INTERNATIONAL STANDARD

ISO/IEC 23988

First edition
2007-02-01

Information technology — A code of practice for the use of information technology (IT) in the delivery of assessments

Technologies de l'information — Code de pratique pour l'emploi des technologies de l'information (TI) dans la livraison des évaluations

Reference number
ISO/IEC 23988:2007(E)

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 23988 was prepared by BSI (as BS 7988) and was adopted, under a special "fast-track procedure", by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by the national bodies of ISO and IEC.

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Introduction

Growth in the power and capabilities of information technology (IT) has led to the increasing use of IT to deliver, score and record responses of tests and assessments in a wide range of educational and other contexts. Suitably used, IT delivery offers advantages of speed and efficiency, better feedback and improvements in validity and reliability, but its increased use has raised issues about the security and fairness of IT-delivered assessments, as well as resulting in a wide range of different practices.

The aims of this Standard are to provide a means of:

— showing that the delivery and scoring of the assessment are fair and do not disadvantage some groups of candidates, for example those who are not IT literate;

— showing that a summative assessment has been conducted under secure conditions and is the authentic work of the candidate;

— showing that the validity of the assessment is not compromised by IT delivery;

— providing evidence of the security of the assessment, which can be presented to regulatory and funding organisations (including regulatory bodies in education and training, in industry or in financial services);

— establishing a consistent approach to the regulations for delivery, which should be of benefit to assessment centres who deal with more than one assessment distributor;

— giving an assurance of quality to purchasers of "off-the-shelf" assessment software.

It is envisaged that the achievement of these aims will enhance the status of IT-delivered assessments and assessment software and encourage their wider use in situations where they are beneficial.

Users' attention is drawn to any existing domain-specific legislation covering the subject matter of this Standard. This could include, but is not limited to legislation relating to disability, special educational needs, data protection, privacy, freedom of information, language and health and safety in relation to equipment or a broader work environment context.

This Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification, and particular care should be taken to ensure that claims of compliance are not misleading.

A Standard does not purport to include all the necessary provisions of a contract. Users of Standards are responsible for their correct application.

Compliance with a Standard does not of itself confer immunity from legal obligations.

This Standard is intended for organisations involved in the use of IT for the delivery of assessments, including (but not limited to):

— universities, colleges, learning centres, and schools who assess their students, for diagnostic, formative and summative (final test) purposes;

— organisations which deliver and/or award educational examinations;

— professional bodies, industry organisations and others who deliver and/or award examinations or assessments in vocational subjects;

— producers and distributors of IT certification tests;

— assessment centres which administer assessments locally;

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— open, distance, or e-learning centres and other organisations which may provide assessment facilities on an occasional basis;

— training companies, employers and governmental/military organisations providing assessments as part of vocational education and training;

— organisations providing assessments required for regulatory purposes, for example a financial services company might be required to assess its sales people for product knowledge, or a pharmaceutical company might be required to assess its staff on safety procedures;

— open learning and distance learning material providers, including on-line universities and commercial publishers and distributors of learning materials, who incorporate assessments in their material;

— producers of item banks, quizzes and "tests" available as revision aids.

This Standard is also relevant to developers of software for delivering assessments, who will need to provide software which enables their clients to comply with this Standard.

This Standard distinguishes three main roles in the IT delivery of assessments:

— assessment sponsors, responsible for assessment content and award of certificates;

— assessment distributors, responsible for delivering assessments via IT including developing or specifying the delivery software;

— assessment centres, where the assessments are taken.

The roles involved in the different stages of the assessment life cycle (see **1.3**) are combined in different ways by the organisations involved and not all organisations are involved in all roles. Thus, a university may combine the roles of assessment sponsor, assessment distributor and assessment centre, whilst the assessments distributed by an awarding body (as assessment sponsor and distributor) are normally taken in assessment centres which are separate organisations. This Standard therefore recommends the action to be taken in relation to each of these three roles, irrespective of the type of organisation undertaking the role. The scenarios in Annex A give examples of how this can work in practice.

The roles of the different organisations are often inter-related, especially in high-stakes assessment. For example, the assessment distributor or awarding organisation might have an overall responsibility for the integrity of the whole process, including monitoring assessment centres. Assessment centres need to comply with the general regulations of assessment distributors, as well as with those which are specific to the use of IT.

It should be noted that some of the organisations to which this Standard is relevant may also need to comply with domain-specific requirements of regulatory authorities in relation to the design and conduct of assessments, including pedagogical aspects. Where the candidates are employees of the assessment centre, there may also be more specific legislative requirements.

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Information technology — A code of practice for the use of information technology (IT) in the delivery of assessments

1 Scope

1.1 General

This Standard gives recommendations on the use of information technology (IT) to deliver assessments to candidates and to record and score their responses. Its scope is defined in terms of three dimensions: the types of assessment to which it applies, the stages of the assessment "life cycle" to which it applies and this Standard's focus on specifically IT aspects.

1.2 Types of assessment

This Standard is relevant to a wide range of assessments, including:

— assessments used in education (both compulsory and post-compulsory), training and compliance (e.g. compliance with legislation relating to health and safety or financial services);

— assessments of knowledge, understanding and skills (i.e. "achievement tests"), but not psychological tests of aptitude and personality;

— high-stakes assessments and examinations and also low-stakes assessments used for feedback on progress, identification of learning needs, self-assessment and remediation;

— assessments which include feedback, as well as those which provide only a result;

— both fixed-date, test-windows and on-demand assessments;

— both items which can be scored by computer and the delivery (but not scoring) of items or tasks which are delivered using IT, but have to be referred to a human marker for scoring; however, the use of IT for scoring lengthy free-text responses ("essays" and similar) is excluded;

— a wide range of computer-scorable assessments, including not only "objective tests" (multiple-choice and other item types), but also assessments of keyboarding skills and software use;

NOTE Items can include graphics, multimedia and access to data, case studies, etc. This Standard does not, however, cover the use of specialist simulations (e.g. of industrial processes or driving/piloting).

— assessments taken in universities, academies, colleges, high-schools, training centres, schools and assessment centres and also assessments taken in less formal settings, including learning centres and in the workplace;

— assessments which are set, taken and scored within a single organisation (for example a university or a company) and assessments taken in an organisation separate from the one responsible for the assessment content;

— assessments delivered in a variety of ways, including on-line, on local networks and on stand-alone computers.

Clause **9** of this Standard is also applicable to the use of IT for the transmission of candidates' coursework.

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1.3 Assessment life cycle

Although assessment procedures vary, the typical life cycle of assessment consists of the following steps:

a) identification of need to assess;

b) design of outcomes/assessment methodology;

c) preparation and calibration;

d) pre-registration (includes payment);

e) distribution[1)];

f) authentication (includes identification)[1)];

g) delivery[1)];

h) response return[1)];

i) scoring, result determination and/or feedback[1)];

j) data return[1)];

k) analysis;

l) appeals;

m) certification.

Preparation of assessment content is outside the scope of this Standard, but where pretesting is undertaken using IT for delivery, the relevant clauses of this Standard should be taken into consideration.

1.4 Focus on specifically IT aspects

The emphasis throughout this Standard is on the additional or different measures which should be taken as a result of the introduction of IT. Measures which are common to both paper and IT-delivered systems are either omitted or covered in only general terms.

This Standard does not cover the purely pedagogical aspects of assessment preparation or scoring, but does cover the use of IT to implement pedagogical decisions and the interface between assessment content and IT delivery. The quality of the assessment content and the scoring procedures are of crucial importance to the validity and reliability of the final result, but fall outside the scope of this Standard.

Compliance with this Standard does not indicate that the assessment is pedagogically sound. This Standard should not be interpreted as reducing the need for assessment sponsors to follow good practice in developing assessments, including standardisation and attention to validity and reliability.

This Standard does not cover scoring by human markers, but does cover:

— IT scoring which may be subject to later review by human markers;

— the IT transmission and delivery of assessments partly or wholly to be scored by human markers and the return of the resulting responses for scoring.

[1)] Covered by this Standard.

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This Standard covers the use of IT to provide automatic feedback and instant results, but not result-determination requiring human decision-making or intervention.

1.5 Focus on principles

The aim of this Standard is to set out principles and good practice, but not the details of the means by which they are to be achieved. It is therefore possible to follow the recommendations using a variety of technological or procedural approaches. This Standard is not specific to any particular hardware or software platform.

In many areas the principles outlined in this Standard will be supplemented by the specific regulations of assessment distributors.

1.6 Compliance

Assessment sponsors, assessment distributors and assessment centres may claim compliance with this Standard if they comply with all the clauses or subclauses applicable to their role (see table below).

Notes to the clauses indicate the role(s) to which each clause or subclause is applicable.

This Standard is applicable to both high-stakes and low-stakes assessments, but some clauses or subclauses are applicable only to high-stakes assessments; this is indicated in Table 1.

Table 1 — Application of ISO/IEC 23988

Role	Assessment type	Relevant clauses or sub-clauses
Assessment sponsors	High-stakes and low-stakes	**5.1**
Assessment distributors	High-stakes	**5.2**, **6** to **12** inclusive
Assessment distributors	Low-stakes	**5.2**, **6.1**, **6.2**, **6.3**, **6.5**, **7.1**, **7.2**, **7.3**, **7.4**, **7.5**, **8.1**, **8.2**, **8.3**, **8.4**, **9.1**, **9.2.1**, **10.1**, **10.2**, **11.1**, **11.2**, **12.1**, **12.2** and **12.3**.
Assessment centres	High-stakes	**13**, **14**, **15**, **16** and **17** inclusive
Assessment centres	Low-stakes	**13.1**, **13.2**, **13.3** and **13.4**

The scenarios given in annex A illustrate how different types of organisation might need to comply with different clauses of this Standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 17799:2005, *Information technology — Security techniques — Code of practice for information security management*

ISO 9241-3, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 3: Visual display requirements*

ISO 9241-4, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 4: Keyboard requirements*

ISO 9241-5, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 5: Workstation layout and postural requirements*

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ISO 9241-8, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 8: Requirements for displayed colours*.

