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RG 0

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Guidelines on the competence of personnel undertaking engineering inspections

Contents

Changes since last edition

- 4.3.2 ‘release of flammables or toxic and the domino effect’ amended to ‘release of stored energy’
- 4.3.5 ‘Writing skills’ replaced by ‘Ability to follow formal procedures / process’
- 4.3.7 ‘*defect* acceptance criteria’ amended to ‘*inspection* acceptance criteria’; ‘Understanding of deterioration’ added
- 4.6.1 ‘Where subject to a prescribed training scheme, monitoring shall be appropriate’ added
- Reference to ILAC P15 updated
- Appendix 1 added - *Qualification categories*
- Competences table - ‘Suitable health and safety awareness’ added (personal training)
- Other minor editorial changes

1. Introduction

1.1 The purpose of this publication is to provide guidelines to inspection bodies and assessors on the application of Section 6.1 (Personnel) of ISO/IEC 17020 *Conformity assessment - Requirements for the operation of various types of bodies performing inspection* (Reference 1) in the area of engineering inspection.

1.2 In addition to the standard, reference should also be made to the ILAC P15, Application of ISO/IEC 17020:2012 for the Accreditation of Inspection Bodies (Reference 2).

1.3 This publication has been produced by UKAS in consultation with the UKAS Engineering Inspection Technical Advisory Committee (EITAC).

1.4 This publication should be read in conjunction with any specific UKAS guidance given for particular fields of engineering inspection.

1.5 Reference should also be made to any legislative requirements, recognised codes of practice or other guidance for particular inspection activities that may have specific requirements which are additional to the general guidelines provided in this publication.

1.6 Accreditation of an inspection body to ISO/IEC 17020 and compliance with the guidelines given in this publication should not be confused with personnel certification where a certification body issues a certificate of competence to an individual to undertake certain tasks. ISO/IEC 17020 and this publication provide guidelines relating to 'competence criteria' for the organisation including the individuals who perform technical tasks within that organisation.

2. Terms and definitions

2.1 For the purposes of this publication the terms and definitions given in ISO/IEC 17020 and the following shall apply.

2.2 **competence** - ability to apply the necessary practical and theoretical knowledge, skills and, personal attributes, for the inspections to be carried out

2.3 **assessment** (of person) - process for measuring a person's competence by one or more means such as written, oral, practical or observational

3. General

3.1 This publication seeks to provide guidance on the means by which inspection bodies can demonstrate that their staff are competent to undertake the inspection activities for which they are authorised.

3.2 UKAS does not endorse or recommend specific routes to achieving competence, such as training courses, etc. References at the end of this publication are given to some other publications which inspection bodies may find useful. This list is given for information purposes only and should not be considered exhaustive.

3.3 The guidelines provided in this publication apply to all inspection personnel irrespective of their terms of employment, e.g. full-time staff, part time staff or contracted.

4. Personnel - Recruitment, training and competence (ISO/IEC 17020 clause 6.1)

4.1 The inspection body should demonstrate that it has management control over the following stages in order to demonstrate that it has the personnel necessary to undertake the range of inspection activities covered by its scope of accreditation:

