



LAB 30

Edition 2 | April 2008

Application of ISO/IEC 17025 for Asbestos Sampling and Testing

CONTENTS

	SECTION	PAGE
1	Introduction	3
2	General Guidance	3
3	Organisation (ISO/IEC 17025 clause 4.1)	4
4	Review of Requests, Tenders and Contracts (ISO/IEC 17025 clause 4.4 & ISO/IEC 17020 clause 10.5)	5
5	Control of Technical Records (ISO/IEC 17025 clause 4.13.2)	6
6	Internal Audits (ISO/IEC 17025 clause 4.14 & ISO/IEC 17020 clause 7.7)	8
7	Personnel (ISO/IEC 17025 clause 5.2 & ISO/IEC 17020 clause 8)	8
8	Accommodation and Environmental Conditions (ISO/IEC 17025 clause 5.3)	12
9	Test and Calibration Methods and Method Validation (ISO/IEC 17025 clause 5.4)	13
10	Estimation of Uncertainty of Measurement (ISO/IEC 17025 clause 5.4.6)	15
11	Equipment (ISO/IEC 17025 clause 5.5 & ISO/IEC 17020 clause 9)	15
12	Measurement Traceability (ISO/IEC 17025 clause 5.6)	17
13	Sampling (ISO/IEC 17025 clause 5.7)	19
14	Handling of Test and Calibration Items (ISO/IEC 17025 clause 5.8)	20
15	Assuring the Quality of Test and Calibration Results (ISO/IEC 17025 clause 5.9)	21
16	Reporting the Results (ISO/IEC 17025 clause 5.10)	23
17	Additional ISO/IEC 17020 Requirements for Four Stage Clearance (ISO/IEC 17020 clause 3.4, 4 8.5, 10.8)	23
Appendix 1:	Fibre Counting (Asbestos) by the Use of Optical Microscopy - An Internal Quality Control Scheme	25
References		33

CHANGES SINCE LAST EDITION

Numerous since the previous edition, changes include update to reference documentation and update/clarification on UKAS policy in several areas

1 INTRODUCTION

- 1.1 Laboratories that have been assessed by UKAS as meeting the requirements of ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*¹ may be granted UKAS accreditation. Several guidance publications on the application of these requirements, providing extra information, detail and limitations, are listed in UKAS Publications, available at www.ukas.com.
- 1.2 This publication provides guidance on the application of specific requirements for laboratories carrying out asbestos sampling and/or testing. It does not cover all of the requirements of ISO/IEC 17025:2005 or *General Criteria for the Operation of Various Types of Bodies Performing Inspection* ISO/IEC 17020:1998², which remain the authoritative documents. ISO/IEC 17025 does not give detailed guidance on accreditation requirements for asbestos surveying activities. For asbestos surveying accreditation, see ISO/IEC 17020: 1998 (and UKAS RG 8³).
- Note: ILAC publication IAF/ILAC-A4:2004⁴ (Guidance on the application of ISO/IEC 17020) also provides useful guidance on the application of ISO/IEC 17020.*
- 1.3 By following the guidance given in this publication, laboratories will be able to demonstrate at assessment that they meet the requirements for sampling and testing. Alternative methods may be adopted provided that they are shown to give an equivalent outcome.
- 1.4 The guidance contained within this publication includes reference to some requirements that are specified by the Health & Safety Executive (HSE).

2 General Guidance

- 2.1 UKAS offers accreditation for two types of sampling - air and bulk sampling.
- (a) Air sampling: sampling of air onto membrane filters for subsequent fibre counting (including the visual inspection that is associated with clearance indicator sampling). Laboratories will be required to demonstrate competence and effective application of ISO/IEC 17025, and of the requirements of ISO/IEC 17020 identified in this guidance document. Laboratories will not be required to comply with all of the requirements of ISO/IEC 17020.
- Accreditation is granted for the 4-stage clearance certification activity (as detailed in the HSE publication HSG 248) under the ISO/IEC 17025 standard.
- (b) Bulk Sampling: sampling of bulk materials for subsequent asbestos identification analysis. Samples that are taken by a laboratory should normally be analysed by that laboratory. In any case, they should always be analysed by a laboratory holding UKAS accreditation for the appropriate asbestos test.

- 2.2 UKAS offers accreditation for two types of asbestos testing - fibre counting and bulk identification.
- (a) Fibre counting: the UK test specification for fibre counting in relation to the Control of Asbestos Regulations (CAR)⁵ is given in Health and Safety Executive (HSE) document *Asbestos: The analysts' guide for sampling, analysis and clearance procedures (HSG 248)*⁶. Other membrane filter methods may be accredited, if judged by UKAS to be satisfactory for the specified purpose.
 - (b) Bulk identification: Health & Safety Executive publication HSG 248 describes the physical and optical characteristics of asbestos, and may be used as the basis of an accredited test method. The techniques described in HSG 248 are based on the use of polarised light microscopy, coupled with dispersion staining techniques. A documented in-house method shall be utilised, and shall enable the following six regulated asbestos types to be identified: crocidolite, amosite, chrysotile, fibrous actinolite, fibrous anthophyllite, and fibrous tremolite. Accreditation held for this method includes the identification of asbestos containing materials in soils samples. The preparation and analysis of soils samples for the subsequent identification of asbestos fibres within the soils sample is not covered by this accreditation/method and is a separate accredited activity.

Management Requirements

3 Organisation (ISO/IEC 17025 clause 4.1)

3.1 FIBRE COUNTING

- 3.1.1 It is a requirement of HSG 248 that laboratories carrying out fibre counting participate in the Regular Inter-laboratory Counting Exchanges (RICE)⁷ scheme.
- 3.1.2 Laboratories should, in addition, maintain a 'satisfactory' performance classification in that scheme. Further guidance for applicant and accredited laboratories is given in this document - see also 'Assuring the quality of test and calibration results' (ISO/IEC 17025 clause 5.9).
- 3.1.3 If a laboratory's performance falls outside 'satisfactory' classification, appropriate corrective action shall be taken. The laboratory shall notify UKAS (via its nominated Assessment Manager) without delay if this occurs.
- 3.1.4 New laboratories must participate in at least two rounds of RICE and produce results which will indicate satisfactory classification is achievable prior to any initial assessment by UKAS for accreditation of this activity.

3.2 BULK IDENTIFICATION

- 3.2.1 It is a requirement of HSG 248 that laboratories carrying out bulk identification participate in appropriate inter-laboratory comparison or proficiency testing programmes, for example, the Asbestos in Materials (AIMS) scheme⁸.

- 3.2.2 Laboratories should, in addition, maintain a 'satisfactory' performance classification in that scheme. Further guidance for applicant and accredited laboratories is given in this document - see also 'Assuring the quality of test and calibration results' (ISO/IEC 17025 clause 5.9).
- 3.2.3 If a laboratory's performance falls outside 'satisfactory' classification, appropriate corrective action shall be taken. The laboratory shall notify UKAS (via its nominated Assessment Manager) without delay if this occurs.
- 3.2.4 New laboratories must participate in at least two rounds of AIMs and produce results, which will indicate that satisfactory classification is achievable prior to any initial assessment by UKAS for accreditation of this activity.

4 Review of Requests, Tenders and Contracts (ISO/IEC 17025 clause 4.4)

- 4.1 The use of standard pro formas may be appropriate for carrying out reviews of requests, tenders and contracts.
- 4.2 In the case of requests, tenders or contracts involving repetitive work for similar sampling or analytical activities, a review shall be carried out prior to the award of the contract. This 'contract review' need not be repeated unless the scope of the work changes during the period of the contract.
- 4.3 AIR SAMPLING - 4SC (Also ISO17020 clause 10.5)**
- 4.3.1 The laboratory's procedure for 'contract review' should also include a requirement to establish whether or not the testing of hygiene unit(s) and any other associated testing, eg, leak or reassurance testing is required to be carried out as part of the laboratory's scope of testing work. During the contract review process, the laboratory should consider the possibility of using more than one analyst during the clearance of "large" or complicated enclosures. The effective planning and use of resources will be of importance in ensuring that inspections (including Stage 2 visuals) are carried out thoroughly.
- Staff responsible for booking-in / logging jobs shall have appropriate competence in implementing 'contract review' procedures.
- 4.3.2 Upon arrival at the site, the analyst shall ensure that the work carried out on-site is in accordance with the scope of work. The analyst shall check that the "actual" on site work practice is in accordance with the job details notified on the method statement. If a copy of the method statement is not available on-site, the analyst should fail Stage 1, indicating the reason for failure on the Certificate of Reoccupation. Any other deviations shall be recorded by the analyst, for reporting on the Certificate of Reoccupation.
- 4.3.3 The conduct of reassurance testing and testing of the hygiene unit(s) following completion of Stage 4 of site clearance certification may not be required as part of the 4-stage clearance testing requirements (see 4.3.1).
- 4.3.4 Analysts shall take rest breaks during lengthy inspections to prevent fatigue.

5 Control of Technical Records (ISO/IEC 17025 clause 4.13.2)

5.1 AIR SAMPLING - Site Assessment for Reoccupation (4-Stage Clearance Process)

5.1.1 The site clearance certification process involves four stages:-

- Stage 1 - preliminary check of site condition and job completeness
- Stage 2 - a thorough visual inspection inside the enclosure/work area
- Stage 3 - clearance air monitoring
- Stage 4 - final assessment post-enclosure/work area dismantling

5.1.2 Prior to commencement of the 4SC procedure the laboratory should conduct and record a site-specific Risk Assessment to establish any potential hazards and to review site arrangements for fire or emergency evacuation. Whilst carrying out the Stage 1 preliminary inspection of areas surrounding the enclosure/work area, transit and waste routes etc, the analyst shall record the presence of materials such as building rubble and debris etc, where this may give rise to any doubt regarding the completeness of the Stage 1 inspection. The analyst shall initially consult with the asbestos removal contractor (see note below), requesting that interfering materials be cleared. If this is not possible or practicable, relevant details shall be recorded on the Certificate of Reoccupation. A detailed inspection of the hygiene unit should also be made to establish that it is fully operational.