ISO 9241-9*, Ergonomic requirements for office work with visual display terminals (VDTs) — Part 9: Requirements for non-keyboard input devices*

ISO 9241-11, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 11: Guidance on usability*.

ISO 9241-12, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 12: Presentation of information*.

ISO 9241-13, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 13: User guidance*.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
assessment

test, examination or similar, designed to assess a candidate's knowledge, understanding or skills in a defined area

NOTE Can be high-stakes or low-stakes (see **3.13** and **3.19**).

3.2
assessment centre

formally designated location where assessments are taken, not necessarily used exclusively for assessments

NOTE An assessment centre has staff with responsibility for the conduct and security of the assessment. Assessment centres are often, but not always, remote from the assessment distributor and part of a different organisation. In high-stakes assessment, centres are normally subject to the approval and monitoring of the assessment distributor. Some assessments, especially those which are low stakes, can be taken outside assessment centres.

3.3
assessment content

the questions and associated images or additional information which is provided to the candidate during the assessment

3.4
assessment distributor

organisation responsible for delivering assessments (especially high-stakes assessments) via information technology, this could include overseeing assessment centres, but not necessarily responsible for assessment content

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3.5
assessment form

alternative version of an assessment; two or more different assessment forms each contain a different mix of items but are designed to assess the same knowledge, understanding or skills based around an assessment specification

3.6
assessment software

software which presents the assessment to the candidate and records the candidate's responses

NOTE Can be generic (capable of running numerous different assessments) or integral with assessment content. Usually (but not necessarily) separate from software to develop and store the assessment items, log candidate entries, manage assessment sessions, etc.

3.7
assessment sponsor

organisation responsible for determining assessment content and awarding certificates or some other formal recognition

NOTE Assessment sponsors often delegate assessment delivery to an assessment distributor.

3.8
assistive technology

functional units and services that facilitate the use of IT by users, such as people with functioning disabilities (e.g., sensory or physical impairment)

3.9
candidate

a person taking an assessment

3.10
correct response

predetermined response which will give a positive score

NOTE Use of this term is not intended to imply that there is only one possible correct response per item. See also **3.19** and **3.20**.

3.11
delivery platform

computer hardware, system software and, where applicable, telecommunication software and associated features which support the delivery of assessments to the candidate and the return of computer held information (e.g. results) to a specific location for scoring purposes, or reporting if scored locally

3.12
fairness

non-bias of a test to a particular group of candidates

NOTE Computer delivery and scoring should be fair to all candidates and, as far as possible, should not disadvantage any candidate as a result of factors which are irrelevant to the knowledge, understanding or skills being assessed (such factors include lack of advanced computer skills, if these are irrelevant);

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3.13
high-stakes assessment

assessment where the result is of importance to the candidate or to an organisation and therefore has to be reliable and valid

NOTE High-stakes assessments include most end-of-course educational examinations leading to a certificate (and also module assessments which contribute to an overall result), proficiency and licensing examinations. Assessments can also be considered high-stakes if the evaluation of an organisation depends on the performance of its employees or students, as might be the case with safety assessments. See also **3.19**.

3.14
ICT

information and communications technology

NOTE This term includes internet connectivity speed or 'bandwidth'.

3.15
IT

information technology

3.16
invigilation

process of overseeing the conduct of an assessment, especially to ensure that there is assessment security and no cheating

NOTE Proctoring is an alternative term for invigilation. Although not covered in this Standard, invigilation could be undertaken remotely using monitoring equipment, if accepted by the assessment sponsor.

3.17
invigilator

person responsible for invigilation

NOTE Proctor is an alternative term for invigilator.

3.18
item

smallest separately identified question, piece of information relating to a question, or task within an assessment

NOTE Can be a closed-response question, an open-ended question, an essay or the performance of a task (e.g. "centre a heading in a given passage of text").

3.19
low-stakes assessment

assessment where the result is of lower importance to the candidate or to a relevant organisation

NOTE Formative and diagnostic assessments are usually low-stakes. See also **3.13**. Low-stakes assessments need not be invigilated or take place in a test-centre if approved by the test sponsor.

3.20
open-ended response

response which is not limited to choosing from a list of options

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NOTE Open-ended response items are most likely to require text input, but can require numerical input or computer graphics. See also **3.10** and **3.24**.

3.21
reliability

consistency with which an assessment measures

EXAMPLE An assessment will have low reliability if two assessment forms are of unequal difficulty or coverage or if there are errors in the scoring procedures or in the reporting of scores.

3.22
response

candidate's answer to an item

NOTE Responses can consist of the selection of one or more from a given set of options, open-ended IT-scorable responses, more complex IT-scorable activities or production of text which has to be marked by a human, but can be transmitted by IT. Or could include the recording of an audio response. See also **3.9** and **3.18**.

3.23
result

outcome of the assessment taken by the candidate

NOTE A result can be expressed as pass/fail, as a grade, as a percentage or in other ways such as item or syllabus level feeback in a diagnostic or formative assessment

3.24
score

numerical measure of the candidate's achievement in the assessment as a whole or on the individual items

3.25
validity

extent to which an assessment achieves its aim by measuring what it is supposed to measure and producing results which can be used for their intended purpose

NOTE An assessment has low validity if the results are unduly influenced by skills which are irrelevant to the stated aims of the assessment.

3.26
workstation

equipment provided for an individual candidate at an assessment centre, including IT hardware, seating and desk or table space

4 Guiding principles

The guiding principles which underpin this code of practice and are relevant to all the organisations concerned are as follows:

a) delivery or scoring of assessments using IT should not result in any reduction in the assessment validity or reliability;

b) computer delivery and scoring should be fair to all candidates and, as far as possible, should not disadvantage any candidate as a result of factors which are irrelevant to the

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knowledge, understanding or skills being assessed (such factors include lack of advanced computer skills, if these are irrelevant);

c) where disabled candidates are involved, reasonable adjustments should be made for their needs, so that no candidate is placed at substantial disadvantage;

NOTE Attention should be drawn to any domain specific legislation with regards to disability and special needs.

d) the health and safety of candidates (or of those developing, arranging or conducting the assessments) should not be put at risk;

e) where the confidentiality of assessment content and correct responses is an important requirement, there should be procedures to maintain it throughout the assessment cycle; this should also extend to the trialling of items;

f) the confidentiality and integrity of candidate data should be maintained throughout;

NOTE Attention is drawn to any domain specific legislation relating to data protection, privacy or freedom of information, etc.

g) an audit trail should be maintained, so that any queries or irregularities can be investigated;

h) back-up facilities and fall-back procedures should be in place to minimise disruptions so that the candidate is not disadvantaged, especially for high-stakes assessment.

5 Interface between assessment content and IT delivery

NOTE This clause concerns the inter-relationship between assessment content and assessment software and is relevant both to assessment sponsors, who define the pedagogical requirements of the assessment, and to assessment distributors, who are responsible for developing or customising the software. Assessment sponsors should comply with **5.1** and assessment distributors with **5.2**.

This clause is applicable to both high-stakes and low-stakes assessments and to the use of both generic assessment software (capable of running a range of different assessments) and software which is specific to a single assessment or group of assessments.

5.1 Responsibilities of assessment sponsors

5.1.1 Assessment sponsors should ensure that they have sufficient familiarity with the software which is being considered or which is to be used and the associated delivery platform to be able to:

a) understand their advantages and limitations;

b) appreciate the likely effect of IT delivery on the validity and reliability of the assessment and of individual items;

c) use software features (e.g. item types, multimedia elements) relevant to the intended assessment;

d) identify assessments for which IT delivery is unsuitable or should be supplemented by other assessment methods.

5.1.2 Assessment sponsors should specify clearly the parameters required for each assessment, including:

a) number and type of items to be used;

b) how the items are selected for each assessment session (e.g. fixed assessment form, computer selection from a bank, any constraints on selection);

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c) any time limit;

d) any restraints on navigation between items (see **7.1**);

e) assessment regulations, including permitted and prohibited resources (see **6.4.3** and **7.3.3**);

f) scoring rules for individual items and for the calculation of the overall result (if applicable), including rules for the scoring of open-ended items (see **8.1** and **8.2**);

g) feedback to be provided (see **8.3**).

5.1.3 Assessment sponsors should try out the assessment (i.e. the combination of software and content) during development and again before operational use to verify that all aspects of the delivery, scoring and feedback operate as intended and in accordance with pedagogical requirements.

NOTE It is acknowledged that some 'off-the-shelf' item banking and delivery software may be being used where this is not relevant.

5.1.4 In developing assessment content, assessment sponsors should consider issues relating to candidates with disabilities, including:

a) whether a non-IT alternative should be provided for such candidates;

b) the effect of using assistive technology on the validity of the items (for example where the wording of a text alternative to a graphic changes the nature of the item).

NOTE Some systems may 'lock-down' the desktop to prevent other software being used during the assessment which may limit the use of assistive technologies.

5.1.5 Ensure that the chosen system from a test distributor is robust enough and scalable to ensure that it can cope with the demand of the assessment so that no candidate is disadvantaged by technical failure of the system.