A) Identify the range of inspection activities

B) Identify the competence required for each activity

C) Train & assess against the competence criteria

D) Authorise persons for activities under appropriate supervision

E) Monitor performance of persons to re-assess competence

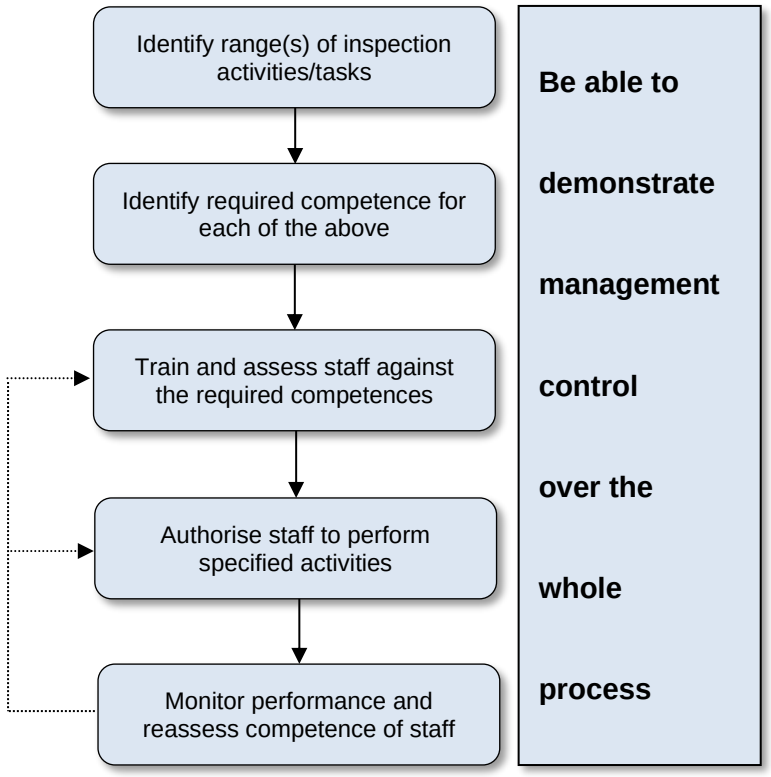


Figure 1 illustrates the stages in the process

4.2 Inspection Activities/Tasks (A)

4.2.1 The inspection body should identify each inspection activity which it provides in such a way that it is able to define the competence requirements for each of these activities.

4.3 Identification of required competence (B)

4.3.1 Inspection bodies should establish and be able to demonstrate that they meet appropriate requirements for the inspection tasks within their scope of accredited activities.

4.3.2 The competence required to undertake particular inspection activities will vary according to the activity, range and complexity of equipment, level of discretion, judgement and decision making and extent of supervision to which the person is subjected. For example, for large complex pressure systems they need to be more aware of the consequences of failure, i.e. release of stored energy.

4.3.3 The following broad headings should be considered:

Personal attributes of inspection personnel
Detection of defects
Evaluation of defects
Decision making
Inspection scheme development, interpretation and review

4.3.4 For each inspection activity the inspection body should establish what the appropriate competence requirements are under each of the above headings. The results of this will be a set of competence requirements for inspection activities in relation to authorisations to inspect and the level of supervision provided.

4.3.5 Personal attributes
These will include, but not necessarily be limited to, such aspects as:

Communication skills (written and verbal)
Physical capability to undertake inspection tasks
Visual acuity
Ability to work alone
Ability to deal with difficult clients
Ability to follow formal procedures / process

4.3.6 Detection of defects
This will include, as appropriate:

Appropriateness of inspection methods/procedures
Acuity of senses
Use of instruments

4.3.7 Evaluation of defects
This will include:

Knowledge of types of defects
Knowledge of inspection acceptance criteria
Understanding of results of detection
Knowledge of failure modes
Understanding of deterioration

4.3.8 Decision Making
This will require:

Understanding of the significance of the evaluation requiring:
Knowledge of the technology used for manufacturing the item being inspected
Knowledge of the use of the item being inspected
Acceptability of defects - fitness for purpose

4.3.9 Inspection scheme development, interpretation, and review
For personnel who may be required to develop, interpret, or review inspection schemes, processes and methods, etc. additional levels of competence should be required in respect of inspection and product standards, the items to be inspected, likely conditions of use, damage and deterioration mechanisms etc.