Note: Throughout this document reference is made to the “contractor”. This should be taken to refer to the asbestos removal contractor who carried out the removal works.

5.1.3 The analyst shall also record, and request the removal of, any obvious asbestos debris arising from the removal work - particular attention should be paid in areas adjacent to waste skips (and the contractor’s vehicle, if present during the inspection). In the event that substantial asbestos debris remains within the area and indicates that the final clean has not been undertaken thoroughly enough, then the analyst shall record (and report) a clearance failure at Stage 1.

5.1.4 A copy of the contractor’s plan of work or method statement must be reviewed by the analyst when carrying out the Stage 1 inspection in order to establish the extent of works to be undertaken (see also ‘Review of requests, tenders and contractors’, as above) If this information is not available the Stage 1 fail must be recorded. In the event that a copy of the diagram from the contractor’s plan of work is not available, the analyst shall produce a site diagram including approximate dimensions, detailing the location of the enclosure, air locks, hygiene unit, transit and waste routes etc. This diagram shall form part of the laboratory’s formal records system. Where changes or amendments to the site layout have been made these should be noted and the revised diagrams counter-signed by the contractor to verify their authenticity.

5.1.5 The analyst shall record the presence or absence of viewing panel(s), for the purpose of inspection of enclosures from the outside. Other methods of viewing, such as webcams or CCTV may also be useful during inspections. In the event that viewing panels are not present, the analyst must record the absence of viewing panels within the site records and proceed with the inspection. Additionally, the analyst should discuss with the contractor’s representative whether smoke tests or leak testing have been carried out on the enclosure and should record details of any discussions held (and any documentation examined). The Licensed Contractor’s Guide⁹ requires daily visual checks of enclosure integrity to be carried out by the contractor. The analyst can also check the contractor’s records for supporting evidence. Such evidence will

be of potential use to the analyst in assessing the integrity of the enclosure, as part of the Stage 1 inspection. The analyst should, however, bear in mind that such testing may have been carried out some time prior to the clearance. The integrity of the enclosure must again be verified and recorded as part of Stage 1.

- 5.1.6 The presence of any known asbestos-containing materials (ACMs) that are to remain in-situ following site clearance certification must be recorded by the analyst on the Certificate of Reoccupation. A record shall be kept of any ACMs noted to remain in the enclosure during the Stage 2 visual inspection.
- 5.1.7 The analyst must record the presence of leaking pipes, seepage of groundwater, 'dusty' surfaces (that may compromise the ability to read the filters after air sampling), inaccessible asbestos etc, on the Certificate of Reoccupation.
- 5.1.8 The analyst must record whether any sealants or lock-down sprays have been used in or around the work area. There should be no use of sealants prior to the 4-stage clearance procedure (unless they are used as part of the control during the removal process - eg removing AIB ceiling tiles, or as permanent sealing). If sealants (eg PVA) have been used in a bid to obtain clearance, then this is a potential fail. If there is evidence of unauthorised use of sealant then the analyst should direct that sealants be removed before proceeding any further with the 4SC procedure. The analyst can authorise the use of sealants, but reasons and justification for their use (eg where non-asbestos dust within the enclosure may cause an air test failure) must be recorded on the Certificate of Reoccupation.
- 5.1.9 The analyst must discuss with the removal contractor whether testing is required in the hygiene unit. It should be noted that separate clearance certification must be issued for this purpose. The analyst must record the outcome of any relevant discussions held with the contractor.
- 5.1.10 Information to be recorded should include enclosure details (including the information which is required by HSG 248), sampling position(s), calibration of individual sampling pumps, details of "pooled" samples (where relevant), on/off times of pumps with dates and relevant environmental conditions (to include temperature and barometric pressure).
- 5.1.11 It is advisable for laboratories to obtain photographic records of prevailing conditions inside and adjacent to enclosures (including records of any suspected asbestos containing materials in or around the enclosure). The laboratory should obtain the permission of the site owner/client prior to taking photographs.
- 5.1.12 In the event that test reports are completed on-site, laboratories should obtain written confirmation of attendance on-site and/or receipt of documentation, from the contractor or clients representative as appropriate.

5.2 BULK SAMPLING

- 5.2.1 It is advisable for laboratories to obtain photographic records to demonstrate the condition and location of suspected asbestos containing materials at the time of sampling/surveying (see also HSE MDHS 100¹⁰). The permission of the site owner/client should be obtained prior to taking photographs.

5.3 FIBRE COUNTING

- 5.3.1 Where tally counters are used, the results shall be recorded on the worksheets and/or test report at the completion of the count. If a paper recording system is used for recording numbers of fibres and/or graticule areas, then the observations shall be recorded immediately after each graticule area has been examined.

5.3.2 The laboratory shall retain all original data relating to internal QC and RICE schemes within its record system.

5.4 BULK IDENTIFICATION

5.4.1 The laboratory shall retain all original data relating to internal QC and AIMS schemes within its record system.

5.5 RETENTION OF RECORDS

5.5.1 Laboratories are required to retain records for a defined retention period. Consideration should also be given to legislative requirements, eg records of compliance (personal) monitoring on identifiable laboratory staff (undertaking licensable work) should be retained for at least 40 years. Associated training, quality control etc, records should also be retained. Records can be stored electronically provided there are sufficient safeguards to protect the integrity of the data.

6 Internal Audits (ISO/IEC 17025 clause 4.14 and ISO/IEC 17020 clause 7.7)

6.1 SAMPLING AND TESTING (AIR AND BULK)

All authorised sampling and testing personnel and procedures shall be audited for each accredited activity on at least a 12 monthly basis in accordance with a planned programme, using documented auditing procedures. These procedures shall include witnessing of authorised personnel carrying out accredited site/laboratory work. Visual auditing techniques should be complemented with sufficient oral questioning of personnel to verify that they possess the knowledge and experience required to be deemed competent for all aspects of work that they are authorised to perform. Such auditing should normally be carried out by a designated “competent person” (ie a person that possesses qualifications, training, experience and knowledge to meet the requirements of each activity). Internal auditing procedures shall include witnessing of authorised personnel carrying out on-site inspection and testing activities associated with site clearance certification.

Technical Requirements

7 Personnel (ISO/IEC 17025 clause 5.2 ISO/IEC 17020 clause 8)

7.1 QUALIFICATIONS/TRAINING (includes Table 1 & 2)

7.1.1 At least one member of the laboratory staff in a position of responsibility (e.g., the quality manager, a member of the technical management team, or the training officer) should hold a relevant formal qualification, which is supported by evidence of appropriate experience and demonstrable competence. The laboratory should notify UKAS in the event that the designated competent person leaves the laboratory.

- 7.1.2 UKAS recognises the British Occupational Hygiene Society (BOHS)¹¹ Certificate of Competences in Asbestos - CoCA (Module S301, plus a pass in the oral examination). Where bulk sampling is being carried out as part of building surveys, personnel carrying out the sampling should either hold the appropriate qualifications, or be working under the close supervision of an appropriately qualified staff member. Further guidance is given in UKAS document RG8.
- 7.1.3 Authorised samplers and analysts shall be suitably qualified and trained, and be able to demonstrate technical competence in the appropriate area of work. Currently recognised qualifications include the relevant BOHS Proficiency Modules (P401 to P405 inclusive).
- 7.1.4 Other equivalent formal qualifications may be accepted by UKAS. Details should be submitted for review and formal approval. An overview of qualification requirements for accreditation is given in table 1.
- 7.1.5 Training of authorised samplers, and analysts carrying out on-site work, should include a substantial content of the on-site experience, under the supervision of authorised personnel.
- 7.1.6 Training records shall include details of sites attended, scope of works carried out, date(s) of attendance, and the identity of trainers and trainees.

Table 1 Overview of qualifications and accreditation

ACTIVITY	QUALIFICATION	ACCREDITATION
A Person taking a bulk sample	There is no formal UKAS requirement for this activity outside of surveying, but individuals are strongly recommended to hold BOHS P402 or RSPH Level 3 Certificate or higher, or work under supervision of qualified surveyor	Recommended that individual holds personnel certification for asbestos surveying from a Body accredited to ISO 17024 or works for a Body accredited for a relevant scope to ISO 17020 or ISO 17025
B Company taking a bulk sample	At least one member of the company must hold P402 plus S301 (not necessary for full CoCA but this is strongly encouraged) or CoCA or equivalent qualification. For individuals refer to A above.	Recommended that company holds relevant scope of accreditation to ISO 17020 or ISO 17025
C Person taking and analysing an air sample (including 4-SC)	Individuals to hold BOHS P403 and P404 (or higher qualification (eg CoCA))	Works for or is an organisation holding a relevant scope of Accreditation to ISO 17025
D Company taking and analysing an air sample (including 4-SC)	Individuals to hold BOHS P403 and P404 At least one member of the company must hold the CoCA (ie S301 plus oral) or equivalent qualification	Relevant scope of Accreditation to ISO 17025
E Person analysing a bulk sample	Individuals to hold BOHS P401 or higher (eg CoCA)	Works for or is an organisation holding relevant scope of Accreditation to ISO 17025
F Company analysing a bulk sample	Individuals to hold BOHS P401 or higher (eg CoCA)	Relevant scope of Accreditation to ISO 17025
G Person analysing an air sample for the purposes of discrimination	Individuals to hold BOHS P401 and P403 or higher (eg CoCA)	Works for or is an organisation holding relevant scope of Accreditation to ISO 17025
H Company analysing an air sample for the purposes of discrimination	Individuals to hold BOHS P401 and P403 At least one member of the company must hold the CoCA (i.e. S301 plus oral) or equivalent qualification	Relevant scope of Accreditation to ISO 17025

Note Accreditation for bulk sampling can be achieved through ISO 17025 for testing laboratories or when carried out as part of a survey through ISO 17020 for Inspection Bodies. UKAS employ the same assessment criteria for both standards.