5.2 Responsibilities of assessment distributors

Assessment distributors should provide assessment sponsors with:

a) full information about the capabilities, limitations and features of the intended software and the associated delivery platform that is relevant to the pedagogical aspects of the assessment;

b) a checklist of the parameters to be specified by the assessment sponsor (see **5.1.2**).

6 IT delivery of assessments — general

NOTE This clause is applicable to assessment distributors who develop, specify, purchase or adapt assessment software. It will also be of interest to software designers and developers. All subclauses are applicable to high-stakes assessments; **6.1, 6.2, 6.3** and **6.5** are also applicable to low-stakes assessments. This clause is applicable both to generic assessment software (capable of running a range of different assessments) and to software which is specific to a single assessment or group of assessments.

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6.1 Interoperability

6.1.1 In the design of assessment software consideration should be given to the need to facilitate exchange of item and response data with other assessment users (for example using IMS standards for question and test interoperability). This could also include a test sponsor's candidate tracking or a commercial organisations Learning Management System.

6.1.2 Where items are imported, the receiving organisation should verify that they operate correctly on the hardware and software used by their candidates.

6.2 Hardware, software and communication considerations

6.2.1 *Taking account of ICT facilities available to candidates*

Design of software for IT delivery of assessments should take account of the ICT facilities likely to be available to the intended candidates and at the assessment centres. Implications which should be considered include the following:

a) the effect on access to the assessment if the assessment software requires a higher ICT specification than is available at most assessment centres;

b) the effect of the assessment centre's delivery platform on the speed of operation of the assessment software;

c) the possible need to provide versions of the assessment software for more than one delivery platform.

d) the speed of any internet connection used as this may affect the item types that can be used.

6.2.2 *Specifying delivery platforms*

The specification of the delivery platform for the assessment software, although it may not be for dedicated use, should include information about:

a) minimum hardware, including network and peripherals;

b) keyboard (e.g. UK, US);

c) screen resolution and colour depth;

d) operating system(s), including the range of acceptable version numbers;

e) language (e.g. English, French) of the operating system (this could affect, for example, display of dates, and of numbers using decimal point, and number of bits for character codes);

f) any software required in addition to the assessment software (for example browser software, plug-ins, specific fonts), including software versions where applicable;

g) communication links;

h) assistive technology to which the assessment software may link (including any particular settings or hardware inclusions).

6.2.3 *Consistency of requirements*

As far as possible, assessment distributors should minimise variations in the delivery platform required for different assessments and over time.

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6.2.4 *Server and connection requirements for network delivery*

6.2.4.1 Where assessments are delivered on a network or intranet, the server and connections should be adequate to give an acceptable response time at the candidate's computer or terminal, taking account of:

a) the average amount of traffic between candidate and server in one assessment (both frequency and size of transactions);

b) the likely maximum number of candidates at any one time.

6.2.4.2 Where assessments are delivered via the Internet or in any other situation where speed of connections cannot be guaranteed, measures should be taken to ensure that candidates are not disadvantaged by slow connections. Depending upon circumstances measures could include one or more of the following:

a) downloading the whole assessment onto a local network or hard disk just before the assessment begins;

b) eliminating any unnecessary use of multimedia;

c) extending the time limit (if any) to compensate for delays (for some assessments this is not a valid option);

d) instituting a clear appeals procedure in case of delay.

6.2.5 *Special characters*

6.2.5.1 Care should be taken to ensure that any necessary special characters or formats are displayed correctly when the assessment is delivered. These may be needed, for example:

a) for assessments of foreign language skills;

b) where the assessment is delivered through the medium of another language;

c) for currency symbols (e.g. Euro, Yen);

d) for some mathematical or scientific symbols, including subscripts and superscripts;

e) in the display of mathematical equations.

6.2.5.2 If the assessment requires candidates to input characters not available on the specified keyboard (as might be the case in assessments of foreign language skills or for mathematical or scientific symbols), they should be provided with an easy method of inputting these characters (e.g. by being told the shortcut key or given a range of characters which may be copied, or dragged and dropped), supported by an informative help system.

6.3 Assessments with time limits

If an assessment has a time limit, timing should not begin until the candidate has had opportunity to read the initial instructions and information.

If an assessment has a time limit, consideration may need to be given to the following:

a) additional time for candidates using assistive technology (see **3.7**);

b) discounting any time delays due to degraded system performance;

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c) stopping and restarting the timing if there is a planned break;

d) provision for the invigilator to re-set the timing after an unplanned break (e.g. emergency or technical factors).

6.4 Security features

6.4.1 *Security of the assessment software*

Assessment software should be protected from unauthorised changes to the code or parameters, during development and use. Procedures for development and maintenance should be carried out in accordance with ISO/IEC 17799:2005, **12.4**, **12.5** and **12.6**.

6.4.2 *Security of items and correct responses*

6.4.2.1 Assessment software should incorporate features to protect the security and integrity of the items and (if applicable) correct responses. For high-stakes assessment, features can include (but are not limited to) the following:

a) password protection at different levels;

b) individual user IDs and passwords;

c) encryption of files of items and correct responses.

6.4.2.2 If the security measures allow each user ID to access the assessment only once, there should be provision for the invigilator to override this to allow the candidate to resume after a planned or unplanned break.

6.4.2.3 The scoring algorithms, correct responses, etc are to be present in the assessment centre, then these should be secured against unauthorised access and the assessment distributor should ensure that any security measures can be implemented in practice by the assessment centre.

6.4.3 *Preventing unauthorised candidate access to outside information and aids*

NOTE This subclause relates only to aids prohibited by the assessment regulations and does not apply if, for example, candidates are required to locate information using the Internet. The precautions outlined in this subclause are unnecessary if there are procedures to ensure that the assessment software is only used on stand-alone computers which do not hold any possible aids. They are most significant in high-stakes assessment, but should be considered for use in low-stakes assessment to ensure reliable results.

6.4.3.1 Wherever possible assessment software should incorporate features to prevent candidates from gaining electronic access during the assessment to aids not permitted by the assessment regulations, for example:

— information sources, including the Internet, and the candidate's own files held elsewhere on the network;

— aids such as calculators, spell checkers and dictionaries;

— communication with other people, including other candidates.

These features could include:

a) hiding all navigation toolbars etc. which could give access to such help;

b) disabling short cut keys which could give such access;

c) preventing return to the assessment software if another program has been accessed;

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d) preventing viewing of the source code in a browser;

e) applying similar safeguards to any information or aids whose use is permitted.

6.4.3.2 Where it is not feasible to provide features in the software to prevent such unauthorised access, there should be measures to detect such access through invigilation procedures.

Consideration should also be given to the use of software features to detect unauthorised access to outside information and aids. This can include:

a) keystroke monitoring;

b) recording the time taken for each item

These can then be monitored retrospectively to detect any unusal occurrences that may be indicative of cheating.

NOTE Candidates should be informed of any keystroke monitoring.

6.4.4 *Preventing unauthorised disclosure during the assessment*

Where possible, software should include features to prevent unauthorised disclosure of the assessment content by the candidate or others during the assessment, for example by preventing:

a) printing assessment items;

b) copying assessment items into another software application;

c) sending files of assessment items to another computer.

Where it is not possible to provide these features in the software, they should be covered by invigilation procedures. These should also include ensuring any notes or workings made during the assessment may not leave the room.

6.4.5 *Provision for breaks*

6.4.5.1 For assessments longer than 1.5 hours and where the candidate works almost entirely at the screen, there should be provision, if not detrimental to the purpose or validity of the assessment, for the candidate to take a break.

6.4.5.2 Where a break is required, there should be measures to ensure that security and invigilation rules are not breached during the break. Depending upon the nature of the assessment these could include:

a) dividing the assessment into two or more independent sub-assessments;

b) software features and procedures which allow a session to be interrupted and resumed;

c) supervision of candidates during breaks.

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6.4.5.3 There should be measures to ensure that there is no unauthorised access to the assessment either by the candidate or by others during a break, whether this is planned or unplanned. The invigilator should control access to the assessment after the break.

6.5 Verification of the assessment software

6.5.1 *Verification by the distributor*

6.5.1.1 *Verification of the software should be:*

a) systematic;

b) planned;

c) documented; and,

d) designed to cover the specific points listed in this Standard.

6.5.1.2 The performance of the assessment software should be thoroughly verified:

a) on all the delivery platforms for which it is stated to be suitable;

b) for all alternative versions of the software (if applicable);

c) at maximum likely loadings.

Verification should confirm that:

1) the assessment meets pedagogical requirements (this should be verified either by pedagogical experts or by reference to a specification provided by pedagogical experts);

2) the software works as intended, including correct display of both text and graphics, correct functioning of multimedia elements, navigation and operation of peripherals and assistive technology (see **7.4**);

3) any differences between workstations in the speed of operation are too small to have an effect on the overall time taken by the candidates (see **6.2.4** for connection times over networks).

NOTE In low-stakes assessment or where there is no time limit for the assessment, some variation in speed of operation may be acceptable.

6.5.1.3 If generic software is used, the operation of each individual assessment or group of assessments should be successfully verified before operational use, with particular attention to any special characteristics, such as use of special characters or fonts and use of non-text features (e.g. graphics, multimedia calls).

6.5.2 *Information and verification opportunities for assessment centres*

6.5.2.1 Information about the hardware, software and communication requirements (including any changes to the requirements) should be provided to assessment centres as far in advance of the assessment session as possible. The information should include:

a) intended delivery platform (see **6.2.2** and **6.2.4**);

b) the combinations of hardware and software on which the operation of the assessment software has been verified by the distributor, including assistive technology;

c) sizes of files to be stored on local hardware and networks.

