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Fire detection and alarm systems —

Part 21: Routing equipment

Systèmes de détection et d'alarme d'incendie —

Partie 21: Équipement de transmission

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member 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 shall not be held responsible for identifying any or all such patent rights.

ISO 7240-21 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 3, *Fire detection and alarm systems*.

ISO 7240 consists of the following parts, under the general title *Fire detection and alarm systems*:

— *Part 1: General and definitions*

— *Part 2: Control and indicating equipment*

— *Part 4: Power supply equipment*

— *Part 5: Point-type heat detectors*

— *Part 6: Carbon monoxide fire detectors using electro-chemical cells*

— *Part 7: Point-type smoke detectors using scattered light, transmitted light or ionization*

— *Part 11: Manual call points*

— *Part 12: Line type smoke detectors using a transmitting light beam*

— *Part 13: Compatibility assessment of system components*

— *Part 14: Guidelines for drafting codes of practice for design, installation and use of fire detection and fire alarm systems in and around buildings* [Technical Report]

— *Part 15: Multisensor fire detectors*

— *Part 21: Routing equipment*

— *Part 22: Duct sampling equipment*

The following part is under preparation:

— *Part 9: Test fire for fire detectors* [Technical Report]

Introduction

This part of ISO 7240 combines the requirements for both fire-alarm routing (transmitting) equipment (ISO 7240-1:—, Figure 1, item E) and fault (trouble) warning routing equipment (ISO 7240-1:—, Figure 1, item J) into a single equipment Standard.

Routing equipment receives signals from control and indicating equipment (ISO 7240-1:—, Figure 1, item B) and sends fire alarm signals to a fire-alarm receiving station (ISO 7240-1, Figure 1, item F) and fault signals to a fault warning (trouble signal) receiving station (ISO 7240-1, Figure 1, item K). The receiving stations may be in the same or different locations.

This part of ISO 7240 describes the mandatory functions which are required to be provided on all routing equipment covered by this part of ISO 7240, and optional functions with their associated requirements. It is intended that the options will be used for specific applications, as recommended in application guidelines.

Each optional function is included as a separate entity, with its own set of associated requirements, in order to permit routing equipment covered by this document with different combinations of functions to conform to this part of ISO 7240. Routing equipment complying with this part of ISO 7240 will need to fulfil the requirements of all of the mandatory functions, together with the requirements of those optional functions which are provided.

Fire detection and alarm systems —

Part 21: Routing equipment

1 Scope

This part of ISO 7240 specifies requirements, methods of test, and performance criteria for fire-alarm routing (transmitting) equipment (ISO 7240-1:—, Figure 1, item E) and for fault (trouble) warning routing equipment (ISO 7240-1:—, Figure 1, item J) for use in fire detection and fire alarm systems installed in buildings.

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 7240-1:—[1)], *Fire detection and alarm systems — Part 1: General and definitions*

ISO 7240-4, *Fire detection and alarm systems — Part 4: Power supply equipment*

IEC 60068-1:1990-05, *Environmental testing — Part 1: General and guidance*

IEC 60068-2-1, *Environmental testing — Part 2: Tests. Tests A: Cold*

IEC 60068-2-6, *Environmental testing — Part 2: Tests. Test Fc: vibration (sinusoidal)*

IEC 60068-2-47, *Environmental testing — Part 2-47: Test methods — Mounting of components, equipment and other articles for vibration, impact and similar dynamic tests*

IEC 60068-2-75, *Environmental testing — Part 2-75: Tests. Test Eh: Hammer tests*

IEC 60068-2-78, *Environmental testing — Part 2-78: Tests — Test Cab: Damp heat, steady state*

IEC 60529:2001-02, *Degrees of protection provided by enclosures (IP Code)*

IEC 60721-3-3:2002-10, *Classification of environmental conditions — Part 3-3: Classifications of groups of environmental parameters and their severities — Stationary use and weatherprotected locations*

EN 50130-4, *Alarm systems — Part 4: Electromagnetic compatibility — Product family standard: Immunity requirements for components of fire, intruder and social alarm systems*

1) To be published.

3 Definitions

For the purposes of this document, the definitions given in ISO 7240-1 and the following apply.

3.1
access level
one of several states of a routing equipment in which selected

— controls can be operated;

— manual operations can be carried out;

— indications are visible, and/or;

— information can be obtained.

NOTE See Annex A.

3.2
field
sub-division of a window

3.3
functional condition
condition of the routing equipment characterized by its indication at the routing equipment

NOTE The functional conditions recognized in this part of the ISO 7240 are the following:

— fire alarm condition, when a fire alarm is indicated;

— supervisory signal condition, when a supervisory signal is indicated;

— fault warning condition, when a fault is indicated;

— disabled condition, when the disablement of functions is indicated;

— test condition, when the testing of functions is indicated;

— quiescent condition, when the routing equipment is powered by a power supply conforming to ISO 7240-4 and no other functional condition is indicated.