4.3.10 Underpinning knowledge and understanding
For all inspection activities the competence requirements should include the appropriate requirements of underpinning knowledge. As an example, for mechanical equipment these might include:

The manufacturing process for the items being inspected
Mechanics of materials
Stress analysis
Functional specialist knowledge
Failure mechanisms
Mechanism of degradation
Risk assessment
Failure mode and criticality analysis (FMECA)
Limits of their own understanding and capability

For simple repetitive inspection tasks, the underpinning knowledge required may only be rudimentary and might be provided as part of a training programme. However, for managing the inspection of complex plant with little supervision it may be considered appropriate that the achievement of such underpinning knowledge is, in the first place, demonstrated by means of formal educational qualifications such as a degree in a relevant subject together with membership of a professional engineering institution.

4.4 Train and assess personnel (C)

4.4.1 It is the responsibility of the inspection body to employ persons who are competent to undertake the inspection tasks required of them.

4.4.2 In order to achieve competence to perform particular inspection tasks a person shall have the necessary personal attributes, education, knowledge, training and experience to be able to perform that task.

4.4.3 Each member of inspection personnel should be assessed to determine that they are competent to undertake the inspection activities for which they are authorised. These assessments should be carried out by a person or persons who are themselves competent in the inspection activity and in the conduct of assessments.

4.5 Authorise personnel (D)

4.5.1 The inspection body shall demonstrate that it only authorises persons to undertake inspections for which it has assessed them to be competent.

4.5.2 When authorising persons to undertake inspection activities the inspection body shall state whether the authorisation is subject to any particular supervision requirements.

4.5.3 It is important that inspection personnel understand the supervision under which they are to work and to whom they can refer for guidance when encountering a situation beyond the limits of their competence.

4.5.4 Personnel under training will necessarily require greater supervision than those whose competence has already been assessed and demonstrated to be satisfactory.

4.6 Monitor personnel (E)

4.6.1 The competence of personnel should be assessed at suitable intervals to determine whether they continue to meet the specified requirements and the need for any further training. Where subject to a prescribed training scheme, monitoring shall be appropriate.

5. Demonstrating competence

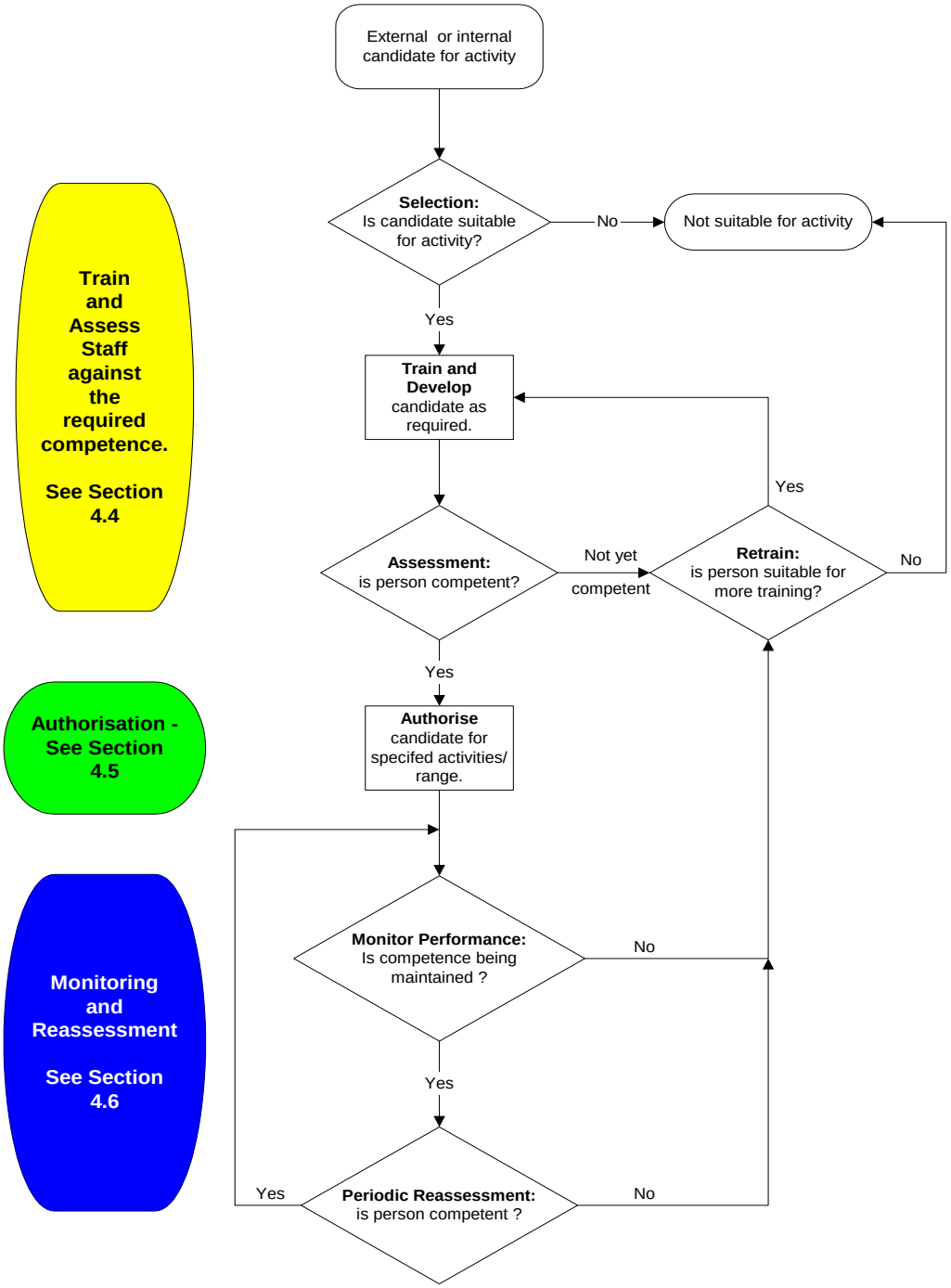
5.1 The inspection body shall demonstrate that it undertakes evaluations of inspection personnel in respect of the application of the above and other relevant attributes to determine that they have the competence to undertake the inspections required of them. See Appendix 1.