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6.5.2.2 There should be opportunities for assessment centres to verify communication links and the compatibility of their delivery platforms with the assessment software in advance of operational assessment sessions.

6.5.2.3 For each assessment (or each group of similar assessments), a sample assessment should be provided to enable assessment centres to verify in advance of the actual assessment session, that all the features work satisfactorily on all the equipment on which they plan to use it. This is particularly important where there are non-text features or special characters.

6.5.2.4 If it is likely that an assessment incorporating non-text features will be used on a wide variety of ICT platforms without thorough verification at all of them, the wording of the items should advise candidates to ask for technical help if the associated non-text objects are not accessible.

7 Software for IT delivery of assessments — navigation and usability issues

NOTE This clause is applicable to assessment distributors who develop, specify, purchase or adapt software and to both high-stakes and low-stakes assessment. It is also relevant to software designers and developers and to open learning materials and revision aids which include tests, quizzes or self-assessments

7.1 Provision of adequate navigation facilities

7.1.1 Assessment software should provide simple, clearly explained and consistent navigational facilities that allow the candidate to navigate through the items in the assessment as freely as permitted by the assessment regulations.

7.1.2 If the candidate is permitted to, miss out, or leave items unanswered the method of doing this should be simple and clear. If it is possible to return to such unanswered items to answer them later, the method of finding the items and returning to them should also be simple and clear.

7.1.3 If the candidate is permitted to answer items in any order, either in the assessment as a whole or within a defined sub-set of items, then:

a) the procedure for moving backwards and forwards through items should be simple and clear, with an easy method of going back one item or forward one item, and with the number of the current item in the assessment or subset being clearly shown;

b) consideration should be given to providing a method of going directly to the first item or the last item and/or going to any item by number;

c) if the candidate is permitted to go back and change the response given to an item, the procedure for this should be simple and clear.

7.1.4 If submitting the responses to an individual item or subset of items is irrevocable, consideration should be given to asking the candidate to confirm that the submission of the answers is final, particularly if some items in a subset remain unanswered.

7.1.5 If the candidate is permitted to quit the assessment before the expiry of the time limit, consideration should be given to asking the candidate to confirm that the submission of the answers is final, particularly if some items remain unanswered.

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7.2 Provision of information and help for candidates

The software should provide adequate information and help for candidates, normally including:

a) information before the assessment begins about how to answer items, navigate and quit;

b) information before the assessment begins about the assessment itself, i.e. number of items, item types, time allowed (if applicable), how the assessment is scored;

c) ongoing information about number of items answered/unanswered, time taken/remaining (if applicable);

d) if there is a time limit, a warning message a suitable time before the end of the assessment (10 minutes is suggested);

e) easily accessible help.

7.3 Usability

7.3.1 *Design for usability*

Design of assessment software should take account of usability requirements including:

a) matching design to user (candidate) needs and characteristics, especially the expected level of IT skills (see ISO 9241-11);

b) conformity to the conventions of the delivery platform and user expectations (see ISO 9241-11);

c) user control over presentation, where this is consistent with pedagogical or measurement requirements (see ISO 9241-11);

d) consistent screen design, layout and colours (see ISO 9241-8, ISO 9241-11 and ISO 9241-12);

e) consistent navigation, functionality, positioning and names of buttons and icons, positioning and terminology of messages (see ISO 9241-11, ISO 9241-12 and ISO 9241-13);

f) alternative input or navigation methods wherever practicable (e.g. choice of arrow key or mouse, use of number keypad or standard number keys) (see ISO 9241-11);

g) selection of colours and fonts for easy legibility, including for candidates with impaired colour vision (see ISO 9241-8).

7.3.2 *Fail-safe features*

7.3.2.1 *Assessment software should incorporate fail-safe features including:*

a) disabling of inapplicable keys;

b) acceptance of both upper and lower case, unless there are pedagogical reasons for a case-sensitive response;

c) measures (e.g. dialogue boxes) to prevent the candidate quitting by accident;

d) measures to prevent inadmissible response patterns (such as checking two responses where only one is required).

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7.3.2.2 Use of fail-safe features should be discussed with pedagogical experts if the IT-delivered assessment is intended to be an equivalent alternative to a paper-based version, as there may be an advantage/disadvantage to candidates using the IT-delivered version.

7.3.3 *Access to on-screen data and aids*

If the assessment allows on-screen access to data, case descriptions or aids (e.g. calculators) these should be:

a) clearly marked;

b) accessible directly from the item screen(s) for which they are needed;

c) able to be viewed, at least in part, at the same time as the item;

d) easily moved or scrolled as needed.

7.4 Links to assistive technology

NOTE Some aspects of good design, such as clearly legible screens and consistent positioning of buttons, benefit all users not only those with disabilities. See Bibliography for sources of advice on access to IT by people with disabilities.

7.4.1 Consideration should be given in the design of assessment software to facilitate interfaces to assistive technology including:

a) alternative and enhanced output devices, such as screen enlargers, screen readers, headphones and packages which produce Braille output;

b) alternative and ancillary input devices, such as speech recognition software, touch screens, , auditory confirmation of key presses.

7.4.2 Measures to facilitate use with alternative output devices can include:

a) text equivalents for images (including graphs and charts) and multimedia;

b) tags to indicate the language used;

c) use of style sheets which allow the user to change aspects of the presentation.

7.4.3 Consideration should be given to the effects of possible interfaces to assistive technology. In particular:

a) inappropriate use of interfaces to assistive technology could change the nature of the item or give an unfair advantage to the candidate with disabilities (for example a description of an image could reveal the answer to the item);

b) use of assistive devices may be slower than usual methods, reducing the validity of the result if there is a time limit;

c) for some assessments or items an alternative method of assessment (e.g. oral questioning) may be preferable to using assistive technology.

NOTE In some circumstances use of assistive technology is not necessary or appropriate, for example for a occupation specific assessment where candidates with some types of special need are barred from that occupation.

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7.5 Trialling software for usability

7.5.1 Assessment software should be trialled with candidates who are representative of the expected eventual users to ensure that it is:

a) easy to use;

b) robust;

c) secure.

Where appropriate, trialling should include candidates needing assistive technology.

7.5.2 Appropriate accessibility analysis tools, where available, should be used to verify accessibility.

8 Instant automated scoring, result determination and feedback

NOTE This clause is applicable to assessment distributors who develop, specify, purchase or adapt software to provide automatic scoring, result determination or feedback. It is also relevant to software designers and developers. It is applicable to both high- and low-stakes assessment. Recording of responses and candidate data is covered in Clause **10**.

8.1 Scoring responses

8.1.1 *Design to support pedagogy*

Software used for scoring candidate responses should be designed to support pedagogical decisions on the scoring rules, especially in relation to:

a) the correctness of responses;

b) the score weighting for individual items or item types;

c) any allocation of lower scores to partially correct responses;

d) the calculation of the overall score or result;

e) any correction for guessing.

Software for scoring responses may need to take account of:

1) random selection of items by the software;

2) shuffling the sequence of items;

3) shuffling the sequence in which alternative responses are presented;

4) insertion of random variables into items.

Scoring rules should be as simple as possible, capable of being explained to candidates and justified pedagogically.

8.1.2 *Trialing of automated scoring*

Automated scoring should be trialed with a wide range of candidate responses to ensure that it operates consistently and as intended.

8.1.3 *Scoring of open-ended responses*

NOTE Scoring of essays using IT and of items designed for scoring only by human markers fall outside the scope of this code of practice.

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8.1.3.1 Software to score open-ended responses (for example where the candidate types a response) should be designed and trialled with particular care to ensure that credit is given for any response which would be accepted by a human marker. Aspects which require consideration include the acceptability of:

a) alternative spellings or mis-spellings;

b) use of capitals or lower case;

c) synonyms;

d) punctuation;

e) the use of "or", "/" "and", "&", , "not" and negative statements; and corresponding terms in other languages;

f) inclusion or omission of units to numerical answers.

8.1.3.2 If the item requires calculation or estimation of a numerical response, consideration should be given to the need to specify a range of acceptable responses, to allow for such factors as possible rounding errors in calculations and differences in number of decimal places used (if not specified by the item).

8.1.3.3 All responses to open-ended text entry items from candidates known to be dyslexic should be reviewed manually, unless correct spelling is a pedagogical requirement.

8.1.3.4 Except where correct responses are very strictly defined, there should be human review of IT scoring of open-ended text-entry items in high-stakes assessment. The review, which should be determined in consultation with pedagogical advice, may be a review of all unforeseen responses, of a representative sample of these or of only those candidates whose results are significantly affected.

8.1.3.5 Feedback from trialling or from operational use should be used to refine definitions of correct and incorrect responses and (if appropriate) scoring algorithms.

8.1.4 *Information for candidates*

Information about the scoring should be made available to candidates prior to the assessment, since this may influence their assessment strategy.

NOTE This should only be done if the information on scoring does not compromise the validity of the test or unnecessarily confuse the candidates.

8.2 Software for result determination

If the software automatically calculates an overall result (e.g. "pass" or "fail") from the candidate responses, this should be based on clear rules which should be made known (at least in general terms) to candidates.

The operation of the software should be verified to ensure that the results are as intended.

NOTE Where scoring and result determination are fully automated and used for an assessment whose result "significantly affects" the candidate, they could fall within the scope of any domain specific legislation relating to data protection or privacy.

