LAB 30

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Application of ISO/IEC 17025 for Asbestos Sampling and Testing

Contents

United Kingdom Accreditation Service, 21-47 High Street, Feltham, Middlesex, TW13 4UN
Website: www.ukas.com Publication requests Tel: +44 (0) 20 8917 8400 Fax: +44 (0) 20 8917 8500 Email: info@ukas.com

Changes since Last Edition

Numerous changes since the previous edition including updates 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[1] *General Requirements for the Competence of Testing and Calibration Laboratories* 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/IEC17020:2012[2], 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 17020:2012 (and UKAS RG 8[3]).

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 HSG248) 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 the following types of asbestos testing - fibre counting, bulk identification and asbestos in soils.

(a) Fibre counting:
The UK test specification for fibre counting in relation to the Control of Asbestos Regulations (CAR)[4] is given in Health and Safety Executive (HSE) document *Asbestos: The analysts' guide for sampling, analysis and clearance procedures (HSG248)*[5]. Additionally other methods such as ISO 10312 for TEM, and ISO 14966 (2002) or VDI 3492 (2004), may be applied for SEM. 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 HSG248 describes the physical and optical characteristics of asbestos, and may be used as the basis of an accredited test method. The techniques described in HSG248 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 (ACMs) 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 (see below).

(c) Asbestos in soils (including aggregates, ballast, slurries etc):
Asbestos in soil is covered by the Control of Asbestos Regulations 2012, and therefore if a laboratory is offering an asbestos testing service with respect to soil samples then accreditation to ISO/IEC 17025 is required for the identification of asbestos in soils. Accreditation may be held for:

- Identification of asbestos fibres and type, and;
- Identification & Quantification of asbestos fibres in soils

Note: If a laboratory (such as a soil testing laboratory) is visually checking soil for signs of potential ACMs for its own Health & Safety purposes, and this information is not being reported to the customer, then the laboratory does not need to be formally accredited to ISO/IEC 17025, and the staff involved do not need to hold a formal qualification.
Please note - This process cannot be used to report results to the customer by omission. *For example, by informing a customer that a sample cannot be analysed due to its content immediately indicates the sample as containing asbestos. It needs to be reported that asbestos is suspected not confirmed.*

Management Requirements

3. Organisation (ISO/IEC 17025 clause 4.1)

3.1 FIBRE COUNTING

3.1.1 It is a requirement of HSG248 that laboratories carrying out fibre counting participate in the Regular Inter-laboratory Counting Exchanges (RICE)[6] scheme.

3.1.2 Laboratories undertaking asbestos counting by electron microscopy are required to participate in the Scanning Electron Microscopy (SEM) Fibre Counting Scheme[7]. The recommended methods of analysis are the ISO 14966 (2002) and the VDI 3492 (2004).

3.1.3 Laboratories should, in addition, maintain a 'satisfactory' performance classification in the relevant 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).

3.1.4 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.

3.1.5 Laboratories (new applicants and those with existing accreditation to ISO/IEC 17025) must participate in at least two rounds of RICE and produce results which will indicate satisfactory classification is achievable prior to any initial grant by UKAS for accreditation of this activity.

3.1.6 Laboratories which extend their accreditation to site locations, which may include laboratories, must also demonstrate suitable participation in RICE by analysts with satisfactory classification prior to any grant by UKAS for accreditation of this activity.

3.1.7 AIMS is deemed suitable by UKAS for asbestos identification testing providers using EM/EDXS in place of PLM.

Note: AIMS may not be appropriate for labs that undertake fibre counting by EM/EDXS who only report results as fibre concentrations and then divide into classes such as amphibole, chrysotile, organic etc (as described in the ISO 14966 method), as these labs do not need to identify individual fibre types.

3.2 IDENTIFICATION OF ASBESTOS IN BULK MATERIALS AND SOILS

3.2.1 It is a requirement of HSG248 that laboratories carrying out bulk identification participate in appropriate inter-laboratory comparison or proficiency testing programmes, for example, the Asbestos in Materials (AIMS) scheme[8] and have a suitable internal QA scheme to support Proficiency Testing participation

3.2.2 Laboratories should, in addition, maintain a 'satisfactory' performance classification in the schemes. 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(s) shall be taken. The laboratory shall notify UKAS (via its nominated Assessment Manager) without delay if this occurs.

3.2.4 Laboratories (new applicants and those with existing accreditation to ISO/IEC 17025) must participate in at least two rounds of an appropriate proficiency testing programme, for example, AIMs and produce results, which will indicate that satisfactory classification is achievable prior to any initial grant by UKAS for accreditation of this activity.

3.2.5 For asbestos in soils; Laboratories shall participate in appropriate inter-laboratory comparison or proficiency testing programmes, for example, the Asbestos in Soils Scheme (AISS)[9] and have a suitable internal QA scheme to support PT participation. The conditions specified in paragraphs 3.2.2 to 3.2.4 above also apply to asbestos in soils laboratories

3.2.6 Laboratories which extend their accreditation to site laboratories must also demonstrate suitable participation in two rounds of an appropriate proficiency testing programme, for example, AIMS/AISS by analysts with satisfactory classification prior to any grant by UKAS for accreditation of this activity.

Note: The AISS does not cover aggregates, ballast or sediments and slurries which may also be on the scope of accreditation. Labs must demonstrate how quality of assurance of these matrices is implemented

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 7.1.5)

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 suitability of the site location for setting-up and the possibility of using more than one analyst during the clearance of "large" or complicated enclosures as well as the time needed to complete the on-site 4SC. 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 should 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, which may be electronic. 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.