7.2 FIBRE COUNTING AND AIR SAMPLING (4SC)

- 7.2.1 The laboratory must have a documented training procedure for new analysts. This must include the criteria of acceptability for each stage of the process, so that it is clear when an analyst becomes 'competent', this includes the counting of suitable reference slides, prior to the inclusion in the list of laboratory-approved fibre counters.
- 7.2.2 All analysts shall participate in, achieve and maintain a satisfactory standard of performance in, the laboratory's internal quality control scheme for fibre counting.
- 7.2.3 The laboratory shall maintain a list of all personnel who are authorised to carry out fibre counting, air sampling and clearance certification activities. Staff training records should contain objective evidence of the achievement of defined criteria of competence, and must include all supporting information.

- 7.2.4 Analysts responsible for conducting inspections as part of the site clearance certification process are required to have appropriate qualifications, training, experience and knowledge. Details of training requirements are given below (see Table 2).
- 7.2.5 Analysts who have no demonstrable previous experience of carrying out site asbestos clearance work will require at least three months relevant experience (whilst working under the close supervision of a fully-authorized person), in order to gain sufficient and detailed knowledge of the 4-stage site clearance process. At the end of the period of supervision, competence must then be verified by conducting, for example, on-site auditing of the trainee. Details of the competency assessment (including the date on which the trainee is designated as ‘fully competent’) must be recorded as part of the training records.
- 7.2.6 The following table gives details of requirements for qualifications, experience and knowledge requirements for analysts carrying out 4-stage site clearance certification.

Table 2**Qualifications, experience and knowledge requirements for analysts carrying out 4-stage clearance procedures.**

Minimum qualification	Minimum experience	Knowledge
<p>The British Occupational Hygiene Society (BOHS) Proficiency Certificate in ‘Asbestos fibre counting’ (P403)</p> <p>and ‘Air sampling and clearance testing of asbestos’ (P404), or other more wide ranging qualifications approved by BOHS.</p> <p>(See notes below)</p>	<p>3 months appropriate experience in 4-stage clearance procedures, followed by competency assessments by a fully qualified analyst.</p> <p>Satisfactory assessments must clearly record that the knowledge and experience of the trainee has been demonstrated, the assessments must consider the types of clearance, the range and types of jobs an analyst will be required to undertake.</p>	<p>Familiarity with the range, location, use and appearance of asbestos products</p> <p>Knowledge of appropriate sampling strategies and inspection regimes for 4-stage clearance work</p> <p>Knowledge of current regulations and guidance (in particular the HSE Analyst’s Guide)</p> <p>Knowledge of the fitting, wearing and care of respiratory protective equipment</p> <p>Knowledge of decontamination procedures, transiting procedures, and the use of airlocks and hygiene facilities</p>

Notes :

BOHS Proficiency Certificate in ‘Asbestos fibre counting’ and ‘Air sampling and clearance testing of asbestos’ can be gained by successfully completing the written examination and practical assessment of BOHS P403 and P404 Modules.

The more wide ranging qualifications approved by BOHS and accepted by UKAS are :

- *BOHS (formerly BIOH) Certificate of Competence in Asbestos (gained by passing BOHS Module S301 ‘Asbestos & other fibres’ and the oral examination).*
- *BOHS (formerly BIOH) Certificate of Operational Competence in comprehensive occupational hygiene (Cert. Occ. Hyg.), which includes a study of asbestos within the course content.*
- *BOHS (formerly BIOH) Diploma of Professional Competence in comprehensive occupational hygiene (Dip. Occ. Hyg.) which includes a study of asbestos within the course content.*

Qualifications other than those specified above may be accepted but the details of any proposed alternative qualifications should be submitted to UKAS for review and agreement.

- 7.2.7 Procedures for Stage 1, Stage 2 and Stage 4 inspections require analysts to be familiar with the appearance and visual identification of various types of asbestos-containing materials. Laboratories must ensure that analysts receive suitable training and instruction in recognising these types of materials (including, in particular, their appearance following wetting and stripping), and that training records contain appropriate confirmatory evidence of competence.
- 7.2.8 Analysts must receive training in the use of airlocks and hygiene facilities, including all entry and exit procedures. In addition, they shall be trained and competent to effectively decontaminate themselves (and their equipment) upon exiting from enclosures - in order to prevent the spread of asbestos fibres, and to minimise exposure to others. Additional guidance is contained within the approved code of practice associated with CAR 2006 and in HSG 248.
- 7.2.9 Analysts must be given training (including refresher training) in the fitting, wearing and care of respiratory protective equipment. Training records must be maintained up-to-date, including details of any refresher training given.

7.3 BULK IDENTIFICATION AND BULK SAMPLING

- 7.3.1 The laboratory must have a documented training procedure for new analysts. This must include the criteria of acceptability, so that it is clear when an analyst is deemed to be competent, and involve the competent analysis of suitable bulk reference samples, covering the scope of all regulated asbestos types, prior to inclusion in the list of laboratory-approved bulk analysts. The training procedure for bulk sampling must also be documented, and must include appropriate criteria of acceptability.
- 7.3.2 Bulk identification analysts should undergo a colour blindness (eg Ishihara) test. Colour blindness, or other visual defects, need not disqualify a prospective analyst, provided that the individual is able to properly assess the optical characteristics described in the test method (ref. also HSG 248). Ishihara tests available to complete “on-line” via the Internet are not accepted.
- 7.3.3 All analysts shall participate in, and achieve a satisfactory standard of performance in, the laboratory’s internal quality control scheme for bulk identification.
- 7.3.4 The laboratory shall maintain a list of all personnel who are authorised to carry out bulk identification and bulk sampling activities. Staff training records should contain objective evidence of the achievement of defined criteria of competence, and must include all supporting information.

8 Accommodation and Environmental Conditions (ISO/IEC 17025 clause 5.3)

8.1 AIR SAMPLING

- 8.1.1 Air sampling within an asbestos enclosure for subsequent analysis to HSG 248 requirements for clearance indicator testing should normally be undertaken in dry conditions. In the event that such conditions are not met, analysts shall record and report any deviations.

8.2 BULK SAMPLING

- 8.2.1 Authorised sampling personnel shall be aware of the potential for contamination of the samples, both from the environment, and/or other samples. A site-specific risk assessment should be conducted prior to any sampling operation. They shall also be aware of the potential for the release of fibres to the environment whilst obtaining bulk samples, and shall have documented procedures to minimise this, and for ensuring that sampling points are repaired, where appropriate. Laboratories should also have, and apply, documented procedures for preventing third-party access during inspection and preparation of an area prior to bulk sampling operations.
- 8.2.2 The equipment used should also include items required to make good those areas from where samples are removed. Sufficient equipment, or the means of cleaning equipment between uses, shall be available to minimise the possibility of cross-contamination, and to minimise the risk of contaminating the area where samples are taken.

8.3 FIBRE COUNTING

- 8.3.1 The environments in which membrane filter preparation and fibre counting are carried out should be monitored for possible fibrous contamination on a regular basis (e.g. monthly), and the results of these tests recorded. The assessments must include monitoring the airborne fibre concentration.
- 8.3.2 Laboratories that carry out fibre counting and bulk identification in adjacent areas (eg, in the same room) shall also carry out some airborne fibre monitoring during bulk analysis activities, and take all precautions necessary to minimise cross-contamination.
- 8.3.3 Fibre counting must be carried out under suitable background lighting conditions, which may involve excluding bright lights (including sunlight).

8.4 BULK IDENTIFICATION

- 8.4.1 All sample handling and preparation for bulk identification must be carried out under controlled conditions in a fume/dust cabinet with an effective filtration system (see 'Equipment'). Only final microscopy on prepared samples should be carried out in the open laboratory. Airborne fibre monitoring shall also be completed in the laboratory periodically during bulk analysis activities.
- 8.4.2 The laboratory shall have and apply documented procedures for the storage and disposal of asbestos waste. These procedures shall comply with all relevant legislative requirements.

9 Test and Calibration Methods and Method Validation (ISO/IEC 17025 clause 5.4)

9.1 AIR SAMPLING

General guidance on airborne fibre monitoring is given in the document HSG 248. This document covers the required flow rates, volumes to be sampled and number of samples required, for a range of asbestos work. Laboratories shall have documented procedures covering the range of sampling and testing activities, and shall clearly distinguish between testing for compliance with the control limit, clearance indicator and other types of testing (eg leak, background).

9.1.1 Visual Inspection

- 9.1.1.1 The primary responsibility for ensuring that an enclosure is clean rests initially with the asbestos removal contractor; however as part of the 4-stage clearance testing process, the laboratory analyst must carry out a thorough visual inspection. Laboratories shall have documented procedures for carrying out visual inspections. The laboratory's inspection shall be carried out by fully trained and authorised personnel for the purpose of clearance testing.

9.1.2 Dust Disturbance

- 9.1.2.1 Dust disturbance during the period of air sampling is a requirement for clearance indicator testing. Laboratories shall document the procedure that is to be adopted, and shall maintain records of dust disturbance activities undertaken, including reference to the method used, duration, frequency and location. (It may not be appropriate to record the location of dust disturbance activities in very small enclosures). Records of the dust disturbance activities shall be traceable to the appropriate samples.