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8.3 Software to provide feedback

8.3.1 *Level of feedback provided*

The level of feedback provided automatically to the candidate and/or the assessment centre should be consistent with pedagogical decisions and the aims of the assessment. (The level of feedback may be the overall result only, the score for the whole assessment, sub-scores or results for sub-sections of assessment, the score for individual items, feedback on correct responses and reasons or explanations, hints for further study and reference to learning material or information sources.)

8.3.2 *Degree of confidence*

The feedback given should be justifiable in pedagogical and measurement terms. For example feedback should not be based on too small a sample of items. Software may need to incorporate routines to suppress or qualify feedback statements where insufficient items have been answered.

8.3.3 *Presentation of feedback*

8.3.3.1 Presentation of feedback (whether on screen or on paper, in text, graphically or otherwise) should be clear, easy to interpret and supported by any necessary explanations.

NOTE It would be considered best practice that results should be provisional, until a period of time after the test, as specified by the test sponsor. E.g. 24 hours. This allow any possible compromises of assessment security to be investigated..

8.3.3.2 Feedback from high-stakes assessment should maintain the confidentiality of the items.

8.3.3.3 Feedback from formative assessments should be designed to promote learning and learner development.

8.3.3.4 If feedback is likely to be distressing, consideration should be given to providing feedback by a human professional (not automatically) or making counselling facilities available.

8.3.4 *Trialling*

Software to provide feedback should be trialled with a range of different candidate responses to ensure that it operates consistently and in accordance with pedagogical requirements.

8.4 Maintaining confidentiality of candidate data during trialling

When actual candidate responses are used in the trialling of software to provide scoring, result determination or feedback, any associated personal details of candidates should be deleted or replaced by dummy data to ensure that confidentiality is maintained.

9 Preparation and transmission of assessment content and correct responses

NOTE 1 This clause, which is applicable to assessment distributors, covers the preparation of the assessment content and responses for operational use and their transmission to the place where the assessment is taken. It is assumed that assessment preparation and assessment delivery will normally take place in separate locations, which could be remote or could be rooms in the same building. Assessment delivery could be at a designated assessment centre or a single candidate taking a low-stakes assessment in a library.

NOTE 2 This clause is applicable to IT transmission of assessment content for IT delivery, irrespective of whether the scoring will be by IT or by human markers.

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NOTE 3 Subclauses **9.1** and **9.2.1** are applicable to both high-stakes and low-stakes assessment. Subclauses **9.2.2** and **9.2.3** are applicable only to high-stakes assessment.

NOTE 4 For storage of assessment content at assessment centres see **13.5.2** and for storage of response files see **13.6**.

9.1 Preparation of assessment content and correct responses for use

9.1.1 *Authenticity and integrity*

Assessment distributors should establish procedures to ensure the authenticity and integrity of assessment content, items and correct responses released for operational use, including verifying that:

a) the assessment form and all individual items relate to the intended assessment;

b) only up-to-date and approved assessment forms and versions of items are used;

c) each assessment form has the correct number of items and conforms to any other requirements;

d) information about correct responses is accurate and correctly linked to the relevant items;

e) records of correct responses and any associated algorithms make provision, where necessary, for selection of items from a bank, shuffling the sequence of items, or of responses, within an item and for insertion of random variables into items.

9.1.2 *Confidentiality*

The confidentiality of assessment content and correct responses should be maintained during any necessary procedures to prepare them for release.

NOTE Confidentiality of assessment material at earlier stages of preparation, although necessary, is outside the scope of this Standard.

9.2 Transmission of assessment content and correct responses

9.2.1 Assessment distributors should establish procedures to safeguard the security of assessment content (including assessment forms, assessment items and correct responses) during transmission between the originating organisation and the recipient. These measures should be designed to ensure that:

a) the assessment content is received by the intended recipient;

b) the authenticity of the assessment is confirmed;

c) the integrity of the assessment is maintained;

d) the assessment content does not become known to unauthorised persons.

9.2.2 For high-stakes assessments the following should be considered:

a) notification of despatch and receipt;

b) security measures comparable to those for paper-based assessments, where physical transport is used (e.g. by CD-ROM);

c) use of cryptographic techniques for material sent electronically, especially via public systems;

d) transmission of assessment content only to a pre-arranged number (using “dial back” if the transmission is in response to a request from the assessment centre);

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e) use of transmission protocols to verify integrity of records;

f) procedures for staff at assessment centres to verify the authenticity and integrity of records;

g) message authentication to check the integrity of assessment content received.

9.2.3 If high-stakes assessments are delivered online from a remote server, consideration should be given to the need for a back-up server in case of technical problems.

10 Software and procedures for recording and transmission of candidates' details and responses and for their storage by assessment distributors

NOTE 1 This clause is applicable to assessment distributors. All subclauses are relevant to high-stakes assessment and **10.1** and **10.2** are also relevant to low-stakes assessment.

NOTE 2 "Response records" include responses to both closed- and open-response items and may include material (e.g. essays) forwarded to a human marker for scoring, either directly or via the assessment distributor.

NOTE 3 This clause is also applicable to software and procedures for the electronic transmission of candidates' coursework.

10.1 Interoperability

In the design of file or record formats consideration should be given to the need to facilitate:

a) exchange of candidates' personal data and/or results with institutional learner records, learning management systems and/or awarding body formats;

b) exchange of item and response data with other assessment users (for example using IMS standards for question and test interoperability);

c) export of responses and scores to database, spreadsheet or statistical software for analysis.

10.2 Recording responses and linking of responses to candidate identification

10.2.1 Software for recording candidate responses should include provision for the following:

a) personal details of the candidate; these may be imported from an existing record (for example an "assessment entry" record) or may be captured immediately before the start of the assessment;

b) details of the assessment and the assessment form or individual items presented to the candidate, including any randomly generated parameters;

c) the candidate's response(s) to each item, including the full text of any open-ended response (even if this is computer-scored);

d) time taken (if required);

e) information about any result or feedback given at the end of the assessment;

f) any candidate comments on the assessment or the assessment centre.

NOTE In some formative assessments or in item trialling it may not be necessary to record the candidate's name, but there may still be a requirement to record other personal details (e.g. age, gender, years of education) to assist with item evaluation or monitoring. In high-stakes assessment details of the items presented to the candidate and his/her responses are needed as an audit trail in case of queries or appeals.

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10.2.2 Where possible, consideration should be given to saving responses at frequent intervals (every ten minutes or every question or group of questions) during an assessment, to provide a record of what has happened so far in case of technical failure or other interruption to the assessment, and to allow a restart with as much data as possible recovered.

10.2.3 The operation of software should be verified in a range of circumstances to ensure that candidate details, item details and responses are always correctly linked. Verification should maintain the confidentiality of personal details of actual candidates, using dummy data wherever practicable.

10.3 Transmission of response files to the assessment distributor

10.3.1 Assessment distributors should establish procedures to maintain the confidentiality and integrity of response records transmitted from the assessment centre to the assessment distributor. The following should be considered, depending upon circumstances:

a) notification of despatch and receipt;

b) use of security measures comparable to those for paper-based assessments when physical transport is used (e.g. by floppy disks);

c) use of cryptographic techniques for material sent electronically, especially via public systems;

d) use of transmission protocols to check integrity of records;

e) procedures for assessment distributor staff to verify the authenticity and integrity of records received;

f) procedures for a back-up to be held at the assessment centre, in secure conditions, at least until receipt has been confirmed.

10.3.2 Security measures should extend to any transmission of response records between assessment distributors and human markers.

If responses are forwarded to a human marker for scoring and anonymous marking is a requirement, there should be procedures to ensure that the human marker does not receive the candidates' personal details, but that the scores can subsequently be matched correctly to the candidate.

10.4 Storage of response files by assessment distributor

Procedures for the storage of candidate and response data by the assessment distributor should take account of:

a) the need to retain full details of candidates' personal data and responses for a predetermined period in case of queries or appeals;

b) the need to safeguard personal data relating to candidates in accordance with data protection legislation;

c) the probable need to maintain an indefinite record of successful candidates;

d) the probable need to retain response data and some biographical data for ongoing monitoring and analysis; these should be anonymised;

e) the likely need to retain data on the full text of open-ended responses for analysis and to inform possible changes in the scoring rules;

f) the need for secure back-ups of the data retained.

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11 Provision of instructions and assessment-specific information for assessment centres

NOTE This clause is applicable to assessment distributors. All subclauses are applicable to high-stakes assessment and **11.1** and **11.2** are also relevant to low-stakes assessment.

11.1 Technical information and help

11.1.1 Assessment distributors should provide assessment centres with clear instructions on how to load and configure assessment software (including any associated software for administration) and how to begin and end assessments.

11.1.2 Technical help should be available for assessment centres, both for initial setting up of assessment software (if needed) and during assessment sessions. Information to assessment centres should include help-line numbers and troubleshooting hints.

11.2 Assessment-specific information

Assessment distributors should provide assessment centres with specific information about each assessment, as far in advance as practicable. This should include:

a) information as provided for candidates (see **12.1**);

b) minimum specification of hardware, software, peripherals and communication links if this differs from the normal minimum standard for the assessment centre;

c) any special requirements for the configuration of the hardware or software, for example a requirement for special fonts or character sets or for removal of help files and spell-checkers from any proprietary software used;

d) any reference material or aids (e.g. calculators) which have to be provided by the assessment centre;

e) any special procedures for planned breaks;

f) whether candidates need to be advised to save their work regularly;

g) whether specialist teachers or instructors may be present to help with troubleshooting.