5.2 For information purposes three examples of competence management approaches are provided in Appendix 2. The examples include a simple repetitive inspection activity, the inspection of complex plant and the inspection of various types of plant remotely from the inspection body's controlling office.
These examples are not to be considered as being comprehensive for these areas of work but only as examples of the content expected.

5.3 Where references are made to qualifications, etc. these are generally based on UK practice and are given to indicate the levels expected rather than providing a definitive list. Alternatives of a demonstrable equivalent level may be equally appropriate. The listing of a particular qualification, etc. does not imply that a qualification or course leading to it is available at a particular time.

5.4 The process is illustrated in Figure 2:

Fig. 2 - Outline Process for the establishment of competence, authorisation, monitoring and reassessment.



References

1. ISO/IEC 17020:2012 *Conformity assessment - Requirements for the operation of various types of bodies performing inspection*

2. ILAC P15:05/2020 *Application of ISO/IEC 17020:2012 for the Accreditation of Inspection Bodies*

Bibliography

1. SAFed Standard SS01 Issue 05 - *Recruitment, training and competency of engineer surveyors*

2. EEMUA Publication No 193 - *Managing competence assurance for personnel undertaking in-service inspection of pressure equipment*
{ISBN 0 85931 190 8}

3. Health & Safety Executive Research Report RR 086 - *Competence assessment for the hazardous industries* {ISBN 0 7176 2167 7}

4. Health and Safety Guidance, HSG197 - *Railway safety principles and guidance: Part 3 Section A - Developing and maintaining staff competence* {ISBN: 0 7176 1732 7}

Appendix 1 - Qualification categories

Category 1. Chartered Engineer as defined by the Engineering Council or equivalent (e.g. appropriate degree with relevant experience, vocational qualification level 7 Engineering) including at least 3 years' experience within an engineering discipline associated with the relevant field of inspection.