9.1.3 Four-Stage Clearance Process (also ISO/IEC 17020 clause 10)

- 9.1.3.1 During Stage 2 of the process, analysts must visually inspect the airlocks, as well as the enclosure/work area itself. The presence of any dust/debris must be notified to the removal contractor, and remedial actions undertaken (by the contractor) prior to Stage 3 clearance air monitoring. The laboratory shall have documented in-house procedural guidance on conducting thorough visual inspections. The analyst must ensure that fine settled dust is located (and subsequently notified to the contractor) during the Stage 2 inspection, and a fingertip search must be carried out on all surfaces within the enclosure - including floor areas, at all heights, behind items etc. Appropriate equipment - eg ladders, torch, mirror, probes or screwdrivers etc, may be required.
- 9.1.3.2 The specific area where the enclosure was located - and the surrounding area - must be carefully inspected for asbestos debris. Transit and waste routes must also be re-inspected if waste has been moved during the 4-stage clearance process. Re-inspection of these areas must therefore be conducted during Stage 4.

9.2 BULK SAMPLING

- 9.2.1 Health & Safety Executive publications MDHS 100 and HSG 248 describe a method for sampling of suspected asbestos containing materials and gives guidance on asbestos sampling frequencies and these may therefore be used as the basis of an accredited test method. Laboratories wishing to use this approach will need to produce a documented in-house procedure to describe the specific methodology adopted.

9.3 FIBRE COUNTING

- 9.3.1 Laboratories shall use the method specified in HSG 248 unless there is an acceptable alternative (eg NIOSH) method, which can be demonstrated to produce equivalent results for the intended field of application.

9.4 BULK IDENTIFICATION

- 9.4.1 A low magnification stereo microscopic examination of the sample and suitable sample preparation, followed by polarised light microscopy (PLM)/dispersion staining on selected fibres - as outlined in HSG 248 - may be used. Laboratories wishing to use HSG 248 as a basis for their accredited test method will need to produce a documented in-house procedure to describe the specific methodology adopted.

- 9.4.2 Laboratories that require accreditation for analysis of asbestos in soils, slurries and sediments will need to have developed appropriate documented in-house methods that include detailed sub-sampling and sample preparation procedures.
- 9.4.3 The laboratory's in-house method for bulk identification should also contain guidance and instruction on the recognition of 'confounding' fibre types, ie, fibres that possess similar morphological/microscopic properties to the various types of asbestos. Further guidance is given in HSG 248 .

10 Estimation of Uncertainty of Measurement (ISO/IEC 17025 clause 5.4.6)

- 10.1 The test results from the counting of airborne fibre samples and identification of asbestos components are known to be liable to variation as a result of subjective assessment, differences in test methods, and operator experience and training. In order to minimise these variations, it is necessary to impose strict controls on test procedures and their implementation. Laboratories should comply with the requirements of relevant published test specifications (for example HSG 248 methods) in order to take into account factors that contribute to the overall uncertainty of measurements.

10.2 FIBRE COUNTING

- 10.2.1 The uncertainty of the method is stated in HSG 248. Laboratories should demonstrate their ability to meet the stated requirements. One way of demonstrating this may be through the use of internal quality control schemes (see Appendix 1), and via participation in proficiency testing schemes.

10.3 BULK IDENTIFICATION

- 10.3.1 This is a qualitative method. The uncertainty of the method adopted needs to be demonstrated in terms of the laboratory's ability to identify all six regulated asbestos types across a range of concentrations (see also HSG 248). The laboratory should utilise, for example, the results of the AIMS samples, internal QC results and/or the analysis of well characterised 'reference materials' in order to estimate the uncertainty of measurement that is associated with bulk identification.

10.4 IN-HOUSE CALIBRATIONS

- 10.4.1 Where flow meters and/or stage micrometers are calibrated using in-house procedures, the laboratory shall produce an estimate of the associated uncertainty of measurement. UKAS publication M3003¹² gives appropriate guidance.

11 Equipment (ISO/IEC 17025 clause 5.5)

11.1 AIR SAMPLING

- 11.1.1 The laboratory shall have documented procedures for the regular maintenance of sampling pumps. The procedures should include provision for assuring satisfactory performance of pumps, and for minimising the occurrence of failures during use. Adequate records of such maintenance shall be maintained. Regular maintenance shall be additional to that which is carried out for the correction of operational failures.

11.1.2 Regular cleaning of equipment that may be liable to contamination, or loss of performance, shall be carried out. The cleaning procedure and frequency shall be documented.

11.2 BULK SAMPLING

11.2.1 Guidance on bulk sampling equipment is contained in MDHS 100 and HSG 248.

11.3 FIBRE COUNTING

11.3.1 A calibrated stage micrometer, traceable to national standards (to an uncertainty of measurement $\leq 1 \mu\text{m}$), is required to calibrate working stage micrometers.

11.3.2 Sufficient working stage micrometers and HSL/Optometrics phase contrast test slides must be made available on-site to allow setting up of the microscope prior to each fibre counting session. In order to meet HSG 248 requirements, working stage micrometers should have maximum graduations of $2 \mu\text{m}$ - eg type S12.

11.3.3 A Walton-Beckett type eyepiece graticule must be used for fibre counting. It must have an observed diameter - compared to the traceable stage micrometer - of $100 \pm 2 \mu\text{m}$.

11.3.4 Tally counters, or other suitable methods, must be used for recording the number of fibres observed and graticule areas examined. The performance of the system should be checked periodically.

11.3.5 The laboratory should ensure that reagents that are used for filter clearance and mounting are regularly inspected and replaced, as required, to avoid potential deterioration (or loss) of samples (see also ISO/IEC 17025 clause 4.11 - preventive action).

11.4 BULK IDENTIFICATION

11.4.1 The laboratory shall be equipped with a fume/dust cabinet with adequate extraction and filter facilities (refer to HSG 248). The unit must be large enough to incorporate a low power stereo microscope and allow sample manipulation/treatment.

11.4.2 The laboratory must hold a set of reference, single component, asbestos samples, together with a selection of samples having characteristics similar to materials likely to be encountered.

11.4.3 The laboratory should have access to suitable facilities and chemicals to enable sample pre-treatment to be carried out if necessary.

11.5 FOUR STAGE CLEARANCE PROCESS (also ISO/IEC 17020 Clause 9)

11.5.1 The laboratory must ensure that respiratory protective equipment is maintained and inspected in accordance with a defined programme. Suitable records must also be maintained in order to meet legislative requirements in this area (ref Also HSG 248 and CAR 2006).

11.5.2 The laboratory shall have documented procedures in place for the regular inspection and maintenance of equipment used during 4-stage clearance work - including, for example, ladders and other access equipment. Relevant records shall also be maintained.

The use of site equipment checklists is desirable, as they will minimise the likelihood of wasted journeys by analysts, thus ensuring that additional time pressures are not placed on analysts carrying out clearance work.

12 Measurement Traceability (ISO/IEC 17025 clause 5.6)

12.1 AIR SAMPLING

12.1.1 To ensure traceability of calibration measurements of flow meters, master flow meter(s) shall be used that is/are traceable directly to national/international standards, over the range at which working flow meters are to be used.

12.1.2 Master and working flow meters will require periodic re-calibration. Generally, calibration intervals should not exceed the following (without the necessary documentary evidence to justify a longer interval):

Master flow meters - annually
Working flow meters - monthly

12.1.3 Master flow meters shall be used to calibrate working flow meters. The working flow meters are used for routine checking of the flow rates of sampling pumps. A documented calibration procedure shall be used, and records shall be kept of all calibrations carried out.

12.1.4 The uncertainty of measurement of working flow meters shall be such as not to compromise the final uncertainty of measurement required, ie, to set the flow rate of the pump to $\pm 10\%$ (and preferably to $\pm 5\%$) of the required flow rate.

12.2 GUIDANCE ON PROCEDURES FOR CALIBRATION OF WORKING FLOW METERS

12.2.1 In order to minimise errors due to pressure drop between the two meters, the tubing connecting the flow meters should not be of smaller internal diameter than the connecting ports of the flow meters, and its length should be kept to a minimum. All connections should be airtight.

12.2.2 Restrictions or valves should not be fitted between the two flow meters.

12.2.3 Where variable area flow meters are chosen for both the master and working flow meters, the scale length of the master should be equal to, or greater than, the scale length of the working flow meter.

12.3 SAMPLING PUMPS

12.3.1 HSG 248 requires that the flow rate of sampling pumps be checked and recorded at the start of the sampling period, and also during the sampling period, where appropriate. The flow rate should also be checked and recorded at the end of the sampling period, and where appropriate a correction applied to account for flow rate variation during sampling. The results of the flow rate checks shall be recorded.

12.4 CORRECTIONS FOR TEMPERATURE AND PRESSURE

12.4.1 Temperature and barometric pressure should be assessed and recorded at the sampling location, where these locations are outside normal operating conditions, before air sampling is undertaken to allow corrections to be made, where appropriate, for any temperature or pressure differential.

12.4.2 For temperature measurements, laboratories may use a thermometer complying with, eg, BS 593:1989¹³ (or other suitable specification) as a reference standard. The laboratory should carry out an ice point check on the reference thermometer after receipt, and should also carry out performance checks (e.g., ice point checks) on at least an annual basis thereafter. In-house calibration of working thermometers shall be carried out in accordance with documented procedures, in accordance with the requirements of UKAS Publication LAB 11¹⁴. (It should be noted that the above-specified guidance is not as stringent as that given in LAB 11 - it is recognised that the uncertainty contribution that is due to temperature variations will normally be relatively small).

12.4.3 For barometric pressure measurements, laboratories may often obtain 'reference' measurements from local meteorological stations, airports etc. In-house calibration of working barometers shall be carried out in accordance with documented procedures, and in accordance with a defined programme.

12.5 TIME

12.5.1 Calibration of working time piece(s) will be carried out against an acceptable 'traceable' source (eg, BT speaking clock, CEEFAX, TELETXT). Timepieces should normally be calibrated at least annually. Records of such calibrations shall be maintained.