11.3 General instructions

Assessment distributors should provide assessment centres (and potential new assessment centres) with clear and adequate instructions concerning the facilities, staffing and operations of centres, in accordance with Clause **13** to Clause **17** of this Standard, but may include more detailed or specific requirements.

Instructions to assessment centres should cover:

a) workstation design and space between workstations;

NOTE This should only be relevant if; the candidates are taking the same assessment; if the candidates are likely to be distracted by being in close proximity to other candidates or if the assessment does not specifically require candidates to work in collaboration.

b) required specification of hardware, software, peripherals and communication links;

c) layout of workstations and environment in the assessment room;

d) any other facilities required at the assessment centre for IT-delivered assessments;

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e) security measures, including, where applicable, the security of assessment content and/or candidate responses;

f) functions and skill requirements of assessment centre staff;

g) minimum ratio of invigilators to candidates for each session;

h) procedures for conduct of assessment sessions and dealing with emergencies and irregularities.

11.4 Appeals

Assessment distributors should specify an appeals procedure which should include:

a) provision for invigilators to log all technical failures and delays and any candidate complaints of this nature which could form the basis of an appeal;

b) provision for human review of automated scoring and result determination where the candidate appeals against this.

12 Provision of information and practice material for candidates

NOTE This clause is applicable to assessment distributors. All subclauses are applicable to high-stakes assessment and **12.1, 12.2** and **12.3** are also applicable to low-stakes assessment. Information may be channelled through assessment centres (who have responsibility for passing the information on to candidates) or through course providers and/or provided direct to candidates.

12.1 Provision of advance assessment-specific information to candidates

12.1.1 Information about the assessment should be made available to candidates before they begin the assessment. For high-stakes assessment this information should be provided in advance. For some low-stakes assessment it may be sufficient to provide the information on the day of the assessment.

Providing the integrity of the assessment is not compromised, information may include:

a) the assessment coverage (for example areas of knowledge or skills to be assessed) in accordance with pedagogical decisions;

b) the number and type(s) of items;

c) any subdivisions of the assessment, by content or by item type;

d) how the items are scored and scores combined into an overall result, including any weighting for different item types or topics, any correction for guessing and any scoring of "method" or sequence of operations (see note to **8.2**);

e) whether any non-scored items are included and, if so, why;

f) the time limit (if applicable) and what measures are in place to compensate for possible system delays (where a technological solution is not possible, for example because transmission is via the Internet, candidates should be advised to report any system delays to the invigilator);

g) how to respond, change responses, navigate and quit (to be supported by practice material — see **12.2**);

h) how to access practice material;

i) any restrictions on navigation (see **7.1**) and the reasons for them;

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j) the level of computer skills required (for example, whether any keyboarding skills are needed);

k) any permitted data, information or aids (e.g. calculators) which are provided on-screen;

l) any other permitted data, information or aids which will be provided by the assessment centre or which the candidate has to supply;

m) provision for candidates using assistive technology;

n) the appeals procedure, which should include reference to technical failures and delays and (if relevant) to appeals against automated decision making.

12.1.2 Candidates should be advised to take "micro breaks" (to relax muscles and look away from the screen) in order to reduce the effects of prolonged VDU use.

12.2 Provision of practice material

12.2.1 Practice material similar to the actual assessment should be provided for candidates before they begin the assessment. For high-stakes assessment this material should be provided in advance; for some low-stakes assessment it may be sufficient to provide it on the day of the assessment. Practice material should include:

a) all the relevant features of the software;

b) all item types used in the actual assessment;

c) a sample of items similar in content, style and difficulty to those used in the actual assessment (not necessarily a full-scale mock assessment);

d) a sample of results and/or feedback.

12.2.2 Practice materials should draw attention to the help and fail-safe features of the software.

12.2.3 Practice material should be made available in more than one format (e.g. via the Internet, on disk, at assessment centres, at learning centres, with or without human helpers available), where appropriate, according to the likely needs of the intended candidates.

12.3 Provision for candidates with disabilities

Candidates with disabilities should be advised to contact the assessment centre well in advance to ensure that adequate provision is made for their needs.

12.4 Provision of assessment security information to candidates

Candidates should be told in advance:

a) the rules and regulations of the assessment process, including what information or aids may be accessed and the penalties or disciplinary measures which may be applied;

b) (if applicable) the regulations which apply to breaks during the assessment;

c) whether any video monitoring and/or monitoring of keystrokes is in place and, if so, why these are considered necessary;

d) what provision is made in case of technical problems;

e) what evidence of identity is required; if identity checks at the centre include taking photographs or fingerprints, this should be stated and the reasons explained;

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f) what use is made of their scores and/or results including whether they are communicated to any other person or organisation.

13 Equipment and facilities at assessment centre, including storage of responses

NOTE 1 This clause is applicable to assessment centres. Subclauses **13.1, 13.2, 13.3** and **13.4** are relevant to both high-stakes and low-stakes assessment; **13.5** and **13.6** are applicable only to high-stakes assessment.

NOTE 2 This clause does not assume the use of a dedicated assessment centre; facilities used as assessment centres may also be used for other purposes at other times.

NOTE 3 In addition to the IT-specific recommendations in this clause, assessment centres will need to comply with the more general requirements of assessment distributors and with health and safety requirements and to safeguard the confidentiality of candidates' personal data, including information relating to health and disability.

13.1 Workstations

13.1.1 Each workstation should conform to the recommendations on ergonomic design of ISO 9241-5.

Design considerations for workstations include:

a) seating position and possibility of adjustment, taking account of whether the expected candidates are adults or children;

b) height of workstation surface and screen;

c) freedom from glare;

d) depth of workstation surface to allow sufficient space for optimum positioning of keyboard, mouse and screen, including for left-handed users;

e) space for any printed or other materials or equipment which may be needed for the assessment;

f) space for making rough notes, if permitted.

13.1.2 Space between workstations should be sufficient for comfortable working. If adjacent candidates take the same assessment, or are not allowed to communicate as part of the assessment**,** there should be measures to ensure that they cannot see each other's screens.

Measures could be:

a) sufficient distance between workstations (a minimum distance of 1.25 m is recommended);

b) partitions between workstations.

13.1.3 Centres should consider the need for some workstations to have additional space or facilities to cater for candidates with disabilities (e.g. wheelchair access, extra equipment, larger monitor, links to assistive technologies).

13.2 Hardware and software

13.2.1 Each workstation should be equipped with hardware, software, peripherals and communication links to the standard specified for the assessment(s) being taken, and conforming to ISO 9241-3, ISO 9241-4 and ISO 9241-9.

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13.2.2 If there will be sound output, either as part of the assessment or to assist candidates with special needs, headphones or separate areas should be provided, to avoid disturbing other candidates.

13.2.3 Assessment centres should consider the need for a range of assistive technology, depending upon the expected needs of candidates.

13.2.4 There should be adequate provision in case of equipment failure, especially for high-stakes assessments. Provision can include:

a) spare workstations (of the required specification);

b) spares of easily replaced items (e.g. mouse, screen);

c) a back-up server if assessments are delivered over the assessment centre's own network.

13.2.5 Hardware should be maintained to minimise the likelihood of failure during an assessment.

13.2.6 Up-to-date virus protection measures should be in place.

13.3 Verification of the software on assessment centre equipment

13.3.1 Centre staff should verify that the assessment software works correctly on all the hardware/software configurations in use at the assessment centre, using the material supplied by the assessment distributor.

Where generic delivery software is used for a number of assessments, its operation with each assessment or group of assessments should be verified separately.

13.3.2 If the assessment is run from the centre's own server, trialling should be undertaken before the actual assessment to ensure that response speed is adequate for the expected number of candidates. This trialling may need to be repeated for assessments with different characteristics.

13.4 Other facilities

13.4.1 *Environment*

To ensure a comfortable assessment environment, attention should be given to the effects of computer use, especially the likely need for:

a) increased ventilation, because of the heat generated by equipment;

b) adaptations to lighting to suit work both on and off screen.

13.4.2 *Additional areas*

Where required by the nature of the assessment and the likely candidates, the assessment centre should have additional areas separate from the main room(s) in which assessments are taken. These may include:

a) separate assessment areas for candidates requiring special assistance or facilities which could distract other candidates (for example, the help of an amanuensis, or use of sound output);

b) segregation for religious reasons

c) opportunities for practice assessments.

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13.5 Assessment and equipment security

13.5.1 The arrangement of the workstations and the position of the invigilator's desk (and of video monitoring if used) should facilitate detection of any unauthorised activity by candidates, for example communication with others or use of unauthorised reference material.

13.5.2 There should be appropriate security facilities if assessment content, correct responses, candidate responses or candidate details are held at the assessment centre before or after the assessment session, including:

a) physical security measures (normally including a safe) for any paper or removable electronic media;

b) electronic protection for any information held on networks;

c) securing the assessment room and related server/communication room(s) after confidential material has been loaded onto the network.

Assessment content should be protected from unauthorised access until immediately before the assessment and also after the assessment unless release is authorised by the assessment sponsor or distributor. Candidate details and responses should be kept secure at all times.

13.5.3 Consideration should be given to the need to remove all confidential data (including assessment content, responses and candidates' personal details) from generally accessible networks immediately after each assessment session.

13.6 Storage of response files at assessment centres

13.6.1 If records of candidate responses are retained at assessment centres there should be measures to protect their security, including:

a) prevention of unauthorised access;

b) prevention of tampering and substitution;

c) destruction of files in accordance with the agreed timescale, for example when receipt of the information has been confirmed by the assessment distributor or at the expiry of the period for possible appeals.