3.4
indicator
device which can change its state to give information

3.5
indication
information given by an indicator

3.6
mandatory
⟨adjective⟩ qualification applied to those functions required to be provided on all routing equipment and the functions' requirements and to the requirements of any optional functions that have requirements, if such optional functions are provided

3.7
non-volatile memory
memory elements which do not require the presence of an energy source for the retention of their contents

3.8
point
component connected to a detection circuit enabling the transmission or reception of information in relation to fire detection

NOTE Includes ISO 7240-1:–, Figure 1, items A and D.

3.9
program
software necessary for routing equipment to comply with at least the requirements of this part of ISO 7240, including initializing data, reset and interrupt vectors, operating code, and declarations

3.10
reset
operation capable of terminating the fire alarm condition and/or the fault warning condition

3.11
running data
alterable data subject to temporary modification during operation, either automatically or by manual controls

3.12
separate
⟨adjective⟩ physically separate and exclusively provided for the purpose or purposes stated in this part of ISO 7240

3.13
silencing
⟨noun⟩ manual operation for switching off the audible signal of a sounding device that is capable of being automatically re-sounded by a new event

3.14
transmission path
connection, external to the cabinet of the routing equipment, for the transmission of information and/or power

— between the routing equipment and other components of a fire detection and fire alarm system as defined in ISO 7240-1, and/or

— between parts of routing equipment contained in different cabinets

3.15
volatile memory
memory elements which require the presence of an energy source for the retention of their contents

3.16
window
part or all of an alphanumeric display used for information relating to one functional condition at a given time

NOTE A sub-division of the display might be realized either by mechanical separation, or under software control.

3.17
zone
geographical sub-division of the protected premises in which one or more points are installed and for which a common zonal indication is provided

4 General requirements

If functions other than those specified in this part of the ISO 7240 are provided, they shall not jeopardize compliance with any requirements of this part of the ISO 7240.

If an optional function is included in the routing equipment, then all the corresponding requirements shall be met.

5 General requirements for indications

5.1 Display of functional conditions

5.1.1 The routing equipment shall be capable of unambiguously indicating the following functional conditions, as described in Clauses 6 to 11:

— quiescent condition;

— fire alarm condition;

— supervisory signal condition;

— fault warning condition;

— disabled condition;

— test condition.

5.1.2 The routing equipment shall be capable of being simultaneously, in any combination of the following functional conditions:

— fire alarm condition;

— supervisory signal condition;

— fault warning condition;

— disabled condition;

— test condition.

5.2 Display of indications

All mandatory indications shall be clearly identifiable, except where otherwise specified in this part of ISO 7240.

5.3 Indications on alphanumeric displays

Where an alphanumeric display is used to display indications relating to different functional conditions, these may be displayed at the same time. However, for each functional condition there shall be only one window in which all of the fields relating to that functional condition are grouped.

5.4 Indication of the supply of power

A visible indication shall be given by means of a separate light-emitting indicator while the routing equipment is supplied with power.

5.5 Additional indications

Where indications are used in addition to mandatory indications, these shall not result in contradiction or confusion.

6 Quiescent condition

Any kind of system information may be displayed during the quiescent condition. However, no indications shall be given which could be confused with control-and-indicating equipment indications used in the

— fire alarm condition,

— supervisory signal condition,

— fault warning condition,

— disabled condition,

— test condition.

7 Fire alarm condition

7.1 Reception and processing of fire signals

7.1.1 The routing equipment shall report the fire alarm condition to the fire alarm receiving station (ISO 7240-1:—, Figure 1, item F) when fire alarm signals are received from the control-and-indicating equipment.

7.1.2 The mandatory indications and/or outputs shall not be falsified by multiple fire signals received from the same or different control-and-indicating equipment, resulting from the simultaneous operation of two control-and-indicating equipment and/or the operation of further control-and-indicating equipment.

7.2 Indication of the fire alarm condition

7.2.1 The fire alarm condition shall be indicated when the routing equipment receives the fire alarm signal from the control-and-indicating equipment.

7.2.2 The time taken for processing of signals from control-and-indicating equipment shall not delay the indication of the fire alarm condition at the routing equipment by more than 60 s.

7.2.3 The signal may be indicated by means of a separate light-emitting indicator and/or a field on the alphanumeric display.

7.2.4 The indicator shall flash when the condition is received by the routing equipment and go steady when the routing equipment receives acknowledgement from the receiving station that the signal has been correctly received.