12.6 STABILISED FLOW PUMPS

12.6.1 Pumps with stabilised flow controls shall also be calibrated in accordance with documented procedures. The laboratory shall demonstrate that the performance requirements as specified in HSG 248 are met.

12.7 GUIDANCE ON SELECTION OF FLOW METERS

The following guidance is given to assist when choosing variable area flow meters, to ensure that appropriate scale divisions and sufficiently long tube lengths are used.

12.7.1 The following table indicates the requirements for three common air flow rates required in asbestos airborne fibre sampling:

Required flow rate (litre/min)	5% setting limit (± litre/min)
8.0	0.40
4.0	0.20
1.0	0.05

12.7.2 In the case of variable area flow meters, the resolution of both master and working flow meters shall be sufficient to allow the above setting limits to be achieved.

12.7.3 The useable scale length of a variable area flow meter is as defined on the calibration certificate, and will normally be less than the scale end points. It is unlikely that a single flow meter of this type will be sufficient to cover the range of flow rates required to monitor airborne fibre concentrations to control limits and the clearance indicator. Laboratories should therefore be equipped with calibrated master and working flow meters to cover the full range of flow rates given in HSG 248.

12.7.4 Although the variable area (rotameter) air flow meter is probably the most common design of flow monitoring equipment utilised in environmental air sampling, the use of alternative techniques is permitted providing that the basic requirements of the test specification are met. With some alternative techniques, the necessity for pressure and temperature correction may be reduced or eliminated. In all cases, the manufacturer's guidance should be followed. The suitability, or otherwise, of alternative techniques will be determined during assessment.

12.8 FIBRE COUNTING

- 12.8.1 Working stage micrometers shall be calibrated at least annually using the traceable stage micrometer. The traceable stage micrometer shall be re-calibrated periodically, eg, every 5 years. Re-calibration should take place sooner if its condition or accuracy appears to have changed (eg, if the annual check reveals changes in the values obtained for the working stage micrometer).
- 12.8.2 Working stage micrometers must be used by analysts to measure the diameter of the Walton-Beckett graticule prior to each fibre counting session, and the result recorded.

12.9 BULK IDENTIFICATION

- 12.9.1 Containers containing refractive index liquids must be labelled with information regarding the liquid's calibration status, the due date for next calibration and expiry date.
- 12.9.2 Refractive index liquids are not generally traceable directly to national standards. Laboratories should have a documented procedure for ensuring that refractive index liquids remain within specification. Performance checks should be made when liquids are suspected of being contaminated by asbestos, or in situations where a laboratory wishes to exceed the recommended shelf life. Confirmation of suitability can be achieved by using a calibrated refractometer, or by the use of reference materials with refractive indices traceable to national standards. (Traceability to international standards, eg, American National Bureau of Standards, is achievable for Cargille refractive index liquids).

13 Sampling (ISO/IEC 17025 clause 5.7)

- 13.1 Check-lists should be used to ensure that all equipment required for on-site sampling is readily available.
- 13.2 Visual records, such as marked-up plans and/or photographic records should be used, wherever practicable. In the absence of formal plans/drawings, the laboratory should use sketches/diagrams to record sampling details.

13.3 AIR SAMPLING

- 13.3.1 Method statements must be consulted by laboratories to establish the scope of works as part of the 4-stage clearance process requirements (see Section 4.3.2, 5.1.4 and 5.1.1). Detailed requirements on air sampling methodology are given in HSG 248.

13.4 BULK SAMPLING

- 13.4.1 Laboratories shall have documented methods to cover both the physical aspects of obtaining a sample, and the sampling procedures to be employed. The laboratory's documented procedures should contain guidance on the planned approach including an appropriate risk assessment to sampling the various types of asbestos-containing materials, ie, asbestos cement products, loose asbestos insulation, sprayed coating etc.
- 13.4.2 In-house methods for bulk sampling shall be based on reliable, published reference sources, such as HSE MDHS 100 and HSG 248.

- 13.4.3 The laboratory should use appropriate labels to identify sampling points, wherever practicable (or when required by the client). The sample details recorded on the labels should be sufficient to allow traceability through the laboratory's test records.

14 Handling of Test and Calibration Items (ISO/IEC 17025 clause 5.8)

14.1 AIR SAMPLING

- 14.1.1 Sampling procedures and records shall be such that there is a traceable link from the sampling pump and cowl, to the individual filter.
- 14.1.2 All samples will be uniquely identified and the date, times and location of sampling, relevant environmental conditions, identification of sampler/wearer (and any other relevant information) shall be recorded at the time of sampling.
- 14.1.3 The use of brushes or brooms for the purpose of dust disturbance may give rise to excessive amounts of particulate matter on filters, and thus invalidate samples taken. Laboratories should therefore consider the use of shorter sampling periods (and the pooling of measurements to give the required minimum sampled volumes), in order to alleviate such problems. Details of alternative sampling strategies adopted must be included in the laboratory's records, and in the air monitoring report accompanying the Certificate of Reoccupation.
- 14.1.4 Filters should be retained in capped filter holders for transport into and out of sampling areas.
- 14.1.5 Slides should be retained for at least six months, in accordance with HSG 248 requirements.

14.2 BULK SAMPLING

- 14.2.1 To avoid cross-contamination, individual bulk samples shall be placed into a double-containment system (eg, double bagging with resealable polythene bags) immediately after taking the samples. Both containers should be labelled with sufficient details to identify the origin and identity of the sample, unless the inner details are clearly visible through the outer container.
- 14.2.2 Sample containers shall be re-opened only in the fume cabinet that is used for the analysis of bulk samples.
- 14.2.3 Bulk samples, or representative sub-samples, should be retained for at least six months, in accordance with MDHS 100 requirements, unless contract review specifies otherwise eg, those items associated with litigation or prosecution.

15 Assuring the Quality of Test and Calibration Results (ISO/IEC 17025 clause 5.9)

15.1 INTERNAL QUALITY CONTROL

15.1.1 Fibre Counting

- 15.1.1.1 All analysts authorised to carry out fibre counting must participate in the laboratory's own internal quality control (QC) scheme and maintain a satisfactory level of performance against a defined set of criteria.
- 15.1.1.2 Guidance on setting-up and maintaining a suitable internal QC scheme is given in Appendix 1 of this document.
- 15.1.1.3 The internal scheme should monitor the performance of analysts relative to the laboratory mean performance. The scheme should incorporate the counting of reference slides with stated acceptable mean results. Fibre density similar to those used in the RICE scheme may assist in the comparison of internal QC performance with RICE performance. Randomly selected routine slides should also be incorporated into the internal QC scheme; this will serve to monitor consistency and performance of each counter from sample to sample, and day-to-day.
- 15.1.1.4 The QC scheme should reflect the nature of the work undertaken by the laboratory. Analysts who undertake fibre counting on-site shall therefore carry out an appropriate proportion of their quality control in on-site locations.
- 15.1.1.5 A minimum acceptable quality control for an established laboratory is 4 reference slides and 1 randomly selected routine slide per working month per analyst.
- 15.1.1.6 A procedure must also be in place, which states the predetermined frequency and method for randomly assessing (replicate testing) routine slides for reproducibility.
- 15.1.1.7 In cases where fibre counting is rarely undertaken, additional quality control will be necessary to demonstrate ongoing competence.
- 15.1.1.8 In the event that the number of graticule areas examined in any 8-hour period exceeds 2400, additional documented quality control shall be undertaken.
- 15.1.1.9 Individual analysts shall receive periodic feedback of their performance, in a graphical form. Their performance shall be assessed against defined and documented criteria of acceptability on at least a monthly basis.
- 15.1.1.10 The laboratory shall have a defined policy and procedure for implementing corrective action, in the event of analyst performance falling outside defined limits of acceptability (see also Appendix 1).

15.1.2 Bulk Identification

- 15.1.2.1 All analysts authorised to carry out bulk identification shall participate in the laboratory's own internal quality control (QC) scheme and maintain a satisfactory level of performance against a defined set of criteria. The performance scoring system may, for example, be based on the AIMS scoring system.
- 15.1.2.2 The laboratory's internal QC scheme should incorporate the use of bulk 'secondary reference' materials and routine samples to reflect the laboratory's accredited scope. The scheme shall incorporate all six regulated asbestos types at a variety of concentrations.

- 15.1.2.3 A minimum acceptable quality control would be 2 samples per working month per analyst. The monthly QC programme should incorporate the use of a routine (previously-analysed) sample, and a sample from the laboratory's stock of secondary bulk reference materials. (In this way, the bulk internal QC scheme will be operated in a similar fashion to the internal QC scheme for fibre counting).
- 15.1.2.4 A routine QA programme in line with HSG 248 Section A2.55 must also be in place.
- 15.1.2.5 In cases where bulk identification is rarely undertaken, additional quality control will be necessary to demonstrate ongoing competence.

15.2 EXTERNAL QUALITY CONTROL

15.2.1 Fibre Counting

- 15.2.1.1 All analysts who are authorised to carry out fibre counting shall participate in the Regular Interlaboratory Counting Exchanges (RICE) scheme. Laboratories should achieve and maintain a 'satisfactory' classification in the scheme.
- 15.2.1.2 Categories of RICE performance are issued after a laboratory has participated in four quarterly rounds (circulations), ie, a minimum of about one year from initial participation.
- 15.2.1.3 The laboratory shall retain copies of all original data that relates to RICE counts within its record system.
- 15.2.1.4 Staff involved in fibre counting at all named sites documented on the schedule of accreditation shall participate in the external proficiency-testing scheme.
- 15.2.1.5 The laboratory shall implement its defined nonconforming work procedures in the event that RICE performance becomes unsatisfactory. If a laboratory's RICE performance falls outside satisfactory classification, UKAS must be informed immediately; the accreditation status of the laboratory will be reviewed and may be suspended or withdrawn.