4.4 IDENTIFICATION OF ASBESTOS IN BULK MATERIALS AND SOILS (including aggregates, ballast, slurries etc)

For ACM in soils:

4.4.1 The contract review process completed prior to undertaking analysis of bulk materials in soil samples, which involves the removal of defined pieces of asbestos-containing-material (ACM) and analysing these in accordance with HSG248, shall ensure that sample amounts are clarified and the customer is aware of the remit and limitations of this asbestos in bulk material analysis. For example, a laboratory, for which accreditation in asbestos in soils is not held, would not normally handle a soil sample of 1kg size to then search for ACM's in the entire sample.

For Asbestos in soils:

4.4.2 The contract review process completed prior to undertaking this work shall ensure that customer needs are clearly ascertained to enable the Laboratory to decide whether appropriate accreditation is held to fulfil customer requirements (see Section 2.2 c) above) for the inspection of free fibres.

5. Corrective Action and Improvement
(ISO/IEC 17025 clauses 4.11 and 4.10 & ISO/IEC 17020 clause 8.7)

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

5.1.1 Accreditation to ISO/IEC 17025 includes the requirement to implement corrective actions and improvement initiatives. Organisations shall implement a programme of site revisits of analysts work when issues of poor work have been identified (either through complaint or internal audit) e.g. return visits to sites of similar conditions immediately or soon after the COR has been issued – to be undertaken more frequently than the requirement to audit staff specified in 'Internal Audits' for QC purposes.

5.1.2 Organisations should also consider the analysts utilising visual media (photographs / video) as part of Stage 2 and to record the cleanliness of the area pre/post stage 4 of the process. Traceability of the date / analyst etc relating to any photographs / video footage does need to be considered, (see also 6.1.11).

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

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

6.1.1 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

6.1.2 Prior to commencement of the 4SC procedure the laboratory shall conduct and record a site-specific Risk Assessment to establish any potential hazards and to review site arrangements for fire or emergency evacuation unless a previous assessment is available and suitable for review with confirmation of any risk present. As part of 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.

6.1.3 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.

6.1.4 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, waste receptacle, 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.

6.1.5 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 Guide[10] 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. The analyst should check that all necessary equipment is present within the enclosure to permit full access for inspection and that adequate lighting is provided.

6.1.6 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.

6.1.7 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. The Certificate of Reoccupation for a failed 4SC must be clearly reported.

6.1.8 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.

6.1.9 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.

6.1.10 Information to be recorded should include enclosure details (including the information which is required by HSG248), 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 (which may include temperature and barometric pressure).

6.1.11 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/customer prior to taking photographs.

6.1.12 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 customer's representative as appropriate.

6.2 BULK SAMPLING

6.2.1 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 HSG264[11]). The permission of the site owner/customer should be obtained prior to taking photographs.

6.3 FIBRE COUNTING

6.3.1 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.

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

6.4 BULK IDENTIFICATION

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

6.5 RETENTION OF RECORDS

6.5.1 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. Where used, 'dry wipe' sheets shall be photographed/scanned before these are reused to ensure original observations are recorded. Records can be stored electronically provided there are sufficient safeguards to protect the integrity of the data.

7. Internal Audits (ISO/IEC 17025 clause 4.14 & ISO/IEC 17020 clause 8.6)

7.1 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 auditor" (i.e. a person that possesses qualifications, training, experience and knowledge to meet the requirements of each activity). "Competent auditor" shall be authorised as an auditor.

Internal auditing procedures shall include witnessing of authorised personnel carrying out on-site inspection and testing activities associated with site clearance certification that covers a range of complexity and/or types of four-stage clearance over a four year period.

Technical Requirements

8. Personnel (ISO/IEC 17025 clause 5.2 & ISO/IEC 17020 clause 6.1)

8.1 QUALIFICATIONS/TRAINING (includes Table 1 & 2)

8.1.1 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.

8.1.2 UKAS recognises the British Occupational Hygiene Society (BOHS)[12] Certificate of Competences in Asbestos - CoCA (refer to Table 1 for detail). 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 direct supervision of an appropriately qualified staff member. Further guidance is given in UKAS document RG8.

8.1.3 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) and the Royal Society for Public Health (RSPH) Certificate for Asbestos Analysts (Air) and RSPH Asbestos Bulk Analysis (PLM) administered by the Asbestos Testing and Consultancy (ATAC)[13].

8.1.4 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**.

8.1.5 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.

8.1.6 For asbestos in soils and the preparation of soil samples; any person involved in the selection of identifiable pieces of suspected asbestos-containing-material (ACM) shall be suitably trained.