7.3 Other indications during the fire alarm condition

If supervisory conditions faults, disablements or tests are indicated by means of separate light-emitting indicators, and such indications are suppressed in the fire alarm condition, it shall be possible to reveal these by means of a manual operation at access level 1.

7.4 Reset from the fire alarm condition

7.4.1 The routing equipment shall reset from reporting and displaying the fire alarm condition when the fire alarm condition is reset at the control-and-indicating equipment. Reset from the fire alarm condition shall not require any manual intervention.

7.4.2 Following a reset, the indication of the correct functional conditions, corresponding to any received signals, shall either remain, or be re-established within 60 s.

8 Supervisory signal condition

8.1 Reception and processing of supervisory signals

8.1.1 The routing equipment shall report the supervisory condition to the fault warning (trouble signal) receiving station (ISO 7240-1:—, Figure 1, item K) when supervisory signals are received from the control-and-indicating equipment.

8.1.2 The mandatory indications and/or outputs shall not be falsified by multiple supervisory signals received from the same or different control-and-indicating equipment, resulting from the simultaneous operation of two control-and-indicating equipment and/or the operation of further control-and-indicating equipment.

8.2 Indication of the supervisory alarm condition

8.2.1 The supervisory condition shall be indicated when the routing equipment receives the supervisory alarm signal from the control-and-indicating equipment.

8.2.2 The time taken for processing of signals from control-and-indicating equipment shall not delay the indication of the supervisory condition at the routing equipment by more than 60 s.

8.2.3 The signal may be indicated by means of a separate light-emitting indicator and/or a field on the alphanumeric display.

8.2.4 The indicator shall flash when the condition is received by the routing equipment and go steady when the routing equipment receives acknowledgement from the receiving station that the signal has been correctly received.

8.3 Supervisory indications during the supervisory condition

If supervisory signals are indicated by means of separate light-emitting indicators, and such indications are suppressed in the fire alarm condition, it shall be possible to reveal these by means of a manual operation at access level 1.

8.4 Reset of supervisory signal

8.4.1 The routing equipment shall reset from reporting and displaying the supervisory condition when the supervisory condition is reset at the control-and-indicating equipment. Reset from the supervisory condition shall not require any manual intervention.

8.4.2 Following a reset operation, the indication of the correct functional conditions, corresponding to any received signals, shall either remain, or be re-established within 60 s.

9 Fault warning condition

9.1 Reception and processing of fault warning signals

9.1.1 The routing equipment shall report the fault warning condition to the fault warning (trouble signal) receiving station (ISO 7240-1:—, Figure 1, item K) when fault warning signals are received from the control-and-indicating equipment.

9.1.2 The mandatory indications and/or outputs shall not be falsified by multiple fault warning signals received from the same or different control-and-indicating equipment, resulting from the simultaneous operation of two control-and-indicating equipment and/or the operation of further control-and-indicating equipments.

9.2 Indication of the fault warning condition

9.2.1 The fault warning condition shall be indicated when the routing equipment receives the fault warning (trouble signal) from the control-and-indicating equipment.

9.2.2 The time taken for processing of signals from control-and-indicating equipment shall not delay the indication of the fault warning condition at the routing equipment by more than 60 s.

9.2.3 The signal may be indicated by means of a separate light-emitting indicator and/or a field on the alphanumeric display.

9.2.4 The indicator shall flash when the condition is received by the routing equipment and go steady when the routing equipment receives acknowledgement from the receiving station that the signal has been correctly received.

9.3 Fault warning indications during the fire alarm condition

If faults are indicated by means of separate light-emitting indicators, and such indications are suppressed in the fire alarm condition, it shall be possible to reveal these by means of a manual operation at access level 1.

9.4 Reset from the fault warning condition

9.4.1 The routing equipment shall reset from reporting and displaying the fault warning condition when the fault warning condition is reset at the control-and-indicating equipment. Reset from the fault warning condition shall not require any manual intervention.

9.4.2 Following a reset operation, the indication of the correct functional conditions, corresponding to any received signals, shall either remain, or be re-established within 60 s.

10 Disabled condition

10.1 Reception and processing of disabled signals

10.1.1 The routing equipment shall report the disabled condition to the disabled signal receiving station (ISO 7240-1:—, Figure 1, item K) when disabled signals are received from the control-and-indicating equipment.

10.1.2 The mandatory indications and/or outputs shall not be falsified by multiple disabled signals received from the same or different control-and-indicating equipment, resulting from the simultaneous operation of two control-and-indicating equipment and/or the operation of further control-and-indicating equipment.

10.2 Indication of the disabled condition

10.2.1 The disabled condition shall be indicated when the routing equipment receives the disabled signal from the control-and-indicating equipment.