15.2.2 Applicant Laboratories

- 15.2.2.1 Laboratories intending to undertake fibre counting are strongly advised to apply for RICE participation at the earliest possible opportunity.
- 15.2.2.2 In order to demonstrate competence in fibre counting at assessment, the laboratory should have completed a minimum of two RICE circulations/rounds. The results of the completed rounds should result in a 'satisfactory' classification by RICE if extrapolated over four rounds.
- 15.2.2.3 If an applicant laboratory's RICE performance subsequently falls outside satisfactory classification, then the laboratory may not be offered accreditation, or the accreditation status will be reviewed and may be suspended or withdrawn (if already granted).

15.2.3 Bulk Identification

- 15.2.3.1 The laboratory shall participate in appropriate interlaboratory comparison exercises or proficiency testing schemes, eg, the Asbestos in Materials (AIMS) scheme.
- 15.2.3.2 In order to demonstrate competence in bulk identification at initial assessment, the laboratory shall have completed a minimum of two AIMS circulations/rounds. The results of the completed rounds should result in a 'satisfactory' classification.

- 15.2.3.3 Staff involved in bulk identification at all named sites documented on the schedule of accreditation will participate in the external proficiency-testing scheme, each member of staff shall participate in the external scheme at least once in every 12 months.
- 15.2.3.4 The laboratory shall implement its defined nonconforming work procedures in the event that deficiencies in interlaboratory comparisons or proficiency testing schemes are identified. If a laboratory's AIMS performance falls outside satisfactory classification, UKAS must be informed immediately; the accreditation of the laboratory will be reviewed and may be suspended or withdrawn.

16 Reporting the Results (ISO/IEC 17025 clause 5.10)

- 16.1 Laboratories shall ensure that the requirements of DTI Publication URN 98/887¹⁵ are met whenever the accreditation symbols or reference to accreditation are used.
- 16.2 Laboratories that include opinions and interpretations in test reports shall follow the guidance contained in UKAS Publication LAB 1¹⁶. Disclaimers shall also be included in reports that include surveying activities, when accreditation for asbestos surveying is not held (see also Section 1.2).

16.3 AIR SAMPLING

- 16.3.1 For clearance indicator testing, it is not considered practical to report the associated estimated uncertainty of measurement. The laboratory shall, however, comply with individual client requirements and report uncertainty, if requested.
- 16.3.2 Activities such as 'smoke testing' (and 'wipe testing') are not covered by UKAS accreditation; the laboratory shall ensure that the test reports contain relevant disclaimers, where appropriate.

16.4 BULK IDENTIFICATION

- 16.4.1 The laboratory shall ensure that the quantification of asbestos content is not reported ("trace" is permitted) Reports must not refer to percentages, minor/major content etc. The laboratory will also ensure that the identification of non-asbestos fibre types are reported as non-accredited activities.

17 Additional ISO/IEC 17020 Requirements – Four-Stage Clearance Process

The following paragraphs contain guidance on specific requirements of ISO/IEC 17020 (inspection activities).

17.1 Liability insurance cover

ISO/IEC 17020 clause 3.4

- 17.1.1 The laboratory shall hold liability insurance cover that relates to the carrying out of site clearance certification following asbestos removal. Public & Employers Liability and Professional Indemnity (this shall also include bodily injury cover) are required as a minimum.

17.1.2 Additional guidance on requirements for insurance liability cover is given in IAF/ILAC-A4: 2004 to which reference should be made.

17.2 Independence, impartiality and integrity **ISO/IEC 17020 clause 4**
(See also ISO/IEC 17025 clause 4.1)

17.2.1 If a laboratory is employed for site clearance certification by the removal contractor who is carrying out the removal work, then the laboratory should be independent from that removal contractor.

17.2.2 This means that if a laboratory has any 'links' with a removal contractor by common ownership, common management, contractual arrangements, informal understanding, or other means that may have an ability to influence the outcome of a site clearance certification, then the laboratory shall not perform site clearance certification for that removal contractor which has links with the laboratory.

If, due to exceptional circumstances, the laboratory has to perform site clearance certification for a removal contractor that has links with the laboratory, then the laboratory must demonstrate that the laboratory's analysts have the necessary independence to be completely impartial when conducting site clearance certification. In such cases the assessment by UKAS of measures taken by the laboratory to assure the impartiality of analysts may require additional assessment effort, depending on the laboratory's arrangements for assuring impartiality and therefore, such arrangements should be discussed with UKAS at the planning stages of the assessment.

17.2.3 Any laboratory, whether it has links with removal contractors or not, shall identify the circumstances in which analysts may encounter commercial, financial or other pressures that may affect their impartiality and operational judgement in carrying out on-site clearance work, and shall demonstrate the measures taken to assure impartiality.

17.3 Guidance on staff conduct **ISO/IEC 17020 clause 8.5**

17.3.1 The laboratory shall provide guidance for the conduct of its staff whilst carrying out 4-stage clearance work. Such guidance may cover issues relating to work ethics, impartiality, personal safety, relationship with clients/contractors, adherence to Company rules, protection of clients' proprietary rights, and any other issues needed to assure the proper conduct of laboratory staff.

17.4 Safety procedures and instructions **ISO/IEC 17020 clause 10.8**

17.4.1 Risk assessments shall be carried out for all jobs involving 4-stage site clearance work. These must be fully documented, and must include consideration of all site-specific hazards that are likely to be encountered. Laboratories must consider aspects such as the possible need for working at heights, 'lone working', working in confined spaces etc - and also their obligation to take reasonable steps to ensure that the health and safety of other persons are not affected by their actions.

17.4.2 Procedures for carrying out risk assessments must be documented, and analysts must receive adequate training in the fitting, wearing and care of respiratory protective equipment (including refresher training, where relevant). In addition, analysts must receive training in decontamination procedures, transiting procedures, and the use of airlocks and hygiene facilities.

17.4.3 Arrangements should be made for effective emergency procedures to be enacted in the event of loss of services to the hygiene unit, failure of any appliance - including negative pressure unit(s), accident or illness, fire etc. Emergency procedures should include access to the emergency services (eg via the use of a mobile telephone), and also knowledge of escape routes etc.

Appendix 1

Fibre Counting (Asbestos) by the Use of Optical Microscopy – An Internal Quality Control Scheme

This guidance is based on the technical paper by Ogden et al¹⁷ and has been prepared by one of the authors, Mr Tim Shenton-Taylor. The paper also contains additional useful information on operating internal QC schemes for fibre counting.

a. INTRODUCTION

- 1.1 Laboratories seeking UKAS accreditation for fibre counting are required to authorise those analysts undertaking the counting. These analysts are required to participate, and maintain a satisfactory performance, in an internal quality control scheme that enables their performance to be assessed on at least a monthly basis. Descriptions of four internal quality control schemes were published by Ogden *et al*, but with the majority of accredited laboratories being primarily involved in counting low density (clearance indicator testing) slides, the most popular scheme adopted is that described as 'The LGC System' in the paper. Some laboratories have, however, encountered difficulties in interpreting the operation of this scheme. In addition, the paper contains only limited guidance on how the individual's performance can be assessed.
- 1.2 This Appendix is intended to give more detailed guidance on how a laboratory might initiate an internal quality control scheme, and how individual counter performance can be assessed. It assumes that no data exists at the starting point, but acknowledges that laboratories may, in practice, be able to incorporate data previously produced by its counters.
- 1.3 One major change that this Appendix makes to the scheme as published is the use of density results (fibres/mm²) rather than number results (fibres counted in a number of fields). This has significant advantages when producing and interpreting the data to be used and removes the problems posed (but often forgotten) of varying values for the Walton-Beckett graticule diameters, and the number of graticule areas actually counted.

2 OBJECTIVES OF FIBRE COUNTING INTERNAL QUALITY CONTROL SCHEMES

- 2.1 The scheme described is designed to meet the needs of the laboratory to ensure that its individual counters are performing satisfactorily both as individuals, and within the laboratory as a whole. It should, however, be remembered that it represents only one aspect of quality control with respect to fibre counting, since there is also the requirement for the laboratory to participate in the Regular Interlaboratory Counting Exchange (RICE) scheme, and to undertake recounting of randomly-selected routine slides. The individual/laboratory performance within these additional quality control activities must be assessed in relation to defined criteria of acceptable performance. Laboratories should be aware that criteria for the counting of routine slides cannot be defined in the way used within RICE, or to the rigours of the internal quality control scheme that this Appendix describes.

3 REFERENCE SLIDES - QUALITY AND FIBRE DENSITY RANGES

- 3.1 Ideally, a set of at least thirty reference slides should be established as soon as possible, but in any case within 12 months after accreditation is granted. In order to reduce the time to get a scheme running, an initial set of ten reference slides is required. The slides must be permanently mounted, preferably by the method routinely used by the laboratory. The density range of the reference slides should reflect the levels routinely encountered by the laboratory, and should be divided into three groups. Laboratories are encouraged also to include slides of other fibre types than the usual amphibole slides, for example chrysotile, machine made vitreous fibres

(MMVF) or synthetic fibres. If necessary such slides could be generated in house or obtained from other sources.

- 3.2 These groups are termed: Low <15f/mm², Medium 15-30f/mm² and High >30f/mm². The reference set for a laboratory concerned primarily with 'clearance indicator' type work should contain ~25% Low, ~50% Medium and ~25% High density slides.
- 3.3 The figure above assume a notional sample volume of ~480 litres, so laboratories that routinely and consistently sample higher volumes may need to set different levels of fibre density for the three ranges.