Security measures can include the following, as appropriate:

1) user ID and password protection of access to computers or networks;

2) encryption of data;

3) removal of records from networks as soon as practicable after the end of the assessment session;

4) storage of removable computer media in a safe;

5) procedures for identifying records for destruction.

13.6.2 If responses are not intended to be stored at the assessment centre, there should be measures to ensure that they are not inadvertently cached on the candidate's machine.

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14 Staffing of assessment centre

NOTE 1 This clause is applicable to assessment centres and relates to high-stakes assessment. This clause relates to the staff who need to be available to the assessment centre; it is not assumed that all or any of them will do this full-time.

NOTE 2 In addition to the IT-specific recommendations in this clause, assessment centres will need to comply with the more general requirements of assessment distributors and with health and safety requirements.

14.1 Staff functions and numbers

14.1.1 Each assessment centre should have at least one member of staff to undertake the following range of functions, either individually or collectively:

a) liaison with the assessment distributor:

b) administration, including managing registration or identification of candidates, starting and ending the assessment;

c) invigilation, overseeing the assessment session and ensuring that there is no unauthorised communication between candidates or access to unauthorised information;

d) technical functions, setting up and maintaining hardware and software, providing technical help and troubleshooting.

14.1.2 The number of staff in the team should be adequate for the frequency of assessment sessions and the number of candidates in each.

14.1.3 The scheduling of staff for specific assessment sessions should take account of:

a) the expected number of candidates;

b) any candidates with special needs;

c) any specific regulations of the assessment distributor, for example concerning invigilator/candidate ratios;

d) any specific restrictions on the use of invigilators who have an interest in the assessment results, for example because they are teachers or relatives of candidates;

e) the knowledge and experience of available staff; a combination of administrative, technical and invigilator skills are required, as detailed in 14.1.1.

NOTE Because of the likely need for technical help or troubleshooting, the number of staff required may be higher than for a paper-based assessment with a similar number of candidates.

14.2 Staff training

14.2.1 ***All assessment centre staff should have:***

a) a general understanding of the principles of fair assessment;

b) an understanding of the importance of security and a knowledge of the security measures required for IT-delivered assessment, especially those applicable to their own centre;

c) a general familiarity with the assessment software and delivery platform in use at their assessment centre;

d) an awareness of possible malpractice in IT-delivered assessment and the precautions needed to prevent or detect it;

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e) an understanding of special needs issues and a knowledge of the special equipment and facilities available at their own centre for use with IT-delivered assessment;

f) an awareness of domain specific, legislation and codes of practice relevant to the operation of the centre.

14.2.2 Assessment centre staff should also have a knowledge of some or all of the following, as appropriate to their functions:

a) the specific regulations of relevant assessment distributors;

b) the specific regulations relating to the assessment(s) with which they are concerned, e.g. concerning use of reference material;

c) assessment start/end and security procedures specific to the assessment distributor and/or the assessment;

d) any hardware, software or configuration requirements specific to the assessment.

14.2.3 There should be a staff training programme to ensure that all assessment centre staff receive both initial training and updating relevant to their role(s).

15 Preparation for the assessment session

NOTE 1 This clause is applicable to assessment centres and relates to high-stakes assessment.

NOTE 2 In addition to the IT-specific recommendations in this clause, assessment centres will need to comply with the more general requirements of assessment distributors and with health and safety requirements and to safeguard the confidentiality of candidates' personal data, including information relating to health and disability.

15.1 Preparation of the room and equipment

Preparation of the room and equipment prior to the assessment session should include:

a) ensuring that the layout and workstations conform to Clause **13** – especially necessary if the room has been used for other purposes;

b) switching on all necessary computers (including spares, if available) and peripherals and checking that they are working;

c) checking communication links, if applicable;

d) verifying that computer date and time are correct;

e) loading assessment software, if necessary, and any other required software;

f) if necessary, configuring software to the requirements of the assessment, or checking the configuration; this may, for example, involve disabling help screens and spell-checks;

g) checking, if practicable, that assessment software and results storage are working correctly;

h) where feasible and required, disabling access to any unauthorised software that could threaten assessment security, for example web access or e-mail.

15.2 Preparation of the assessment

Preparation of the assessment should include, unless this process has not been automated:

a) loading, logging on to or starting the assessment;

b) verifying that it is the correct assessment for the candidate(s);

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c) checking that it is the most up-to-date version of the assessment, if necessary;

d) verifying the integrity of the assessment, as appropriate;

e) providing any necessary additional materials and paper for rough notes, if permitted.

15.3 Preparation of the candidate(s)

15.3.1 The candidate's identity should be verified; at least one proof of identify should be required unless the candidate is well known to the invigilator.

NOTE The assessment distributor may set higher requirements including taking a photographic or fingerprint record in case of later queries.

15.3.2 Before the assessment session begins, **and if it is a feature not automatically provided by the assessment distributor** . a link should be made and verified between the candidate's personal details and/or assessment registration number and the workstation being used. This is so that the candidate's responses are recorded against the correct name. If it is necessary to enter the candidate's personal details, for example in a "drop in" assessment centre, this may best be done outside the assessment room.

15.3.3 Assessment centre staff should ensure that the candidate:

a) is comfortably seated;

b) has any agreed assistive technology and knows how to use it;

c) is familiar with the assessment instructions, procedures and regulations, including how to navigate and answer items (see Clause **12**);

d) knows the time limit (if any) and how the assessment will be terminated;

e) knows how to request technical or emergency assistance.

15.3.4 If required by the assessment distributor, the candidate should be asked to sign an agreement that he/she will not disclose the content of the assessment.

16 Conduct of assessment session

NOTE This clause is applicable to assessment centres and to high-stakes assessment. In addition to the IT-specific recommendations in this clause, assessment centres will need to comply with the more general requirements of assessment distributors and with health and safety requirements and to safeguard the confidentiality of candidates' personal data, including information relating to health and disability.

16.1 Invigilation

16.1.1 At least one invigilator should be present in the room throughout the assessment session. If there is a single invigilator, he/she should be able to summon help (including technical help) quickly if needed. Unless there is only one candidate, the invigilator should not be distracted from invigilation duties by having to provide technical help.

16.1.2 The invigilator(s) should ensure that assessment regulations are observed and in particular that:

a) candidates do not attempt to communicate with one another, unless allowed as part of the assessment, or with an outside person (e.g. by mobile telephone or e-mail);

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b) there is no copying of other candidates' work (e.g. by reading another screen);

c) candidates do not access any unauthorised information or aids, either on screen or otherwise;

d) any authorised breaks are taken in accordance with the assessment regulations and with minimum disruption to other candidates;

e) any time limit is applied;

f) any regulations concerning late arrivals and early departures are observed.

To fulfil their role the invigilator(s) will normally need to observe candidates' screens by patrolling the room.

16.1.3 If it is not technically or operationally feasible to prevent unauthorised candidate access to outside information and aids from within the software (see **6.4.3**), consideration should be given to monitoring and recording all keystrokes in order to detect unauthorised activity.

16.2 Assistance to candidates

16.2.1 Technical help should be available throughout the assessment in case of hardware/software problems. Other assistance to candidates which may be available throughout the assessment session in accordance with the regulations for the assessment includes:

a) help to candidates on how to navigate, record responses etc. unless specifically prohibited by the assessment regulations (as might be the case in an assessment of IT skills);

b) explanation of instructions and assessment regulations;

c) assistance to candidates with disabilities; this should normally be in accordance with a prior agreement with the assessment distributor.

16.2.2 Unless specifically permitted by the assessment regulations, candidates should not be given any help in understanding or answering assessment items.

16.3 Records of attendance

Centre staff should complete any necessary records of attendance required by the assessment distributor or (if applicable) verify that log-in records correspond with the number of candidates present.

16.4 Concluding the assessment

At the end of the assessment, centre staff should ensure that:

a) assessment software is closed as necessary;

b) candidate details and responses are stored securely or transmitted as required;

c) any necessary back-ups are made and stored securely;

d) no unauthorised materials (e.g. printouts) are taken from the assessment room by candidates.

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17 Procedures relating to emergencies, technical failures and irregularities

NOTE This clause is applicable to assessment centres and to high-stakes assessment. In addition to the IT-specific recommendations in this clause, assessment centres will need to comply with the more general requirements of assessment distributors and with health and safety requirements and to safeguard the confidentiality of candidates' personal data, including information relating to health and disability.

17.1 Emergencies

Procedures for dealing with emergencies (such as fire alarms and bomb scares) should include provision to:

a) safeguard the security of assessment content and responses (for example by locking an assessment room which has been evacuated without closing down software);

b) minimise opportunities for collusion between candidates or communication with others during interruptions to an assessment;

c) ensure that candidates have the full working time for the assessment;

d) safeguard access to the server room if applicable.

17.2 Technical failures and delays

17.2.1 Procedures for dealing with hardware, software and communication failures (which may affect individual workstations or the whole network) should normally allow the candidate(s) to continue the assessment session at a different workstation or at a later time, if necessary, without loss of working time.

In extreme cases it may be preferable to provide a paper assessment.

17.2.2 To minimise disruptions due to technical failures, consideration should be given to:

a) maintenance of hardware;

b) provision of spare workstations and/or easily replaced items (see **13.2.4**).