8.1.7 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, (RSPH Certificate in Asbestos Surveying) or work under supervision of a qualified surveyor	Recommended that individual 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 either P402 plus S301 or P402 plus P405 (not necessary for full CoCA but this is strongly encouraged) or CoCA or equivalent qualification. For individuals refer to A above. *Note: If the organisation relies on the P405 qualification, then this needs to have been attained post February 2004*	Recommended that company holds relevant scope of accreditation to ISO 17020 or ISO 17025
C Person taking and analysing an air sample (not including 4-SC)	Individuals to hold BOHS P403 (since September 2010) or RSPH Certificate for Asbestos Analysts (Air) (or higher qualification (eg CoCA)) *Note: Prior to September 2010 individuals will require P403 and P404 for taking and analysing air samples,*	Works for or is an organisation holding a relevant scope of Accreditation to ISO 17025
D Company taking and analysing an air sample (not including 4-SC)	Individuals to hold BOHS P403 or RSPH Certificate for Asbestos Analysts (Air). At least one member of the company must hold the CoCA (i.e. S301/W504 + Personal Learning Portfolio (PLP) plus oral) or equivalent qualification	Relevant scope of Accreditation to ISO 17025
E Person undertaking 4-SC work (including Hygiene Facility Clearances/clearance of non-licensed work)	Individuals to hold BOHS P403 and P404 or RSPH Certificate for Asbestos Analysts (Air) (or higher qualification (eg CoCA))	Works for or is an organisation holding a relevant scope of Accreditation to ISO 17025
F Company undertaking 4-SC work	Individuals to hold BOHS P403 and P404 or RSPH Certificate for Asbestos Analysts (Air). At least one member of the company must hold the CoCA (i.e. S301/W504 + PLP plus oral) or equivalent qualification	Relevant scope of Accreditation to ISO 17025
G Person analysing a bulk sample and/or asbestos in soil (qualitative only)	Individuals to hold BOHS P401 or RSPH Asbestos Bulk Analysis (PLM) or higher (eg CoCA)	Works for is an organisation holding relevant scope of Accreditation to ISO 17025
H Company analysing a bulk sample and/or asbestos in soil (qualitative only)	Individuals to hold BOHS P401 or RSPH Asbestos Bulk Analysis (PLM) or higher (eg CoCA)	Relevant scope of Accreditation to ISO 17025

ACTIVITY	QUALIFICATION	ACCREDITATION
I Person analysing asbestos in soil for quantification purposes	Individuals to hold BOHS P401 or RSPH Asbestos Bulk Analysis (PLM) or higher (eg CoCA)	Recommended that company holds relevant scope of accreditation to ISO 17025
J Company analysing asbestos in soil for quantification purposes	Individuals to hold BOHS P401 or RSPH Asbestos Bulk Analysis (PLM) or higher (eg CoCA) At least one member of the company holds the BOHS P403 (or equivalent) and recommended that at least one member of the company should hold the CoCA	Recommended that company holds relevant scope of accreditation to ISO 17025
K Person* analysing an air sample for the purposes of discrimination	Individuals to hold BOHS P401 and P403 or BOHS P401/RSPH Asbestos Bulk Analysis (PLM) and RSPH Certificate for Asbestos Analysts (Air) or higher (eg CoCA)	Works for or is an organisation holding relevant scope of Accreditation to ISO 17025
L Company* analysing an air sample for the purposes of discrimination	Individuals to hold BOHS P401 and P403 or BOHS P401/RSPH Asbestos Bulk Analysis (PLM) and RSPH Certificate for Asbestos Analysts (Air). At least one member of the company must hold the CoCA (i.e. S301/W504 + PLP 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 employs the same assessment criteria for both standards.*
** The P401 is not required when using SEM & TEM techniques for the purposes of fibre discrimination*

8.2 FIBRE COUNTING AND AIR SAMPLING (4SC)

8.2.1 The laboratory must have a documented training procedure for new analysts (with or without previous experience). 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.

8.2.2 All analysts shall participate in, achieve and maintain a satisfactory standard of performance in, the laboratory's internal quality control scheme for fibre counting.

8.2.3 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.

8.2.4 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**).

8.2.5 Analysts who have no demonstrable previous experience of carrying out site asbestos clearance work will require at least two months relevant experience and at least 6 clearances to cover the range of enclosures / removals for which the staff will be authorised (whilst working under the close supervision of a fully-authorised person), in order to gain sufficient and detailed knowledge of the 4-stage site clearance process. This is to be supported by a training diary (or equivalent) with records of training needs analysis. At the end of the period of supervision, competence must then be verified by conducting 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. The level of authorisation attained must reflect the nature of the work experienced and the assessments of competence undertaken.

8.2.6 An extended CV will be required for analysts who do have demonstrable previous experience of carrying out site asbestos clearance work &/or air sampling and fibre counting. Analysts will require to be authorised as part of a defined process, which includes an on-site audit for each type of removal/clearance for which they are to be authorised.

8.2.7 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
The British Occupational Hygiene Society (BOHS) Proficiency Certificate in 'Asbestos fibre counting' (P403) and 'Air sampling and clearance testing of asbestos' (P404), or other more wide ranging qualifications approved by BOHS or RSPH Level 3 Certificate for Asbestos Air Monitoring Analysts (HSG 248 – Sampling, Analysis and Clearance Procedures) **(See notes below)**	2 months appropriate on-site experience in 4-stage clearance procedures, with competency audits (minimum of 6) by a fully qualified analyst**,** followed by on-site auditing of the trainee on all 4 stages per audit; x2 audits and a follow-up in 3 months. 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, (e.g. Boiler rooms, A.I.B, sprayed coatings).	Familiarity with the range, location, use and appearance of asbestos products Knowledge of appropriate sampling strategies and inspection regimes for 4-stage clearance work Knowledge of current regulations and guidance (in particular the HSE Analyst's Guide) Knowledge of the fitting, wearing and care of respiratory protective equipment Knowledge of decontamination procedures, transiting procedures, and the use of airlocks and hygiene facilities

Notes:

Training for individuals who are to be authorised for air sampling and fibre counting only (not 4SC) needs to follow a defined process encompassing on-site experience in air monitoring procedures, with competency audits by a fully qualified analyst. This is to be followed by on-site auditing of the trainee and followed-up in 3 months by a further audit.

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' or W504+PLP 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.

8.2.8 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.

8.2.9 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 2012 and in HSG248.

8.2.10 Analysts must be given training (including refresher training) in the fitting, wearing and care of respiratory protective equipment, (ref CAR 2012 regulation 10). Training records must be maintained up-to-date, including details of any refresher training given.

