper)	RICE B (Lower)	RICE B (Upper)	RICE C (Lower)	RICE C (Upper)
66.3	158.1	51	204	<51	>204

APPENDIX 1

Sample 4 (6AEM4) - Total asbestos fibre density (fmm⁻²)

Lab Number	Total Asbestos	RICE
7	0.0	A
7	0.0	A
807	0.0	A
807	0.0	A
1181	0.0	A
1277	0.0	A
1277	0.0	A
1282	0.0	A
1445	0.0	A
1477	0.0	A
1477	0.0	A
1507	0.0	A
1510	0.0	A
1510	0.0	A
1569	0.0	A
1575	0.0	A
1576	0.0	A
1576	0.0	A
1579	0.0	A
1579	0.0	A
1582	0.0	A
1620	0.0	A
1620	0.0	A
1620	0.0	A
1669	0.0	A
1669	0.0	A
1669	0.0	A
1738	0.0	A
1738	0.0	A
1738	0.0	A
1767	0.0	A
1774	0.0	A
1813	0.0	A
1813	0.0	A
1813	0.0	A
1814	0.0	A
1828	0.0	A
1828	0.0	A
1828	0.0	A
1832	0.0	A
1832	0.0	A
1848	0.0	A
1852	0.0	A
1856	0.0	A
1871	0.0	A

APPENDIX 1

1871	0.0	A
1871	0.0	A
1875	0.0	A
1922	0.0	A
1922	0.0	A
1922	0.0	A
1937	1.0	A
1937	1.9	A
1938	0.0	A
1938	0.0	A
1939	0.0	A
1939	4.0	B
1941	0.0	A
1973	0.0	A
1981	157.7	C
1981	172.1	C
1992	0.0	A
1999	0.6	A
2020	0.0	A
2020	0.0	A
2020	0.0	A
2022	0.0	A
2024	0.0	A
2024	0.0	A
2024	0.0	A
2025	0.0	A
2027	0.0	A
2029	0.0	A
2034	0.0	A

Mean	4.6
Median (Ref)	0.0
STDev	26.9
Min	0.0
Max	172.1

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

APPENDIX 2

DATA ANALYSIS – METHOD 1

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 .