Category 2. Incorporated Engineer as defined by Engineering Council or equivalent (e.g. appropriate HNC with relevant experience, (vocational qualification level 4) including at least 5 years' experience within a relevant engineering discipline of which at least one year** shall have been spent working within an engineering discipline associated with the relevant field of inspection.

Category 3. Engineering Technician as defined by Engineering Council or equivalent (e.g. appropriate ONC with relevant experience, vocational qualification level 3) having a minimum of 5 years' experience within a relevant discipline of which at least one year shall have been spent working within an engineering discipline associated with the relevant field of inspection.

Category 4. Person trained* in a relevant engineering discipline with a recognised and documented engineering apprenticeship with a minimum of 5 years' experience within a relevant discipline of which at least one year shall have been spent working within an engineering discipline associated with the relevant field of inspection.

Category 5. Person with less than tradesman's apprenticeship but with a minimum of 5 years*** spent working with or within the industry associated with pressure systems and has general knowledge of the field of inspection. Personnel shall be placed on recognised training courses with appropriate documented tests in in-service inspection of pressure systems. The minimum age for this category is 21 years.

Category 6. Person subject to training in line with a recognised apprenticeship / Traineeship with less than 5 years' experience within a relevant discipline. Personnel shall be subject to appropriate documented training and monitoring including observing competent tradespersons. The expected term of the training scheme shall not be less than 2 years resulting in a vocational qualification Level 4 or higher.**** The minimum age for this Category is 18 years.

* Persons in Categories 4,5 shall pass a qualifying test, established by the Inspection Body, associated with the particular inspection activities relating to the relevant field of Inspection and this should cover relevant knowledge of the law, codes of practice and inspection techniques.
** Where a person meets the minimum requirement for a specific discipline and is to be trained in a second discipline, it may not be necessary to have experience of at least one year in the second discipline provided that the required competence can be demonstrated.

***For some routine, well-monitored activities this period may not be necessary.

**** A person on completion of a minimum 2 year term as a Category 6 having gained a level 4 qualification shall be deemed to meet the requirements of Category 3, Where experience exceeds 4 years they shall meet the requirements of Category 2.

Equivalence defined by The European Qualifications Framework (EQF) or the Framework for Qualifications of the European Higher Education Area (FQ-EHEA) is accepted.

Appendix 2 - Competence management (informative)

This appendix gives three examples of approaches to competence management to illustrate how the guidelines might be applied to different situations.

Example 1

Limitations of example

The requirements in this example are considered appropriate only for inspectors working for a Type B inspection body with the following limitations:

- Controlled population of standardised products
- Low risk products
- Single or very limited range of product characteristics
- Strictly defined acceptance/rejection criteria
- Minimal scope for personal judgement
- Close supervision/access to technical advice
- Working in a controlled plant environment
- Items about which there is any doubt can be segregated for later examination by staff of a higher level of technical competence

Examples of inspections which might be considered under this appendix are the routine inspection of LPG cylinders at filling plants or the routine inspection of lifting slings at a central location.

Identification of competences

The competences required for routine inspection tasks are listed in the table, below.

Train and assess staff against the required competences

Candidates for routine period inspection work are considered not to need any specific academic qualifications but are only recruited from staff that have already demonstrated their basic personal and work abilities by successfully completing a range of general plant activities.
Prior to consideration for appointment to inspection work, all candidates are required to undertake training and assessment in all associated areas work within the plant, spending at least one week on each job. Each area of work is assessed by observation and questioning by team leaders and supervisors. On satisfactory completion of each module, both candidate and supervisor are required to sign the candidates training record.
Based on the supervisor's assessment, candidates who have demonstrated, not only work ability, but also the ability to work unsupervised and in a conscientious manner, are given inspection training.
Following training candidates are assessed by practical tests and questioning, and if successful allocated to inspection work, under constant supervision. On completion of a period of working under supervision, candidates considered suitable are appointed and both they and the supervisor sign the training record.