10.2.2 The time taken for processing of signals from control-and-indicating equipment shall not delay the indication of the disabled condition at the routing equipment by more than 60 s.

10.2.3 The signal may be indicated by means of a separate light-emitting indicator and/or a field on the alphanumeric display.

10.2.4 The indicator shall flash when the condition is received by the routing equipment and go steady when the routing equipment receives acknowledgement from the receiving station that the signal has been correctly received.

10.3 Disabled indications during the fire alarm condition

If disabled conditions are indicated by means of separate light-emitting indicators, and such indications are suppressed in the fire alarm condition, it shall be possible to reveal these by means of a manual operation at access level 1.

10.4 Reset from the disabled condition

10.4.1 The routing equipment shall reset from reporting and displaying the disabled condition when the disabled condition is reset at the control-and-indicating equipment. Reset from the disabled condition shall not require any manual intervention.

10.4.2 Following a reset operation, the indication of the correct functional conditions corresponding to any received signals shall either remain or be re-established within 60 s.

11 Test condition

11.1 Reception and processing of test signals

11.1.1 The routing equipment shall report the test condition to the fault warning (trouble signal) receiving station (ISO 7240-1:—, Figure 1, item K) when test signals are received from the control-and-indicating equipment.

11.1.2 The time taken for processing of signals from control-and-indicating equipment shall not delay the indication of the test condition at the routing equipment by more than 60 s.

11.1.3 The mandatory indications and/or outputs shall not be falsified by multiple test signals received from the same or different control-and-indicating equipment, resulting from the simultaneous operation of two control-and-indicating equipment and/or the operation of further control-and-indicating equipment.

11.2 Indication of the test condition

11.2.1 The test condition shall be indicated when the routing equipment receives the test signal from the control-and-indicating equipment.

11.2.2 The signal may be indicated by means of a separate light-emitting indicator and/or a field on the alphanumeric display.

11.2.3 The indicator shall flash when the condition is received by the routing equipment and go steady when the routing equipment receives acknowledgement from the receiving station that the signal has been correctly received.

11.3 Test indications during the fire alarm condition

If test conditions are indicated by means of separate light-emitting indicators, and such indications are suppressed in the fire alarm condition, it shall be possible to reveal these by means of a manual operation at access level 1.

11.4 Reset from the test condition

11.4.1 The routing equipment shall reset from reporting and displaying the test condition when the test condition is reset at the control-and-indicating equipment. Reset from the test condition shall not require any manual intervention.

11.4.2 Following a test operation, the indication of the correct functional conditions, corresponding to any received signals, shall either remain, or be re-established within 60 s.

12 Design requirements

12.1 General requirements and manufacturer's declarations

The routing equipment shall comply with the design requirements of Clause 12, where relevant to the technology used.

In order to assist the process of design inspection, the manufacturer shall declare the following in writing:

a) that the design has been carried out in accordance with a quality management system, which incorporates a set of rules for the design of all elements of the routing equipment (e.g. ISO 9001);

b) that the components of the routing equipment have been selected for the intended purpose, and are expected to operate within their specification when the environmental conditions outside the cabinet of the routing equipment comply with class 3k5 of IEC 60721-3-3:2002-10.

12.2 Documentation

12.2.1 The manufacturer shall prepare installation and user documentation, which shall be submitted to the testing authority together with the routing equipment. This shall comprise at least the following:

a) a general description of the equipment, including a list of

   — optional functions with requirements of this part of ISO 7240,

   — functions relating to other parts of ISO 7240,

   — ancillary functions not required by this part of ISO 7240;

b) technical specifications of the inputs and outputs of the routing equipment, sufficient to permit an assessment of the mechanical, electrical and software compatibility with other components of the system (e.g. as described in ISO 7240-1), including where relevant

   — power requirements for recommended operation,

   — maximum number of control-and-indicating equipment, zones and/or points per routing equipment,

   — maximum and minimum electrical ratings for each input and output,

   — information on the communication parameters employed on each transmission path,

   — recommended cable parameters for each transmission path,

   — fuse ratings;

c) installation information, including

   — the suitability for use in various environments,

   — if the routing equipment is contained in more than one cabinet, how the requirements of 12.3.2 and 12.5.2 can be met,

   — if the routing equipment is designed to be used with a power supply contained in a separate cabinet, how the requirements of 12.3.2 and 12.5.3 can be met,

   — mounting instructions,

   — instructions for connecting the inputs and outputs;

d) configuring and commissioning instructions;

e) operating instructions;

f) maintenance information.

12.2.2 The manufacturer shall prepare design documentation, which shall be submitted to the testing authority together with the routing equipment. This documentation shall include drawings, parts lists, block diagrams, circuit diagrams and a functional description to such an extent that compliance with this part of ISO 7240 may be checked and that a general assessment of the mechanical and electrical design is made possible.