8.3 IDENTIFICATION OF ASBESTOS IN BULK MATERIALS AND SOILS ANALYSIS AND BULK SAMPLING

8.3.1 The laboratory must have a documented training procedure for new analysts (with or without previous experience). 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/soil 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. At the end of the period of supervision, competence must then be verified by auditing of the trainee.

8.3.2 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 HSG248). Ishihara tests available to complete “on-line” via the Internet or by power point are not accepted as these may affect the validity of the test.

8.3.3 All analysts shall participate in, and achieve a satisfactory standard of performance in, the laboratory’s internal quality control scheme for bulk identification.

8.3.4 The laboratory shall maintain a list of all personnel who are authorised to carry out bulk identification, asbestos in soils analysis 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.

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

9.1 AIR SAMPLING

9.1.1 Air sampling within an asbestos enclosure (including hygiene facility) for subsequent analysis to HSG248 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.

9.2 FIBRE COUNTING

9.2.1 The environments in which filter preparation and fibre counting are carried out (i.e. permanent, site and mobile labs) should be monitored for possible fibrous contamination on a regular basis (e.g. monthly) and if possible contamination concerns are raised, with the results of these tests recorded. The assessments must include monitoring the airborne fibre concentration.

9.2.2 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. Refer also to Section 9.4.2.

9.2.3 Fibre counting must be carried out under suitable background conditions, which may involve excluding bright lights (including sunlight) and undue vibration (caused by mobile engine units for example).

9.3 BULK SAMPLING

9.3.1 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.

9.3.2 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.

9.4 IDENTIFICATION OF ASBESTOS IN BULK MATERIALS AND SOILS

9.4.1 All sample handling and preparation for bulk identification in a permanent or mobile laboratory 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.

9.4.2 Laboratories shall ensure that airborne fibre monitoring is undertaken either by a UKAS accredited laboratory (for air monitoring / fibre counting) or in-house meeting the requirements of ISO/IEC 17025 and this publication (with supporting documented records to demonstrate compliance). Monitoring shall be completed monthly in the laboratory (whether permanent, site based or mobile) during bulk analysis activities.

9.4.3 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.

9.4.4 The laboratory must have a documented procedure for the safe evacuation and cleaning should an uncontrolled release of asbestos, or failure of power supply occurs – (ref CAR 2012 regulation 15 (1)).

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

10.1 AIR SAMPLING

General guidance on airborne fibre monitoring is given in the document HSG248. 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 (e.g. leak, background). It is a requirement for all organisations to ensure staff always prepare, expose, mount and retain a field blank sample for each job undertaken and sent with the field samples to the laboratory.

10.1.1 Visual Inspection

10.1.1.1 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.

10.1.2 Dust Disturbance

10.1.2.1 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.

10.1.3 Four-Stage Clearance Process (also ISO/IEC 17020 clause 7.1)

10.1.3.1 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 using (in addition to adequate lighting provision by the contractor), a torch (preferably L.E.D.) - including floor areas, at all heights, behind items etc. Appropriate equipment - eg ladders, mirror, probes or screwdrivers etc, may be required.

10.1.3.2 On completion of Stage 3 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 for asbestos debris. Re-inspection of these areas must therefore be conducted during Stage 4.

10.2 BULK SAMPLING

10.2.1 Health & Safety Executive publications HSG264 and HSG248 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.

10.3 FIBRE COUNTING

10.3.1 Laboratories shall use the methods specified in HSG248 for PCM and methods such as ISO 10312, ISO 14966 (2002) and the VDI 3492 (2004) for SEM/TEM, unless there are acceptable alternative methods which can be demonstrated to produce equivalent results for the intended field of application.

10.4 BULK IDENTIFICATION

10.4.1 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 HSG248 - may be used. Laboratories wishing to use HSG248 as a basis for their accredited test method will need to produce a documented in-house procedure, to describe the specific methodology adopted. Laboratories which do not use HSG248 must still have a documented in-house procedure.

10.4.2 Laboratories that require accreditation for analysis of asbestos in soils and associated materials (including for example slurries, aggregates, ballast and sediments) will need to have developed appropriate documented in-house methods that include detailed sub-sampling and sample preparation procedures.

10.4.3 The laboratory's in-house method for bulk identification should also contain guidance and instruction on the recognition of 'confounding' fibre types, i.e., fibres that possess similar morphological/microscopic properties to the various types of asbestos. Further guidance is given in HSG248.

10.4.4 The number of bulk samples for identification (either for commercial/QA/QC purposes) which can be analysed by authorised analysts per 8 hour shift is deemed acceptable at 60 samples / 70 points.

10.4.5 The number of soil samples for identification (either for commercial/QA/QC purposes) which can be analysed by authorised analysts needs to be commensurate with the method employed

Note *Ref 10.4.4: For any samples/points analysed in excess of these numbers the Laboratory will need to investigate and justify the approach taken.*
UKAS will continue to assess and investigate further if laboratories consistently analyse >60 samples or >70 points per analyst per 8 hr shift.
Points defined for samples as; cement, AIB, floor tiles, bituminous products, lagging = 1 point and; hard set lagging, vinyl floor tiles, textured coatings, soils = 2 points.

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

11.1 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, for example. 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 HSG248 methods) in order to take into account factors that contribute to the overall uncertainty of measurements.

11.2 FIBRE COUNTING

11.2.1 The uncertainty of the method is stated in HSG248. 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.

11.3 IDENTIFICATION of ASBESTOS IN BULK MATERIALS AND SOILS

11.3.1 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 HSG248). 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.