Candidates who do not demonstrate the required work or personal attributes are restricted to non-inspection work.

Under this system, inspectors are also skilled in other plant activities, and in practice, workers are job rotated to maintain all relevant skills and minimise the onset of boredom.

The technical manager of the inspection body is required to be of degree/Incorporated Engineer level with relevant experience of the inspection requirements gained over a number of years. Managerial supervisory staff are required to meet intermediate requirements of academic qualifications and experience gained.

Competences table

Attribute	Requirement	Training	Assessment
Personal	Ability to understand and comply with verbal, written or demonstrated instructions. Ability to behave in a responsible manner in a safety-critical environment.	General plant work, incl. Unloading/unpacking and pre-inspection sorting and preparation, manual handling. Suitable health and safety awareness.	Observation and questioning to determine job understanding and ability to work without continuous supervision.
Basic industry knowledge	Basic understanding of product characteristics, Health & Safety at Work requirements, familiarity with product types.	Plant induction training Plant activity training.	Written or oral assessment of each module of training, together with supervisor observation of initial work period.
Basic product inspection knowledge	Outline knowledge of legal requirements to inspect & dangers of faulty inspection. Returned / faulty product segregation requirements.	Training in IB procedures and requirements for inspection of various product types. Initial service return segregation training.	Written or oral assessment of initial inspection training. Practical assessment.
Detailed product inspection knowledge	Knowledge of inspection requirements for product types. Knowledge of inspection methods to be applied. Knowledge of acceptance/rejection criteria. Actions for rejected products. Understanding of limitations of activity and sources of assistance.	Specific product inspection training, covering inspection methods to be applied to various product types, acceptance/rejection criteria. Product reconditioning & scrapping criteria.	Written or oral assessment of each inspection method. Supervisor assessment of initial work under supervision, followed by signing off by candidate and supervisor. Periodic audits. Live witness of inspection at least once every 2 years.

Authorisation

Candidates who successfully complete the training, working under supervision and assessments are required to sign their training record, which is countersigned by the supervisor. These staff are then added to the site held register of authorised inspectors. This register indicates any restrictions of activity within the overall inspection procedures for the products.

Monitor performance and reassess competence

Inspectors working in this field of inspection are subject to very regular, if not continuous, supervision by team leaders and/or supervisors, allowing identification of poor performance or need for further training, immediately.

All inspectors in this field of inspection are subject to live witnessing of each inspection activity for which they are authorised, at least once every two years by staff of a managerial supervisory level or above.

Inspectors found to be performing inadequately or showing loss of competence are removed from inspection work or retrained and reassessed before being re-authorised for continued inspection work.

Records of training, assessment and live witness inspections are retained.

Example 2

Limitations of example

This example is of the inspection of plant on a major hazard / high risk plant environment.

The owner/operator of the plant has a legal obligation to establish a routine inspection regime to written procedures.

The items to be inspected range from small laboratory and workshop items which in themselves are low risk to high-risk plant the failure of which would cause a major public / environmental incident.

Identification of competences

The company requires its inspection staff to be authorised for the full range of activities on the complete range of equipment types.

It maintains a training document listing the generic types of equipment that staff may encounter. The list also includes the techniques that will be required during inspection work.

The company is a member of a trade association that publishes agreed guidance to be followed within its industry. An example of this would be the Engineering Equipment and Materials Users Association (EEMUA) Guide 193. The company uses this guide, as well as considering the specific requirements for particular types of equipment to be inspected, in identifying the specific topics/areas of competence that are appropriate for its inspection staff. This list is then used as a checklist and training record and assessment document.

Train and assess staff against the required competences

For new recruits the company applies a policy for inspection staff roles of recruiting staff with a minimum of an HNC qualification (or equivalent). This provides a basic threshold of academic ability required for staff that would be capable of understanding and applying the wide range of procedures and technical guidance in order to become and remain competent inspectors. Approved codes of practice dictate that some inspection staff are also required to be of degree/chartered engineer level. The technical manager is required to be of this level.