12.3 Mechanical design requirements

12.3.1 The cabinet of the routing equipment shall be of robust construction, consistent with the method of installation recommended in the documentation. At access level 1 it shall meet at least classification IP30 of IEC 60529:2001-02.

12.3.2 The routing equipment may be housed in more than one cabinet. If the documentation shows that the cabinets may be installed in locations distributed within the protected premises, then all of the mandatory manual controls and indicators shall be in one cabinet, or in cabinets declared to be suitable only for mounting adjacent to each other.

12.3.3 All mandatory manual controls and light-emitting indicators shall be clearly labelled to indicate their purpose. The information shall be legible at 0,8 m distance in an ambient light intensity from 100 lx to 500 lx.

12.3.4 The terminations for transmission paths and the fuses shall be clearly labelled.

12.4 Electrical and other design requirements

12.4.1 The processing of signals shall give the highest priority to the indication of fire alarms.

12.4.2 Transitions between the main and the standby power sources shall not change any indications and/or the state of any outputs, except those relating to the power supplies.

12.4.3 If the routing equipment has provision for disconnecting or adjusting the main or the standby power source, this shall be possible only at access level 3.

12.5 Integrity of transmission paths

12.5.1 A fault in any transmission path between the routing equipment and other components of the fire detection system, as defined in ISO 7240-1, shall be simultaneously indicated at the routing equipment and the fault warning (trouble signal) receiving station in not more than 90 s.

12.5.2 Where the routing equipment is connected to the fault warning (trouble signal) receiving station by more than one transmission path, one transmission path may be used to signal a fault on another transmission path.

12.5.3 If the manufacturer's documentation shows that a routing equipment contained in more than one cabinet may be installed in separate locations (e.g. signal concentrator equipment), then means shall be specified and provided which ensure that a short circuit or an interruption in any transmission path between the cabinets does not affect more than one function for longer than 90 s following the occurrence of the fault.

12.5.4 Where the routing equipment is designed to be used with a power supply (ISO 7240-1:—, Figure 1, item L) contained in a separate cabinet remote from the routing equipment, then an interface shall be provided for at least two transmission paths to the power supply, such that a short circuit or an interruption in one does not prevent the supply of power to the routing equipment.

12.6 Accessibility of indications and controls (see also annex A)

12.6.1 Four access levels shall be provided on the routing equipment, from access level 1 (most accessible) to access level 4 (least accessible). Allocation to an access level shall prevent access to an access level with a higher number, but allow access to an access level of a lower number. Manual controls and other functions shall be grouped on the appropriate access level, as specified in this part of ISO 7240.

12.6.2 All mandatory indications shall be visible at access level 1 without prior manual intervention (e.g. the need to open a door).

12.6.3 Manual controls at access level 1 shall be accessible without special procedures.

12.6.4 Indications and manual controls that are mandatory at access level 1 shall also be accessible at access level 2.

12.6.5 The entry to access level 2 shall be restricted by a special procedure.

12.6.6 The entry to access level 3 shall be restricted by a special procedure, differing from that for access level 2.

12.6.7 The entry to access level 4 shall be restricted by special means that are not part of the routing equipment.

12.7 Indications by means of light-emitting indicators

12.7.1 Mandatory indications from light-emitting indicators shall be visible in an ambient light intensity up to 500 lx, at any angle up to 22,5° from a line through the indicator perpendicular to its mounting surface

— at 3 m distance for the general indications of functional condition,

— at 3 m distance for the indication of the supply of power,

— at 0,8 m distance for other indications.

12.7.2 For flashing indications, both the “on” period and the “off” period shall be greater than or equal to 0,25 s, and the frequencies of flash shall not be less than

— 1 Hz for fire alarm indications

— 0,2 Hz for fault indications.

12.8 Indications on alphanumeric displays

12.8.1 If an alphanumeric display consists of elements or segments, the failure of one of these shall not affect the interpretation of the displayed information.

12.8.2 Alphanumeric displays used for mandatory indications shall have at least one clearly distinguishable window, consisting of at least two clearly identifiable fields.

12.8.3 If not included in the displayed information, the purpose of each field shall be clearly labelled.

12.8.4 Mandatory indications on an alphanumeric display shall be legible for the lesser of 1 h or the duration of the standby power source, following the display of a new indication of fire or fault, at 0,8 m distance, in ambient light intensities from 5 lx to 500 lx, at any angle from the normal to the plane of the display up to

— 22,5° when viewed from each side;

— 15° when viewed from above and below.

Following the lesser of 1 h or the duration of the standby power source, the indications shall be legible at 100 lx to 500 lx, at the above distance and angles. It shall be possible to re-establish the legibility at 5 lx to 100 lx by means of a manual operation at access level 1.