11.3.2 For Laboratories undertaking asbestos in soils analysis the estimated uncertainty of measurement should be formulated an on an on-going basis using accumulated data.

11.4 IN-HOUSE CALIBRATIONS

11.4.1 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 M3003[14] gives appropriate guidance.

12. Equipment (ISO/IEC 17025 clause 5.5)

12.1 AIR SAMPLING

12.1.1 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.

12.1.2 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.

12.2 BULK SAMPLING

12.2.1 Guidance on bulk sampling equipment is contained in HSG264 and HSG248.

12.3 FIBRE COUNTING

12.3.1 A calibrated stage micrometer, traceable to national standards (to an uncertainty of measurement ≤ 1 μm), is required to calibrate working stage micrometers.

12.3.2 Sufficient working stage micrometers and HSL 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 HSG248 requirements, working stage micrometers should have maximum graduations of 2 μm – e.g. type S12.

12.3.3 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 ± 2 μm.

12.3.4 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.

12.3.5 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).

12.3.6 Microscopes used for the purposes of fibre counting should have provisions available to maintain optimum performance, e.g. lens tissue.

12.4 BULK IDENTIFICATION

12.4.1 The laboratory shall be equipped with a fume/dust cabinet with adequate extraction and filter facilities (refer to HSG248) for re-circulatory and/or direct extraction designs. Bi-annual assessment of operational integrity to be undertaken as required following regulatory requirements. Minimum face velocities of 0.5m/s are to be ascertained daily with suitable records to demonstrate compliance during periods of operational activity. The unit must be large enough to incorporate a low power stereo microscope and allow sample manipulation/treatment.

12.4.2 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 at each of its accredited locations, (including mobile).

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

12.4.4 The laboratory shall have access to accurate and traceable records associated with consumables and supplies (e.g. coverslips and microscope slides) which are suitably maintained. In particular those for refractive index liquids shall reflect their life-span, i.e. storage, usage and disposal.

12.5 FOUR STAGE CLEARANCE PROCESS (also ISO/IEC 17020 Clause 6.2)

12.5.1 The laboratory must ensure that respiratory protective equipment is maintained and inspected in accordance with a defined programme, (ref HSG53[15]). Suitable records must also be maintained in order to meet legislative requirements in this area (ref HSG248 and CAR 2012).

12.5.2 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, torches, 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.

13. Measurement Traceability (ISO/IEC 17025 clause 5.6)

13.1 AIR SAMPLING

13.1.1 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.

13.1.2 Master and working flow meters will require periodic re-calibration. Generally, calibration intervals should not exceed the following:

Master flow meters – annually (non rotameter types may be extended to two years)
Working flow meters – quarterly (with necessary documentary evidence of at least one year to justify this longer interval)

13.1.3 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.

13.1.4 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 ± 5% of the required flow rate.

13.2 GUIDANCE ON PROCEDURES FOR CALIBRATION OF WORKING FLOW METERS

13.2.1 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.

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

13.2.3 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.

13.3 SAMPLING PUMPS

13.3.1 HSG248 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 before switching the pump off, and where appropriate a correction applied to account for flow rate variation during sampling. The results of the flow rate checks shall be recorded.

13.4 CORRECTIONS FOR TEMPERATURE AND PRESSURE

13.4.1 Temperature and barometric pressure should be assessed and recorded at the sampling location when these locations are outside normal operating conditions as experienced, (as defined in HSG248), Corrections will need to be made, where appropriate, for any temperature or pressure differential.

13.4.2 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.

13.5 TIME

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

United Kingdom Accreditation Service, 21-47 High Street, Feltham, Middlesex, TW13 4UN
Website: www.ukas.com Publication requests Tel: +44 (0) 20 8917 8400 Fax: +44 (0) 20 8917 8500 Email: info@ukas.com

13.6 STABILISED FLOW PUMPS

13.6.1 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 HSG248 are met.

13.7 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.

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

Required flow rate (litre/min)	5% setting limit (± litre/min)
15.0	0.75
8.0	0.40
4.0	0.20
1.0	0.05

13.7.2 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.

13.7.3 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 HSG248.

13.7.4 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.

13.8 FIBRE COUNTING

13.8.1 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).

13.8.2 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.

13.9 BULK IDENTIFICATION

13.9.1 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.

13.9.2 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. Due to heightened sensitivity in the PLM method

for identifying single fibres in a few milligrams of dispersed material, performance checks should be undertaken on liquids to counter possible contamination by particles and fibres. In situations where a laboratory wishes to implement or 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).

14. Sampling (ISO/IEC 17025 clause 5.7)

14.1 Check-lists should be used to ensure that all equipment required for on-site sampling is readily available.

14.2 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.

14.3 AIR SAMPLING

14.3.1 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, 6.1.1 and 6.1.4). Detailed requirements on air sampling methodology are given in HSG248.

14.4 BULK SAMPLING

14.4.1 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.

14.4.2 In-house methods for bulk sampling shall be based on reliable, published reference sources, such as HSG264 and HSG248.

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

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

15.1 AIR SAMPLING

15.1.1 Sampling procedures and records shall be such that there is a traceable link from the sampling pump and cowl, to the individual filter.

15.1.2 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.

15.1.3 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.

15.1.4 Filters should be retained in capped filter holders for transport into and out of sampling areas.

15.1.5 Slides should be retained for at least six months, in accordance with HSG248 requirements.

15.2 BULK SAMPLING, IDENTIFICATION OF ASBESTOS IN BULK MATERIALS AND SOILS ANALYSIS

15.2.1 To avoid cross-contamination, individual bulk and soil samples shall be placed into a double-containment system (i.e., double bagging with resealable polythene bags or plastic pots for example) 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.