The process for training and successfully completing the assessment of competence to be **fully** authorised typically takes between 12 to 18 months for staff entering at the basic academic level with some relevant engineering experience. If staff are recruited with previous direct inspection experience the period may be shorter. Without suitable / sufficient engineering experience it might be longer.

The process followed for new recruits is as follows:

Initial training

a. induction into site and inspection body procedures
b. accompanying an authorised inspector witnessing / shadowing inspections
c. attendance on appropriate courses and discussions of inspection methods and failure mechanisms with existing authorised inspection staff (continues throughout training period and beyond).

Training under supervision

The trainee Inspector undertakes the inspection of the range of equipment types under the guidance of an experienced, authorised inspector, utilising the knowledge and skills acquired during initial training. The extent of guidance on the inspections is left largely to the experienced Inspector, but **the trainee** will:

i. Prepare for the inspections; discuss it with the experienced inspector.

ii. Inspect the equipment and discuss their findings with the inspector who will also inspect the equipment to satisfy himself that their inspection in combination with that of the trainee is complete.

iii. Draft the report and have it approved and signed by the experienced Inspector.

iv. Review the inspection requirements with the experienced inspector to consider if any changes are necessary or improvements can be made.

Throughout all the phases of practical training described above the trainee records every item of equipment that they are involved with.

Assessment

The trainee inspector's understanding of the training received and supervised work is assessed and recorded by the technical manager or his nominated deputy on the checklists completed by the trainee. This validation is a combination of reviewing the results of examinations set as part of formal training courses, discussion of the topics covered in courses and during inspections and confirming through a series of regular meetings that the trainee has understood their responsibilities and the requirements of the controlled procedures operated by the inspection body.

The technical manager or deputy will witness a selection of inspections towards the end of the supervised training period.

The technical manager/deputy signs off each of the topics on the checklist when they are satisfied with the trainee's understanding of them.

Authorisation

As trainees progress through the stages of training and demonstrate their competence they are issued with an internal certificate of authorisation. These identify the extent of authorisation in terms of equipment type(s) and the level of supervision under which they must work. Once the trainee has completed all training requirements and is deemed competent to work with a minimum of supervision they are issued with a completion/full authorisation certificate signed by the technical manager.

Monitor performance and reassess competence

Training and development needs for every employee are reviewed at least annually and as part of this the inspection body reviews the training and development needs for each of the inspection personnel.

The following monitoring activities are also undertaken to confirm the ongoing competence of individuals and identify any additional refresher/training needs:

Documented reviews of reports by senior inspection staff
Regular monthly meetings between inspectors and senior inspection staff
Monitoring of inspections
Audits as part of the internal Quality Management System
Reviews of any incidents or abnormal occurrences
Feedback from customers - both formal and informal

Example 3

Limitations of example

This example is of the inspection of wide ranges of plant/equipment by a Type A inspection body at the premises of users/owners of the plant/equipment. The items inspected may range from simple low risk products to plant presenting a major risk to personal injury and/or a major hazard to the public and/or environment. In general, inspection staff work remotely from their controlling office with minimal direct supervision.

The owner/operator of the plant/equipment generally has a legal obligation to establish a routine inspection regime for the items under their control. This obligation is often met by means of a contract with a Type A inspection body either directly or via an intermediary such as an insurance broker.

Identification of competences

The inspection body requires its inspection staff to be authorised for the full range of activities on each range of equipment types.

It maintains training documents listing the types of equipment that staff may encounter. The list also includes the techniques that will be required during inspection work.

Train and assess staff against the required competences

The company is a member of a trade association that publishes agreed guidance to be followed within its industry. An example of this would be the Safety Assessment Federation Standard 01:2001 (SS01:2001). The company uses this guide, as well as considering the specific requirements for particular types of equipment to be inspected, in recruiting and training its inspection staff.