4 REFERENCE SLIDES - SETTING THE LABORATORY REFERENCE VALUE

- 4.1 In order to set a laboratory reference value, in fibres/mm², for the reference slides, at least ten counts should be carried out on each slide. These counts should preferably be generated by those analysts in the laboratory who perform to the requirements of 'satisfactory' classification in the RICE scheme. Counts on prospective reference slides can be provided by external counters but care should be taken to check the eventual data carefully to ensure that a grouping effect is not present (ie, that the external counters are not consistently 'outliers' when compared to those of the laboratory's own counters).
- 4.2 The laboratory reference value is then obtained by calculating the arithmetic mean of the set of counts obtained on the prospective reference slide.
- 4.3 The use of the arithmetic mean represents the simplest solution and is consistent with previous approaches. However, it is recognised that other systems might be more appropriate, eg, the use of the median if the results were to fit a skewed normal distribution. This possibility was investigated, in a limited way, by examining data on prospective reference slides produced by three laboratories on three different sets of slides. For two of the three laboratories there was no significant difference (a visual, not statistical assessment) between the value of the arithmetic mean and the median. This was not the case in the third, but it is believed that this may have been attributed to the fact that the data had been generated by counters at different locations, and that individual counters appeared to be counting somewhat erratically. It should be emphasised that limited data was available in all cases. It is interesting to note that the data from the latter laboratory appeared to approach a log-normal distribution.

5 REFERENCE SLIDES - SCREENING PROCESS

- 5.1 The reference slides should be checked to ensure that they are of good quality in respect of mounting, and that the fibres are evenly distributed over the whole of the filter area. An example of the data that might be collected for two prospective reference slides is given in Table 1. Some check should be made on the spread of data to ensure that the slide is suitable for use as a reference slide. As an initial suggestion, the following criteria should be met: for low density slides, the standard deviation should be <50% of the mean value, for medium density it should be <40%, and for high density it should be <30%. It must be emphasised that these values are a first 'guesstimate' based on limited data, and they may need to be revised as more data becomes available.

Table 1

Reference slide No.1

COUNT			COUNT DATA			RESULT	
No.	Date	Counter	W/B Diam.	Fibres	Fields	Fibres/mm ²	
1	3 rd Jan.	AB	100	17	200	10.83	
2	3 rd Jan.	CD	102	20	200	12.24	
3	4 th Jan.	EF	99	17	210	10.51	
4	5 th Jan.	AB	100	13½	200	6.60	
5	5 th Jan.	CD	102	15	200	9.18	
6	5 th Jan.	EF	99	26	204	16.55	
7	5 th Jan.	AB	100	24½	200	15.61	
8	8 th Jan.	AB	100	10	200	6.37	
9	12 th Jan.	EF	99	16	200	10.39	First 10 counts:-
10	16 th Jan.	CD	102	19½	220	10.85	Mean = 11.11 ESD = 4.01
11	16 th Jan.	EF	99	19	200	12.34	[Suitability check gives
12	18 th Jan.	AB	100	18	200	11.46	standard deviation of 3.07,
13	1 st Feb.	CD	102	21½	200	13.16	which is 27.6% of Mean - i.e.
14	1 st Feb.	EF	99	20	200	12.99	<50%, so slide is OK].

Reference slide No.2

COUNT			COUNT DATA			RESULT	
No.	Date	Counter	W/B Diam.	Fibres	Fields	Fibres/mm ²	
1	3 rd Jan.	AB	100	102½	42	310.9	
2	5 th Jan.	AB	100	120	45	339.7	
3	5 th Jan.	CD	102	101	38	325.3	
4	5 th Jan.	EF	99	50	20	324.8	
5	12 th Jan.	AB	100	110	35	400.4	
6	12 th Jan.	CD	102	102½	46	272.7	
7	16 th Jan.	EF	99	50	30	216.5	
8	20 th Jan.	AB	100	100	34	374.7	
9	20 th Jan.	CD	102	101½	47	264.3	First 10 counts:-
10	24 th Jan.	EF	99	50½	22	298.2	Mean = 312.7 ESD = 64.99
11	1 st Feb.	CD	102	102	40	312.1	[Suitability check gives
12	1 st Feb.	EF	99	100½	33	395.5	standard deviation of 53.73,
13	5 th Feb.	AB	100	52	24	276.0	which is 17.2% of Mean - i.e.
14	17 th Mar.	AB	100	102	44	295.3	<30%, so slide is OK].

- 5.2 The standard deviations given for the reference slides in Table 1 have been calculated using the formula most commonly used in electronic calculators:

$$\text{Standard Deviation} = \sqrt{\frac{\sum(X - \bar{X})^2}{n - 1}}$$

6 CALCULATION OF THE EXPECTED STANDARD DEVIATION (ESD)

- 6.1 When the laboratory reference value has been assigned to a slide, the 'ESD', for that slide, may be calculated. This may be achieved by substituting the Laboratory Reference Data value for N , in terms of fibres/mm², in the Ogden¹⁸ equation:

$$\text{ESD} = \sqrt{(N + 0.04N^2)}$$

This equation is strictly only applicable when using the number result system (see Section 1.3). In order to minimise the effects of changing to the fibre density system, it is necessary to ensure that 200 fields or 100 fibres are counted when using the reference slides. It remains appropriate to require that at least 20 fields are counted.

Where the mean fibre density is less than approximately 2 f/mm², apply a minimum ESD value of 2.0. Where the reference density is less than 10 f/mm², there is a risk that counts which are within the confidence limits in Table A1.6 in HSG 248 will give rise to unacceptable PV results in this scheme. Laboratories should be discouraged from using slides below 10 f/mm² if possible. Preferably, they should use slides which are at or just below the 'clearance indicator' (equivalent to about 13f/mm²).

- 6.2 An example for a reference set of thirty slides is given in Table 2. The ESD values are given to two decimal places but this should not be taken to imply any particular level of accuracy.
- 6.3 It is recommended that the laboratory reference value is recalculated when a slide has results from twenty counts. This value is then used to calculate the new ESD for future use. Recalculation of the laboratory reference value should take place after every subsequent ten counts but no action is taken unless the new value is more than a defined value from the reference value. The defined value for unacceptable change may have to vary with slide density, but an initial value of 10% should be tried. This is obviously more likely to cause problems with low density slides. Should this limit be exceeded, then the data from the reference slide should be examined to check whether counter performance, or the quality of the slide, is deteriorating. The former circumstance might require retraining of a counter, whilst the latter may necessitate removal of the individual slide from the reference stock.

7 CALCULATION OF PERFORMANCE

- 7.1 Each authorised counter should count at least four laboratory reference slides per month (see Section 15.1.1.5). These should generally reflect the type of slides routinely encountered. The typical mix for a counter primarily involved in 'clearance indicator' type work should be 2 low, 1 medium and 1 high, but this should not be a standard mix for obvious reasons.

Table 2

Reference Slide No.	Date Introduced	Reference Data		
		N (f/mm ²)	ESD	No. of Counts
1	16 th Jan.	11.11	4.01	10
2	24 th Jan.	312.7	64.99	10
3	16 th Jan.	5.48	2.58	10
4	16 th Jan.	25.22	7.12	20
5	24 th Jan.	45.09	11.24	20
6	16 th Jan.	8.08	3.27	10
7	24 th Jan.	144.8	31.36	20
8	24 th Jan.	22.17	6.47	10
9	24 th Jan.	10.77	3.93	10
10	24 th Jan.	4.96	2.44	10
11	19 th Feb.	2.14	2.00	10
12	19 th Feb.	68.53	16.01	10
13	19 th Feb.	12.20	4.26	10
14	19 th Feb.	37.46	9.67	10
15	19 th Feb.	8.47	3.37	10
16	19 th Feb.	110.2	24.41	10
17	19 th Feb.	12.62	4.36	10
18	19 th Feb.	47.47	11.73	10
19	19 th Feb.	14.39	4.76	10
20	19 th Feb.	3.58	2.02	10
21	29 th Mar.	20.31	6.07	10
22	29 th Mar.	6.14	2.77	10
23	29 th Mar.	247.3	51.90	10
24	29 th Mar.	10.31	3.82	10
25	29 th Mar.	16.47	5.23	10
26	29 th Mar.	12.92	4.43	10
27	29 th Mar.	28.39	7.79	10
28	29 th Mar.	18.00	5.56	10
29	29 th Mar.	1.07	2.00	10
30	29 th Mar.	14.80	4.85	10

- 7.2 Table 3 shows the results produced by counter 'AB' over the period January to April. It shows the date of counting, microscope used, the reference slides counted, and the results obtained in terms of numbers of fibres and fields. The counter also submits the calculated density (f/mm²) using the measured value for the Walton-Beckett graticule diameter. The Laboratory Reference Values are known and the performance of 'AB' must now be assessed by comparison of the individual's results with the reference value. AB's performance value (PV) is calculated - for each individual slide counted - using the following formula:

$$PV = \frac{\text{AB's result (f / mm}^2\text{)} - \text{Laboratory Reference Value } N \text{ (f / mm}^2\text{)}}{\text{Laboratory Reference Value ESD}}$$

- 7.3 The performance results obtained can then be plotted in a graphical format (see Section 15.1.1.8). The results generated from the counting of low density slides are differentiated from medium and high density in order to facilitate the identification of possible retraining requirements, should those become necessary.

- 7.4 The scheme described can be computerised, eg, using spreadsheets.

8 ASSESSMENT OF COUNTER PERFORMANCE

- 8.1 Each individual counter's performance should be checked on a monthly basis (ie after the completion of a QC round for the counter) against a defined set of acceptance criteria. Whilst it would be desirable to be able to set tight controls at the outset, it is more sensible to set achievable limits to begin with (within reason of course), and to gradually tighten them as experience of the scheme increases.