15.2.2 Sample containers shall be re-opened only in a suitable fume cabinet, often that which is used for the subsequent analysis, (for soils this may be a cabinet used for drying and preparation).

15.2.3 Bulk samples, or representative sub-samples, should be retained for at least six months, in accordance with HSG264 requirements, unless contract review specifies otherwise eg, those items associated with litigation or prosecution.

15.2.4 Samples used for the purposes of analysing asbestos in soils (including for example, aggregates, ballast, slurries etc) shall be retained for 6 months: If not in their entirety, then representative sub samples shall be retained.

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

16.1 INTERNAL QUALITY CONTROL

16.1.1 Fibre Counting

16.1.1.1 All analysts authorised to carry out fibre counting using PCM and/or electron microscopy 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.

16.1.1.2 Guidance on setting-up and maintaining a suitable internal QC scheme is given in Appendix 1 of this document.

16.1.1.3 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/SEM schemes may assist in the comparison of internal QC performance with RICE/SEM 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. SEM accredited laboratories may retain samples sent as part of the SEM PT scheme and use them for training or QC purposes.

16.1.1.4 The QC scheme should reflect the nature of the work undertaken by the laboratory. Analysts who undertake fibre counting on-site for example shall therefore carry out an appropriate proportion of their quality control in on-site locations.

16.1.1.5 A minimum acceptable quality control for an established laboratory is 4 reference slides and 1 randomly selected routine slide per working month per analyst, i.e. all analysts have one of their site slides re-counted and all analysts undertake a recount of a colleague's slides.

16.1.1.6 A procedure must also be in place, which states the predetermined frequency and method for randomly assessing (replicate testing) routine slides for reproducibility.

16.1.1.7 In cases where fibre counting is rarely undertaken, additional quality control will be necessary to demonstrate ongoing competence.

16.1.1.8 In the event that the number of graticule areas examined in any 8-hour period exceeds 2400, additional documented quality control shall be undertaken.

16.1.1.9 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.

16.1.1.10 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).

16.1.2 Bulk Identification

16.1.2.1 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.

16.1.2.2 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 over an annual cycle. A minimum acceptable quality control would be 2 samples per working month per analyst. The monthly QC programme should incorporate samples from the laboratory's stock of secondary bulk reference materials.

16.1.2.3 A routine QA programme in line with HSG248 Section A2.55 must also be in place. Daily re-analysis of working samples per analyst will normally fulfil this requirement. However, in cases where additional daily QC of routine samples is not required, due to low numbers of samples analysed daily, (see HSG248 table A2.4) this shall instead be undertaken on a monthly frequency of 2 samples per analyst via the use of routine (previously-analysed) samples.

16.1.2.4 Reanalysis of working samples for QC (as per HSG248) needs to be undertaken by an authorised analyst who has not already reached their maximum daily sample/point allowance (see para 10.4.4).

16.2 EXTERNAL QUALITY CONTROL

16.2.1 Fibre Counting

16.2.1.1 All analysts who are authorised to carry out fibre counting shall participate in the Regular Inter-laboratory Counting Exchanges (RICE) scheme and/or the Scanning Electron Microscopy (SEM) Fibre Counting Scheme as appropriate. Laboratories should achieve and maintain a 'satisfactory' classification in the schemes.

16.2.1.2 Categories of RICE performance are issued after a laboratory has participated in four rounds (circulations), i.e. a maximum of about 16 months from initial participation. UKAS will accept extra rounds if the laboratory needs to demonstrate competence, e.g. for initial assessment or when an Unsatisfactory classification is attained. The performance of an SEM laboratory is assessed as soon as two consecutive rounds have been completed. Performance scores may be published on the HSL website unless the laboratory has specifically requested otherwise.

Note *The SEM PT is a new scheme and as such Laboratories will not be formally classified during the first two years of the scheme.*

16.2.1.3 The laboratory shall retain copies of all original data that relate to Scheme counts within its record system.

16.2.1.4 All staff involved in fibre counting at all named sites documented on the schedule of accreditation shall participate in the external proficiency-testing scheme.

16.2.1.5 The laboratory shall implement its defined nonconforming work procedures in the event that RICE/SEM fibre counting performance becomes unsatisfactory or the performance of individuals produces unsatisfactory results, i.e. Band 'C'. If a laboratory's RICE/SEM PT 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.

16.2.2 Bulk Identification and/or Asbestos in Soils

16.2.2.1 The laboratory shall participate in appropriate inter-laboratory comparison exercises or proficiency testing schemes, eg, the Asbestos in Materials (AIMS) or Asbestos in Soils (AISS) scheme.

16.2.2.3 All staff involved at all named sites documented on the schedule of accreditation will participate in the relevant external proficiency-testing scheme, each member of staff shall participate in the external scheme at least once in every 12 months. UKAS will accept extra rounds if the laboratory needs to demonstrate competence, e.g. for initial assessment or when an Unsatisfactory classification is attained.

16.2.2.4 The laboratory shall implement its defined nonconforming work procedures in the event that deficiencies in inter-laboratory comparisons or proficiency testing schemes are identified or the performance of individuals produces unsatisfactory results, i.e. 'critical/supercritical'. If a laboratory's AIMS/AISS performance falls outside satisfactory classification, UKAS must be informed immediately; the accreditation of the laboratory will be reviewed and may be suspended or withdrawn.