For new recruits the company applies a policy for inspection staff roles of recruiting staff with a minimum of an HNC qualification (or equivalent). This provides a basic threshold of academic ability required for staff that would be capable of understanding and applying the wide range of procedures and technical guidance in order to become and remain competent inspectors. Approved codes of practice dictate that some inspection staff are also required to be of degree/chartered engineer level. For some routine tasks where a higher level of supervision may also be possible recruitment may be at a lower level of academic requirement. The technical manager for each inspection discipline is required to be of degree/chartered engineer level.

The process for training and successfully completing the assessment of competence to be **fully** authorised typically takes between 12 to 18 months for staff entering at the basic academic level with

some relevant engineering experience. If staff are recruited with previous direct inspection experience the period may be shorter. Without suitable / sufficient engineering experience it might be longer.

The process followed for new recruits is set out in the industry guidance and requires a formal written examination to be completed as well as on-site assessment of inspection capabilities. The process to be followed includes the following stages:

Candidate selection
Identification of training needs
Training plan and training implementation
Determination of competency
Authorisation

The stages followed broadly follow those set out in Example 2 but tailored for inspection work carried out remotely from the inspection body's controlling office.

Initial Training

a. induction into inspection body procedures
b. induction into general health and safety requirements including risk assessments
c. accompanying an authorised inspector witnessing / shadowing inspections
d. attendance on appropriate courses and discussions of inspection methods and failure mechanisms with existing authorised inspection staff (continues throughout training period and beyond).

Training under supervision

The trainee Inspector undertakes the inspection of the range of equipment types under the guidance of an experienced, authorised inspector, utilising the knowledge and skills acquired during initial training. The extent of guidance on the inspections is left largely to the experienced Inspector, but **the trainee** will:

i. Prepare for the inspections; discuss it with the experienced inspector.

ii. Inspect the equipment and discuss their findings with the inspector who will also inspect the equipment to satisfy himself that their inspection in combination with that of the trainee is complete.

iii. Draft the report and have it approved and signed by the experienced Inspector.

iv. Review the inspection requirements with the experienced inspector to consider if any changes are necessary or improvements can be made.

Throughout all the phases of practical training described above the trainee records every item of equipment that they are involved with.

Assessment

The trainee inspector's understanding of the training received and supervised work is assessed and recorded by the technical manager or his nominated deputy on the checklists completed by the trainee. This validation is a combination of reviewing the results of examinations set as part of formal training courses, discussion of the topics covered in courses and during inspections and confirming through a series of regular meetings that the trainee has understood their responsibilities and the requirements of the controlled procedures operated by the inspection body.

The technical manager or deputy will witness a selection of inspections towards the end of the supervised training period.

The technical manager/deputy signs off each of the topics on the checklist when they are satisfied with the trainee's understanding of them.

Authorisation

At the end of the formal training process and once trainees have demonstrated their competence to inspect and have passed a formal written examination, they are issued with an internal certificate of authorisation signed by the technical manager. These identify the extent of authorisation in terms of equipment type(s), which they are authorised to inspect.

Monitor performance and reassess competence

Following the authorisation of a new inspector the reports which he produces are monitored over a period of months by a supervising engineer. This monitoring is initially of 100% of the reports produced and is reduced as the supervising engineer becomes satisfied with the standard of the reports for the full range of equipment for which the inspector is authorised.

Training and development needs for every employee are reviewed at least annually and as part of this the inspection body reviews the training and development needs for each of the inspection personnel.

The following monitoring activities are also undertaken to confirm the ongoing competence of individuals and identify any additional refresher/training needs:

Documented reviews of reports by senior inspection staff
Meetings between inspectors and senior inspection staff at least annually
Monitoring of inspections
Audits as part of the internal Quality Management System
Reviews of any incidents or abnormal occurrences
Feedback from customers - both formal and informal