9 CRITERIA OF ACCEPTABLE PERFORMANCE

- 9.1 An established laboratory that has run an internal quality control scheme for some time (perhaps with a fairly stable group of counters) should be able to meet the following criteria:
- (a) No individual performance value to be outside the range of -2.0 to +2.0.
 - (b) A running modulated (i.e., ignore signs) mean, for an individual counter, of the last six performance values, to be maintained at <1.0.
 - (c) At least 80% of the performance values from the last 4 months to lie between -1.25 and +1.25.
- 9.2 For a laboratory beginning to operate an internal quality control scheme for fibre counting, the following criteria might be more appropriate. (It must be remembered that the aim will be to tighten the acceptable performance limits as soon as practicable). The initial criteria might then be:
- (a) No individual performance value to be outside the range -2.0 to +2.0.
 - (b) A running modulated mean of the last six performance values to be maintained at <1.5, with 1.0 acting as a warning level.
 - (c) At least 80% of the performance values from the last four months to lie between -1.5 and +1.5.

Table 3

QC Period	Date Counted	Micro Used	AB				Laboratory Reference Values		AB's Performance Value	AB's Rolling Mean
			Count Results				N (f/mm ²)	ESD		
			Slide	Fibres	Fields	f/mm ²				
January	28 th Jan.	A	1	18	200	11.46	11.11	4.01	+0.09	
January	28 th Jan.	A	2	100	51	249.8	312.7	64.99	-0.97	
January	28 th Jan.	A	3	7½	200	4.78	5.48	2.58	-0.27	
January	28 th Jan.	A	4	32	200	20.38	25.22	7.12	-0.68	
January	28 th Jan.	A	5	50½	126	51.06	45.09	11.24	+0.53	
February	7 th Feb.	A	6	6½	200	4.14	8.08	3.27	-1.20	0.62
February	10 th Feb.	B	7	100	104	122.49	144.8	31.36	-0.71	0.73
February	10 th Feb.	B	8	35	200	22.29	22.17	6.47	+0.02	0.57
February	16 th Feb.	A	9	17	200	10.83	10.77	3.93	+0.02	0.53
February	16 th Feb.	A	10	16	200	10.19	4.96	2.44	+2.14	0.77
(February)	3 rd Mar.	A	10(recount)	10	200	6.37	4.96	2.44	+0.58	
March	17 th Mar.	A	2	102	44	295.3	312.7	64.99	-0.27	0.73
March	17 th Mar.	A	13	30½	200	19.43	12.20	4.26	+1.70	0.81
March	17 th Mar.	A	15	14	200	8.92	8.47	3.37	+0.13	0.71
March	17 th Mar.	A	17	20½	200	13.06	12.62	4.36	+0.10	0.73
March	17 th Mar.	A	20	2½	200	1.59	3.58	2.02	-0.99	0.89
April	10 th Apr.	B	7	50	48	132.7	144.8	31.36	-0.39	0.60
April	10 th Apr.	B	8	38½	200	24.52	22.17	6.47	+0.36	0.61
April	12 th Apr.	A	27	50	180	35.39	28.39	7.79	+0.90	0.48
April	12 th Apr.	A	19	17½	200	11.15	14.39	4.76	-0.68	0.57
April	12 th Apr.	A	20	6½	200	4.14	3.58	2.02	+0.28	0.60

Note: Performance Values that are obtained from slide recounts (e.g., February recount value of +0.58) should not be used in calculation of the (6-point) Rolling Mean.

10 CONSEQUENCES OF FAILING TO MEET CRITERIA OF ACCEPTABLE PERFORMANCE

- 10.1 Failure of a counter to meet any of the above criteria must result in appropriate action by a designated person (normally the quality manager) who is responsible for checking system performance on a month basis. The three criteria will require different responses and are discussed separately.
- 10.2 A counter returning a performance value outside the range -2.0 to +2.0 (see paragraphs 9.1(a) and 9.2(a)) should be required to recount the slide concerned as soon as possible, and the counter should be temporarily withdrawn from the authorised list (ie, without amendment to the list of approved counters). The original performance values should be used when calculating the analysts running modulated mean value to give an accurate modulated mean value and any re-count values should be documented but should be excluded from the modulated mean value calculation (see footnote to Table 3). If the recount result enables the counter's performance to be assessed as 'satisfactory' then no specific further action is necessary. If the recount result still leaves the analyst outside the acceptable criteria, then action must be taken to identify and correct the problem. If informal or formal retraining takes place, the counter should be required to count a defined number of reference slides, usually linked to the laboratory's training schedules, and must meet defined acceptance criteria in order to return to the authorised list. If a long delay is anticipated in the corrective action programme (eg, of more than 1 week) then the analyst should be formally removed from the list of authorised counters.
- 10.3 The use of a warning level indicator (see paragraph 9.2(b)) is designed to prevent counters going outside the level set for the running modulated mean. Should a counter fail to meet this criterion (see paragraphs 9.1(b) and 9.2(b)), then they should be removed from the list of authorised counters and undergo some formal retraining. This should again be linked to the training schedule, but before returning to the list of authorised counters the individual must complete a formal assessment, using reference slides, to ensure that they are meeting the criteria laid down. Since this process is likely to take more time than the action required under 10.2, it is probable that the name of the individual will need to be formally removed from the list of authorised counters.
- 10.4 Interpretation of an individual's performance to the third criterion (see paragraphs 9.1(c) and 9.2(c)) must be a little more flexible, since it must allow the quality manager (or other designated person), the opportunity to interpret reasons for failing to comply. This interpretation will include consideration of the types of samples involved, and the degree of non-compliance. It must always be remembered that the possibility of 'rogue' results when dealing with low density slides is quite high, and the QC scheme should not result in a constant stream of counters requiring retraining.
- 10.5 When an individual fails to meet any of the criteria laid down, all 'observations' and 'corrective actions' must be documented. Where the defined criteria are overruled (e.g., see paragraph 10.4), then justification for this action must also be documented. Where an analyst's performance is found to be unsatisfactory, serious consideration should be given as to whether recent results produced by the analyst should be checked. Again, all actions must be documented.
- 10.6 The application of trend analysis techniques should also monitor "positive" or "negative" bias in an analysts counting performance to address tendency to consistently undercount or overcount.

11 RECORDS

- 11.1 Comprehensive records should be kept for all aspects of the internal quality control scheme. This should include the data used to establish reference slides, records of data generated by individual counters within the scheme, data showing individual counter performance, and any documentation resulting from failure of counters to meet defined criteria of acceptable performance.
- 11.2 Analysts must receive feedback of their performance. It is recommended that this is achieved by use of graphical presentations (see also Section 15.1.1.8). Laboratories, both established and new, may find it beneficial to display the performance graphs for all of their individual counters in the laboratory.

12 AUDITING

- 12.1 The laboratory should include all aspects of the internal fibre counting quality control scheme in the audit programme of the laboratory. Special attention should be paid to checking that individuals have participated at the required level, that the criteria for acceptable performance have been met, that the criteria set remain acceptable, that any failure to meet the criteria has resulted in appropriate action, and that all records are maintained.

References

- 1 ISO/IEC 17025 International Standards *General Requirements for the Competence of testing and Calibration Laboratories*, ISO/IEC 2005.
- 2 ISO/IEC 17020 *General Criteria for the Operation of Various Types of Bodies Performing Inspection*, ISO/IEC 1998.
- 3 UKAS Publication RG 8 *Accreditation of Bodies Surveying for Asbestos in Premises*, UKAS 2002.
- 4 IAF/ILAC-A4: 2004 *guidance on the Application of ISO/IEC 17020*, ILAC 2004.
- 5 *The Control of Asbestos Regulations 2006* (ISBN 0110751914); HSE Books 2006.
- 6 *Asbestos: The analysts guide for sampling analysis and clearance procedures*, HSG 248. HSE Books 2005 (ISBN 0 7176 0677 5).
- 7 Health and Safety Executives, RICE (Regular Interlaboratory Counting Exchanges) is organised by:

Health and Safety Laboratory
Harpur Hill
Buxton
Derbyshire
SK17 9JN

Tel +44 (0)1298 218553
- 8 Asbestos in Materials (AIMS) scheme. Administered by:

Health and Safety Laboratory
Harpur Hill
Buxton
Derbyshire
SK17 9JN

Tel +44 (0)1298 218553
- 9 *Asbestos: the licensed contractors' guide*, HSG 247. HSE Books 2006 (ISBN 0 7176 2874 4).
- 10 *Surveying, Sampling and Assessment of Asbestos-Containing Materials*. MDHS 100. HSE Books 2001. (ISBN 0 7176 2076 X). *NB: At the time of LAB 30 going to print, this publication was undergoing substantial review by HSE with the intention of replacing it with a revised document outside of the MDHS series.*
- 11 British Occupational Hygiene Society

5/6 Melbourne Business Court
Millennium Way
Pride Park
Derby
DE24 8LZ

Tel. +44 (0)1332 298 101

-
- 12 UKAS Publication M3003 *The Expression of Uncertainty and Confidence in Measurement*, UKAS 2007.
 - 13 BS 593 : 1989. *Specification for Laboratory Thermometers*.
 - 14 UKAS Publication LAB 11. *Traceability of Temperature Measurement*, UKAS, 2000.
 - 15 Department of Trade and Industry Publication URN 98/887. *Conditions for the Use of National Accreditation Marks* by UKAS and UKAS accredited organisations. Published 2003.
 - 16 UKAS Publication LAB 1. Reference to Accreditation for Laboratories. UKAS, 2004.
 - 17 Within-Laboratory Quality Control of Asbestos Counting - T L Ogden *et al.*, *Annals of Occupational Hygiene*, Vol. 30, No.4, pp. 411-425, 1986.
 - 18 The Reproducibility of Asbestos Counts. HSE Research Paper No.18. Health and Safety Executive, London. TL Ogden, 1982 (ISBN 0 7176 0101 3).
 - 19 L143 Work with materials containing asbestos - Approved Code of Practice and Guidance - Health and Safety commission, 2006.