16.2.3 Applicant Laboratories

16.2.3.1 Laboratories intending to undertake fibre counting, bulk identification or asbestos in soils analysis are strongly advised to respectively apply for RICE, SEM, AIMS and/or AISS participation at the earliest possible opportunity.

16.2.3.2 In order to demonstrate competence in fibre counting, bulk identification or asbestos in soils analysis at initial grant of accreditation, the laboratory should have completed a minimum of two circulations/rounds. The results of the completed rounds should result in a 'satisfactory' Classification if extrapolated over 1 year.

16.2.3.3 If an applicant laboratory's performance in any Scheme 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).

Note: Non UK based P/T Schemes other than those specified above may be accepted but the details of any proposed alternatives should be submitted to UKAS for review and agreement.

17. Reporting the Results
(ISO/IEC 17025 clause 5.10 & ISO/IEC 17020 clause 7.4)

17.1 Laboratories shall ensure that the requirements of BIS Publication URN 14/902[16] are met whenever the accreditation symbols or reference to accreditation are used.

17.2 Laboratories that include opinions and interpretations in test reports shall follow the guidance contained in UKAS Publication LAB 1[17]. Disclaimers shall also be included in reports that include surveying activities, when accreditation for asbestos surveying is not held (see also Section 1.2).

17.3 AIR SAMPLING

17.3.1 For clearance indicator testing, it is not considered practical to report the associated estimated uncertainty of measurement. The laboratory shall, however, comply with individual customer requirements and report uncertainty, if requested.

17.3.2 Activities such as 'smoke testing' are not covered by UKAS accreditation; the laboratory shall ensure that the test reports contain relevant disclaimers, where appropriate.

17.4 BULK IDENTIFICATION

17.4.1 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.

17.5 ASBESTOS IN SOILS

For ACM in soils:

17.5.1 Where analysis of soil samples involves the removal of defined pieces of asbestos-containing-material (ACM) and analysing these in accordance with HSG 248, the report shall clearly state the matrix of the sample being that of the ACM. The report shall not state soil as the matrix.

For Asbestos in soils:

17.5.2 Where identification only is undertaken by the Laboratory, the resulting reports from this analysis shall state soil as the matrix, but cannot report any quantification of the asbestos content as accredited work.

18. Additional ISO/IEC 17020 Requirements - Four-Stage Clearance Process

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

18.1 Liability insurance cover ISO/IEC 17020 clause 5.1.4

18.1.1 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 and Property Damage cover) are required as a minimum.

18.1.2 Additional guidance on requirements for insurance liability cover is given in ILAC-P15:06/2014[18] to which reference should be made.

18.2 Impartiality and Independence **ISO/IEC 17020 clause 4 (See also ISO/IEC 17025 clause 4.1)**

18.2.1 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.

18.2.2 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.

18.2.3 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.

18.3 Safety procedures and instructions **ISO/IEC 17020 clause 7.1.9**

18.3.1 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.

18.3.2 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.

18.3.3 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 al[19] 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.

1 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/mm^2) 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 to those specified in 3.2.

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/mm²	
1	3rd Jan.	AB	100	17	200	10.83	
2	3rd Jan.	CD	102	20	200	12.24	
3	4th Jan.	EF	99	17	210	10.51	
4	5th Jan.	AB	100	13½	200	6.60	
5	5th Jan.	CD	102	15	200	9.18	
6	5th Jan.	EF	99	26	204	16.55	
7	5th Jan.	AB	100	24½	200	15.61	
8	8th Jan.	AB	100	10	200	6.37	
9	12th Jan.	EF	99	16	200	10.39	First 10 counts:-
10	16th Jan.	CD	102	19½	220	10.85	Mean = 11.11 ESD = 4.01
11	16th Jan.	EF	99	19	200	12.34	[Suitability check gives
12	18th Jan.	AB	100	18	200	11.46	standard deviation of 3.07,
13	1st Feb.	CD	102	21½	200	13.16	which is 27.6% of Mean - i.e.
14	1st 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/mm²	
1	3rd Jan.	AB	100	102½	42	310.9	
2	5th Jan.	AB	100	120	45	339.7	
3	5th Jan.	CD	102	101	38	325.3	
4	5th Jan.	EF	99	50	20	324.8	
5	12th Jan.	AB	100	110	35	400.4	
6	12th Jan.	CD	102	102½	46	272.7	
7	16th Jan.	EF	99	50	30	216.5	
8	20th Jan.	AB	100	100	34	374.7	
9	20th Jan.	CD	102	101½	47	264.3	First 10 counts:-
10	24th Jan.	EF	99	50½	22	298.2	Mean = 312.7 ESD = 64.99
11	1st Feb.	CD	102	102	40	312.1	[Suitability check gives
12	1st Feb.	EF	99	100½	33	395.5	standard deviation of 53.73,
13	5th Feb.	AB	100	52	24	276.0	which is 17.2% of Mean - i.e.
14	17th 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:

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

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 Ogden[20] 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/mm^2, there is a risk that counts which are within the confidence limits in Figure A1.6 in HSG248 will give rise to unacceptable PV results in this scheme. Laboratories should be discouraged from using slides below 10 f/mm^2 if possible. Preferably, they should use slides which are at or just below the 'clearance indicator' (equivalent to about 13 f/mm^2).