12.9 Colours of indications

12.9.1 The colours of the general and specific indications from light-emitting indicators shall be as follows:

a) red for indications of fire alarms;

b) yellow for indications of

- supervisory signals,
- fault warnings,
- disablements,
- control-and-indicating equipment in the test state;

c) green for the indication that the routing equipment is supplied with power.

12.9.2 The use of different colours is not necessary for indications on alphanumeric displays. However, if different colours are used for different indications, the colours used shall be as specified in 12.9.1.

12.10 Testing of indicators

All mandatory visible indicators shall be testable by a manual operation at access level 1.

13 Additional design requirements for software-controlled routing equipment

13.1 General requirements and manufacturer's declarations

The routing equipment may contain elements that are controlled by software in order to fulfil requirements of this part of ISO 7240. In this case, the routing equipment shall comply with the requirements of Clause 12, where relevant to the technology used.

13.2 Software documentation

13.2.1 The manufacturer shall prepare documentation that gives an overview of the software design, which shall be submitted to the testing authority together with the routing equipment. This documentation shall be in sufficient detail for the design to be inspected for compliance with this part of ISO 7240.

13.2.2 The manufacturer shall prepare and maintain detailed design documentation. This need not be submitted to the testing authority, but shall be available for inspection in a manner that respects the manufacturer's rights of confidentiality.

13.3 Software design

In order to ensure the reliability of the routing equipment, measures shall be included in the program to prevent the occurrence of a deadlock in the system.

13.4 Program monitoring (see also Annex B)

13.4.1 The execution of the program shall be monitored. The monitoring device shall signal a system fault if routines associated with the main functions of the program are not executed within a time limit of 100 s.

13.4.2 The functioning of the monitoring device and the signalling of a fault warning shall not be prevented by a failure in the execution of the program of the monitored system.

13.5 The storage of programs and data (see also Annex B)

13.5.1 All executable code and data necessary to comply with this part of ISO 7240 shall be held in memory that is capable of continuous, unmaintained, reliable operation for a period of at least ten years.

13.5.2 The program shall be held in non-volatile memory, which can only be written to at access level 4. Each memory device shall be identifiable such that its contents can be uniquely cross-referenced to the software documentation.

13.5.3 For site-specific data, the following requirements shall apply.

a) Alteration of site-specific data shall be possible only at access level 3.

b) Alteration of site-specific data shall not affect the structure of the program.

c) If stored in volatile memory, the site-specific data shall be protected against power loss by a back-up energy source which can only be separated from the memory at access level 4, and which is capable of maintaining the memory contents for at least two weeks.

d) If stored in read-write memory, there shall be a mechanism which prevents the memory being written to during normal operation at access level 1, such that its contents are protected during a failure in program execution.

e) Site-specific data shall be given a version reference, which shall be updated when each set of alterations is carried out.

f) It shall be possible to identify the version reference of the site-specific data at access level 3.

13.6 The monitoring of memory contents

The contents of the memories containing the program and the site-specific data shall be automatically checked at intervals not exceeding 1 h. The checking device shall signal a system fault if a corruption of the memory contents is detected.

14 Marking

The routing equipment shall be marked with the following information, which shall be legible at access level 1:

a) number of this part of ISO 7240 (ISO 7240-21);

b) name or trademark of the manufacturer or supplier;

c) type number or other designation of the routing equipment;

It shall be possible to identify a code or number that identifies the production period of the routing equipment at access level 2.

15 Tests

15.1 General

15.1.1 Standard atmospheric conditions for testing

Unless otherwise stated in a test procedure, conduct the testing after the test specimen has been allowed to stabilize in the standard atmospheric conditions for testing as described in IEC 60068-1 as follows:

— temperature: 15 °C to 35 °C;

— relative humidity: 25 % to 75 %;

— air pressure: 86 kPa to 106 kPa.

The temperature and humidity shall be substantially constant for each environmental test where the standard atmospheric conditions are applied.

15.1.2 Specimen configuration

The specimen configuration shall include at least one of each type of routing equipment and transmission path.

The details of the routing equipment shall be given in the test report (Clause 16).

15.1.3 Mounting and orientation

Unless otherwise stated in a test procedure, mount the specimen in its normal orientation by the normal means of mounting indicated by the manufacturer. The equipment shall be in the condition of access level 1, except where otherwise required for functional testing.

15.1.4 Electrical connection

If the test procedure requires the specimen to be in the operating condition, it shall be connected to a power supply complying with the requirements in ISO 7240-4.

Unless otherwise required, the power supply shall be in the nominal operating condition.