17.2.3 Invigilators should record and report any candidate complaints of system delays.

17.3 Restarting after an unplanned break

Procedures for restarting an assessment after an unplanned break (i.e. an emergency or a technical failure) should ensure that the invigilator:

a) controls the restart;

b) re-sets the timing, where necessary;

c) ensures that candidates can reaccess their previous responses where this is technically feasible and permitted by the assessment regulations (see **10.2.2**).

17.4 Recording

All emergencies, technical failures and irregularities, together with the action taken, should be recorded and should be reported to the assessment centre manager and/or the assessment distributor in accordance with procedures. (Irregularities include threatened or actual breaches of the security of assessment content, correct responses or candidate response records and attempted or actual cheating).

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Annex A
(informative)

Scenarios

A.1 General

The scenarios given in this annex illustrate the different ways in which IT-delivered assessment can be used and how the organisations involved may claim compliance with this code of practice.

A.2 Scenario 1, Awarding Body A

Organisation A offers an on-demand assessment of IT skills for certification, taken at a large number of schools and colleges. This is a high-stakes assessment. The organisation A is responsible for the content (and therefore acts as assessment sponsor); it has developed its own software and is responsible for delivery (and therefore also acts as assessment distributor).

In its role as assessment sponsor, organisation A should comply with **5.1**; in its role as assessment distributor it should comply with **5.2** and Clause **6** to Clause **12** inclusive. The schools and colleges at which the assessment is taken are assessment centres and should comply with Clause **13** to Clause **17** inclusive.

A.3 Scenario 2, Awarding Body B

Organisation B, which is a specialist industrial body, offers certificates in Health and Safety knowledge which are taken on demand. In some parts of the industry, workers can only be employed on certain tasks if they have passed this assessment and the fact that workers have this certification has implications for employers' legal responsibilities and for insurance premiums and claims. Although the content of the assessment is quite straightforward, it is nevertheless a high-stakes assessment. Organisation B is responsible for the assessment content (and therefore acts as assessment sponsor), but uses a commercial assessment distributor for delivery. The distributor has its own delivery software and franchised assessment centres.

In its role as assessment sponsor organisation B should comply with **5.1**. The assessment distributor should comply with **5.2** and Clause **6** to Clause **12** inclusive; it also takes responsibility for overseeing the assessment centres. The assessment centres should comply with Clause **13** to Clause **17** inclusive.

A.4 Scenario 3, University c

University C offers a range of summative assessments which are taken by students as part of the assessment for degree modules. Assessments are taken by all students on a fixed date. Since they count towards an important award, they are high-stakes assessments. University C both prepares and delivers the assessments in-house using proprietary software, with a central unit responsible for the IT aspects of the assessments. University C is therefore acting as assessment sponsor (individual departments are responsible for the assessment content), as assessment distributor (the central unit fulfils this function) and as an assessment centre (the learning resource centre is taken over for this purpose during examination periods).

In its role as assessment sponsor university C should comply with **5.1** and in its role as assessment distributor should comply with **5.2** and Clause **6** to Clause **12** inclusive. In its role as assessment

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centre it should comply with Clause **13** to Clause **17** inclusive. The software producer does not itself claim compliance but needs to produce software with which the university can achieve compliance.

A.5 Scenario 4, University D

ThUniversity D produces a number of self-assessments in knowledge and skills which provide essential preparation for first year degree modules; examples are numerical and mathematical skills and foreign languages. University D has developed its own software for this purpose. The students can access and use these assessments as they wish; there is no compulsion and the assessment results do not count towards their degree, although the university has found that students who use the assessments normally achieve better results. The assessments are therefore low-stakes. They are taken in the learning centre without supervision. University D is acting as an assessment sponsor (the individual departments are responsible for the assessment content), as assessment distributor and as an assessment centre.

In its role as assessment sponsor university D should comply with **5.1** and in its role as assessment distributor for low-stakes assessments should comply with the following: **5.2, 6.1, 6.2, 6.3, 6.5, 7.1, 7.2, 7.3, 7.4, 7.5, 8.1, 8.2, 8.3, 8.4, 9.1, 9.2.1, 10.1, 10.2, 11.1, 11.2, 12.1**, **12.2** and **12.3**. In its role as assessment centre for low-stakes assessments it should comply with **13.1, 13.2, 13.3** and **13.4**.

A.6 Scenario 5, Company E

Company E is a financial services company and uses on-demand computer-delivered assessments to assess its salesmen on their knowledge of financial products and regulations, in order to demonstrate compliance with the requirements of financial services legislation. This is a high-stakes assessment; salesmen could lose their jobs if they fail. Company E prepares the assessments in-house using proprietary software and delivers them over its own network to local branches, where they are taken in controlled and supervised conditions, although often with only one or two salesmen taking the assessment at any one time.

Company E is acting as assessment sponsor (it sets its own items at head office), as assessment distributor and as assessment centre. It will therefore need to comply with all the clauses in this code of practice. The software producer does not itself claim compliance but needs to produce software with which the company can achieve compliance.

A.7 Scenario 6, Company F

Company F is a retail chain which runs in-house courses on procedures and product knowledge for its staff at local training centres. At the end of each course the employees take an assessment at the centre; this is an incentive to take the course seriously and is also used to measure the effectiveness of the course. It is a summative assessment, but it is low-stakes. Company F has devised its own software for this purpose and is acting as an assessment sponsor (the items are set by the training department), as an assessment distributor and also as an assessment centre.

In its role as assessment sponsor the company should comply with **5.1** and in its role as assessment distributor should comply with the following: **5.2, 6.1, 6.2, 6.3, 6.5, 7.1, 7.2, 7.3, 7.4, 7.5, 8.1, 8.2, 8.3, 8.4, 9.1, 9.2.1, 10.1, 10.2, 11.1, 11.2, 12.1, 12.2, 12.3.** In its role as assessment centre for low-stakes assessments it should comply with **13.1, 13.2, 13.3** and **13.4**.

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A.8 Scenario 7, Testing Company G

Testing company G offers assessments in language proficiency through computer-based tests taken on demand. The assessment has a variety of uses, ranging from placement (relatively low-stakes) to screening at job interviews (relatively high-stakes). Testing company G is responsible for the assessment content (and therefore acts as assessment sponsor). Acting as distributor, it distributes the assessment form in an interoperable format directly to approved assessment centres. The assessment centres use their own general purpose assessment delivery software to deliver the assessment forms to the candidates.

Testing company G in its role as assessment sponsor should comply with **5.1**. To maintain the security of the assessment forms for use in high-stakes assessments, the testing company in its role as assessment distributor should comply with **5.2** and Clause **6** to Clause **12** inclusive, either directly or by approving the assessment centre's general purpose software. When the assessments are used for high-stakes purposes, the assessment centres should comply with Clause **13** to Clause **17** inclusive. When the assessments are used for low-stakes purposes the assessment centres need comply only with **13.1, 13.2, 13.3** and **13.4**.

A.9 Scenario 8, Open Learning Provider H

Open learning provider H develops learning material which is distributed on-line and used both in local learning centres and by learners working on their own at home or in the workplace. The material covers a wide range of subject matter and some courses are designed to lead to external certification. One example is that learners who have taken IT courses may wish to enter for the certification described in **A.2**; this is a high-stakes assessment.

To facilitate access to such assessments, the open learning provider H has negotiated with the relevant ceritification organisations to access to its network of assessment centres for those learners seeking assessment, including those who have studied at home. The network includes traditional learning providers (schools, colleges and universities) and also smaller learning centres and even libraries.

In order to meet the security requirements for high-stakes assessment, these assessment centres should comply with Clause **13** to Clause **17** inclusive, although some of them will be operating on a very small-scale, perhaps with a single workstation and two available staff.

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Bibliography

Standards publications

BS 7925-2, *Software testing — Part 2: Software component testing*.

ISO 9241-1, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 1: General introduction*.

ISO 9241-6, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 6: Guidance on the work environment*.

ISO 9241-7, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 7: Requirements for display with reflections*.

ISO 9241-8, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 8: Requirements for displayed colours*.

ISO 9241-10, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 10: Dialogue principles*.

ISO 9241-11, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 11: Guidance on usability*.

ISO 9241-12, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 12: Presentation of information*.

ISO 9241-13, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 13: User guidance*.

ISO 9241-14, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 14: Menu dialogues*.

ISO 9241-15, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 15: Command dialogues*.

ISO 9241-16, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 16: Direct manipulation dialogues*.

ISO 9241-17, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 17: Form-filling dialogues*.

Internet resources

NOTE At the time of publication the following website addresses (URLs) were valid. Please be aware that specific organisations and/or companies may change these URLs in the future.

—

W3C (World Wide Web Consortium) Web Accessibility Initiative (WAI):

— http://www.w3.org/WAI/ for WAI documents;

— http://www.w3.org/TR/WAI-WEBCONTENT/ for web content accessibility guidelines;

— http://www.w3.org/TR/ATAG10/ for “Authoring tool accessibility guidelines”;

— http://www.w3.org/WAI/EO/Drafts/PWD-Use-Web/Overview.html for working draft of “How people with disabilities use the web”.

The higher and further education TechDis (Technologies for disability information service) project:

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— http://www.techdis.ac.uk

IMS Global Learning Consortium:

— http://www.imsglobal.org for information about IMS work in developing standards for interoperability

Other resources

McKENNA, Colleen and BULL, Joanna, *Blueprint for Computer-assisted assessment*. CAA Centre, 2001.

This document provides general information about the capabilities of IT-delivered assessment and suggestions for good practice.

Using computer delivered assessment in the workplace, Guildford Educational Services Ltd, 1997 (print) or on CD-ROM with Directory of Computer Assisted Assessment Products and Producers (2000).

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