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/mm²)	ESD	No. of Counts	
1	16th Jan.	11.11	4.01	10	
2	24th Jan.	312.7	64.99	10	
3	16th Jan.	5.48	2.58	10	
4	16th Jan.	25.22	7.12	20	
5	24th Jan.	45.09	11.24	20	
6	16th Jan.	8.08	3.27	10	
7	24th Jan.	144.8	31.36	20	
8	24th Jan.	22.17	6.47	10	
9	24th Jan.	10.77	3.93	10	
10	24th Jan.	4.96	2.44	10	
11	19th Feb	2.14	2.00	10	
12	19th Feb.	68.53	16.01	10	
13	19th Feb.	12.20	4.26	10	
14	19th Feb.	37.46	9.67	10	
15	19th Feb.	8.47	3.37	10	
16	19th Feb.	110.2	24.41	10	
17	19th Feb.	12.62	4.36	10	
18	19th Feb.	47.47	11.73	10	
19	19th Feb.	14.39	4.76	10	
20	19th Feb.	3.58	2.02	10	
21	29th Mar.	20.31	6.07	10	
22	29th Mar.	6.14	2.77	10	
23	29th Mar.	247.3	51.90	10	
24	29th Mar.	10.31	3.82	10	
25	29th Mar.	16.47	5.23	10	
26	29th Mar.	12.92	4.43	10	
27	29th Mar.	28.39	7.79	10	
28	29th Mar.	18.00	5.56	10	
29	29th Mar.	1.07	2.00	10	
30	29th 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 16.1.1.8). 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) shall 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 modulised (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 for each individual 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 modulised 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 for each individual to lie between -1.5 and +1.5.

Table 3

QC Period	Date Counted	Micro Used	AB Count Results				Laboratory Reference Values		AB's Performance Value	AB's Rolling Mean
			Slide	Fibres	Fields	f/mm²	N (f/mm²)	ESD		
January	28th Jan.	A	1	18	200	11.46	11.11	4.01	+0.09	
January	28th Jan.	A	2	100	51	249.8	312.7	64.99	-0.97	
January	28th Jan.	A	3	7½	200	4.78	5.48	2.58	-0.27	
January	28th Jan.	A	4	32	200	20.38	25.22	7.12	-0.68	
January	28th Jan.	A	5	50½	126	51.06	45.09	11.24	+0.53	
February	7th Feb.	A	6	6½	200	4.14	8.08	3.27	-1.20	0.62
February	10th Feb.	B	7	100	104	122.49	144.8	31.36	-0.71	0.73
February	10th Feb.	B	8	35	200	22.29	22.17	6.47	+0.02	0.57
February	16th Feb.	A	9	17	200	10.83	10.77	3.93	+0.02	0.53
February	16th Feb.	A	10	16	200	10.19	4.96	2.44	+2.14	0.77
(February)	3rd Mar.	A	10(recount)	10	200	6.37	4.96	2.44	+0.58	
March	17th Mar.	A	2	102	44	295.3	312.7	64.99	-0.27	0.73
March	17th Mar.	A	13	30½	200	19.43	12.20	4.26	+1.70	0.81
March	17th Mar.	A	15	14	200	8.92	8.47	3.37	+0.13	0.71
March	17th Mar.	A	17	20½	200	13.06	12.62	4.36	+0.10	0.73
March	17th Mar.	A	20	2½	200	1.59	3.58	2.02	-0.99	0.89
April	10th Apr.	B	7	50	48	132.7	144.8	31.36	-0.39	0.60
April	10th Apr.	B	8	38½	200	24.52	22.17	6.47	+0.36	0.61
April	12th Apr.	A	27	50	180	35.39	28.39	7.79	+0.90	0.48
April	12th Apr.	A	19	17½	200	11.15	14.39	4.76	-0.68	0.57
April	12th Apr.	A	20	6½	200	4.14	3.58	2.02	+0.28	0.60

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 monthly 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 commercial counting (i.e. without amendment to the list of authorised counters). The original performance values should be used when calculating the analysts running modulised mean value to give an accurate modulised mean value and any re-count values should be documented and included in the modulised mean value calculation. 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 commercial counting. 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 modulised 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 Where analysts have been absent from the QC scheme for a consecutive period, (greater than 2 months) they must be fully assessed prior to being reauthorised.

10.7 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 16.1.1.9). 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.

Appendix 2
Glossary

4SC	Four Stage Clearance
ACM	Asbestos-Containing-Material
AIB	Asbestos Insulation Board
AIMS	Asbestos in Materials Scheme
CAR	Control of Asbestos Regulations 2012 (as amended)
CCTV	Closed-circuit Television
CoCA	Certificate of Competence in Asbestos
CoR	Certificate of Reoccupation
LED	Light-emitting Diode
PCM	Phase Contrast Microscopy
PLM	Polarised Light Microscopy
PLP	Personal Learning Portfolio
PT	Proficiency Testing
PVA	Polyvinyl Acetate
QA	Quality Assurance
QC	Quality Control
RICE	Regular Inter-laboratory Counting Exchange
SEM	Scanning Electron Microscopy
TEM	Transmission Electron Microscopy

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[12] British Occupational Hygiene Society

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

Tel. +44 (0)1332 298 101
Email: admin@bohs.org

[13] Asbestos Testing and Consultancy

Unit 1 Stretton Business Park
Brunel Drive
Stretton
Burton upon Trent
Staffordshire
DE13 0BY

Tel. 01283 566467
Fax 01283 505770
Email: info@atac.org.uk

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† Health and Safety Executive's RICE (Regular Interlaboratory Counting Exchange) and Scanning Electron Microscopy (SEM) Fibre Counting Scheme, Asbestos in Materials (AIMS) and Asbestos in Soils Scheme (AISS) schemes are organised by:

Health & Safety Laboratory
Harpur Hill
Buxton
Derbyshire
SK17 9JN

Tel +44 (0)1298 218553
Email: proficiency.testing@hsl.gsi.gov.uk