All circuits and transmission paths shall be connected to cables and equipment or to dummy loads. At least one of each type of circuit shall be maximally loaded, all within manufacturer's specification. Equipment other than the routing equipment may be kept in the standard atmospheric condition during the tests.

15.1.5 Provision for tests

At least one routing equipment shall be provided for testing compliance with this part of ISO 7240.

The specimen or specimens submitted shall be representative of the manufacturer's normal production and shall include the claimed options.

15.2 Functional test

15.2.1 Object of the test

To demonstrate the operation of the equipment before, during and/or after the environmental conditioning.

15.2.2 Test schedule

Draw up a test schedule that ensures that during the functional test each type of input function and each type of output function is exercised.

15.2.2.1 Fire alarm condition

Initiate and reset the fire alarm condition.

Check that the correct indication and the correct output to item F of ISO 7240-1:—, Figure 1, is given.

15.2.2.2 Supervisory condition

Initiate and reset the supervisory condition.

Check that the correct indication and the correct output to item J of ISO 7240-1:—, Figure 1, is given.

15.2.2.3 Fault warning condition

Initiate and reset the fault warning condition.

Check that the correct indication and the correct output to item J of ISO 7240-1:—, Figure 1, is given.

15.2.2.4 Disabled condition

Initiate and reset the disabled condition.

Check that the correct indication and the correct output to item J of ISO 7240-1:—, Figure 1, is given.

15.2.2.5 Test condition

Initiate and reset the test condition.

Check that the correct indication and the correct output to item J of ISO 7240-1:—, Figure 1, is given.

15.2.2.6 Integrity of transmission paths

Initiate and reset a fault on each transmission path.

Check that the correct indication and the correct output to item J of ISO 7240-1:—, Figure 1, is given.

15.3 Environmental tests

15.3.1 General

One, two or three specimens may be supplied for environmental testing. The tests to be applied are shown in Table 1.

Table 1 — Environmental tests

Test	Operational or endurance	Subclause number
Cold	operational	15.4
Damp heat, steady state	operational	15.5
Impact	operational	15.6
Vibration, sinusoidal	operational	15.7
Electromagnetic compatibility (EMC) immunity test	operational	15.8
Supply voltage variations	operational	15.9
Damp heat, steady state	endurance	15.10
Vibration, sinusoidal	endurance	15.11

15.3.2 Tests for one specimen

If a single specimen is supplied for environmental testing, subject the specimen to all the operational tests, which may be carried out in any order. After the operational tests, conduct the endurance tests on the same specimen in any order. Before and after each environmental test, conduct a functional test.

NOTE The functional test after one environmental test can be taken as the functional test before the next environmental test.

15.3.3 Tests for two specimens

If two specimens are supplied for environmental testing, then subject the first test specimen to all the operational tests, which may be carried out in any order, followed by one of the endurance tests. Subject the second specimen to the other endurance test. Before and after each environmental test, conduct a functional test.

NOTE For the first specimen, the functional test after one environmental test can be taken as the functional test before the next environmental test.

15.3.4 Tests for three specimens

If three specimens are supplied for environmental testing, then subject one test specimen to all the operational tests, which may be carried out in any order. Subject the second specimen to one of the endurance tests, and subject the third specimen to the other endurance test. Before and after each environmental test, conduct a functional test.

NOTE For the first specimen, the functional test after one environmental test can be taken as the functional test before the next environmental test.

15.3.5 Requirements

During the tests of 15.4 to 15.9, the specimen shall not change status in each of the functional conditions as specified in the corresponding clauses, except when such a change is required by the test procedure or when the change is a result of a functional test.

However, in the tests of 15.8, 15.10 and 15.11, visible and audible indications of purely transitory nature occurring during the application of the conditioning are allowed.

When subjected to the functional test, each specimen shall respond correctly (see 15.2).

15.4 Cold (operational)

15.4.1 Object of the test

To demonstrate the ability of the equipment to function correctly at low ambient temperatures appropriate to the anticipated service environment.

15.4.2 Test procedure

15.4.2.1 General

Use the test procedures with gradual changes in temperature described in IEC 60068-2-1. Use test Ad for heat-dissipating specimens (as defined in IEC 60068-2-1:1990-05) and use test Ab for non-heat-dissipating specimens.

15.4.2.2 Initial examination

Before conditioning, subject the specimen to the functional test.

15.4.2.3 State of the specimen during conditioning

Mount the specimen as specified in 15.1.3 and connect it to suitable power supply, monitoring and loading equipment (see 15.1.4).

The specimen shall be in the quiescent condition.

15.4.2.4 Conditioning

Apply the following severity of conditioning:

— temperature: – 5 °C ± 3 °C or other minimum rated temperature;

— duration: 16 h

15.4.2.5 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any change in status. During the last hour of the conditioning period, subject the specimen to the functional test.

15.4.2.6 Final measurements

After the recovery period, subject the specimen to the functional test and inspect it visually for mechanical damage both externally and internally.

15.5 Damp heat, steady state (operational)

15.5.1 Object of the test

To demonstrate the ability of the equipment to function correctly at high relative humidities (without condensation) which can occur for short periods in the service environment.

15.5.2 Test procedure

15.5.2.1 General

Use the test procedure described in IEC 60068-2-78.

15.5.2.2 Initial examination

Before conditioning, subject the specimen to the functional test.

15.5.2.3 State of the specimen during conditioning

Mount the specimen as specified in 15.1.3 and connect it to suitable power supply, monitoring and loading equipment (see 15.1.4).

The specimen shall be in the quiescent condition.

15.5.2.4 Conditioning

Apply the following severity of conditioning:

— temperature: 55 °C ± 2 °C;

— relative humidity: 93 % $^{+2}_{-3}$ %;

— duration: 4 d.

Precondition the specimen at the conditioning temperature (55 ± 2 °C) until temperature stability has been reached to prevent the formation of water droplets on the specimen.

15.5.2.5 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any change in status. During the last hour of the conditioning period, subject the specimen to the functional test.

15.5.2.6 Final measurements

After the recovery period, subject the specimen to the functional test and inspect it visually for mechanical damage both externally and internally.

15.6 Impact (operational)

15.6.1 Object of the test

To demonstrate the immunity of the equipment to mechanical impacts upon the surface, which it can sustain in the normal service environment and which it can reasonably be expected to withstand.

15.6.2 Test procedure

15.6.2.1 General

Apply the test apparatus and procedure described in IEC 60068-2-75.

15.6.2.2 Initial examination

Before conditioning, subject the specimen to the functional test.

15.6.2.3 State of the specimen during conditioning

Mount the specimen as specified in 15.1.3 and connect it to suitable power supply monitoring and loading equipment (see 15.1.4).

The specimen shall be in the quiescent condition.

15.6.2.4 Conditioning

Apply impacts to all surfaces of the specimen that are accessible at access level 1.

For all such surfaces, three blows shall be applied to any point(s) considered likely to cause damage to or impair the operation of the specimen.

Care should be taken to ensure that the results from a series of three blows do not influence subsequent series.

In case of doubts, the defect shall be disregarded and a further three blows shall be applied to the same position on a new specimen.

Apply the following severity of conditioning:

— impact energy: $0{,}5 \pm 0{,}04$ J;

— number of impacts per point: 3.

15.6.2.5 Measurements during conditioning

Monitor the specimen during the conditioning periods to detect any changes in functional condition, and to ensure that results of three blows do not influence subsequent series.

15.6.2.6 Final measurements

After the conditioning, subject the specimen to the functional test and inspect it visually for mechanical damage both externally and internally.

15.7 Vibration, sinusoidal (operational)

15.7.1 Object of the test

To demonstrate the immunity of the equipment to vibrations at levels appropriate to the service environment.

15.7.2 Test procedure

15.7.2.1 General

Use the test procedure described in IEC 60068-2-6.

The vibration operational test may be combined with the vibration endurance test, so that the specimen is subjected to the operational test conditioning followed by the endurance test conditioning in each axis.

15.7.2.2 Initial examination

Before conditioning, subject the specimen to the functional test.

15.7.2.3 State of the specimen during conditioning

Mount the specimen as specified in 15.1.3 and in accordance with IEC 60068-2-47 and connect it to a suitable power supply, monitoring and loading equipment (see 15.1.4).

Test the specimen in each of the following functional conditions:

a) quiescent condition;

b) fire alarm condition, initiated in a zone;

c) disabled condition, initiated by disablement of a zone and an output in accordance with ISO 7240-1.

15.7.2.4 Conditioning

Subject the specimen to vibration in each of the three mutually perpendicular axes in turn, one of which is perpendicular to the plane of mounting of the specimen.

Apply the following severity of conditioning:

— frequency range: 10 Hz to 150 Hz;

— acceleration amplitude: 0,981 m/s^2 (0,1 g_n);

— number of axes: 3;

— number of sweep cycles per axis: 1 for each functional condition.

15.7.2.5 Measurements during conditioning

Monitor the specimen during the conditioning periods to detect any changes in functional conditions.

15.7.2.6 Final measurements

After the conditioning, subject the specimen to the functional test and inspect it visually for mechanical damage both externally and internally.

15.8 Electromagnetic compatibility (EMC) immunity tests (operational)

15.8.1 Conduct the following EMC immunity tests as described in EN 50130-4.

a) Mains supply voltage variations: These tests are included as they should be applied to power supply equipment housed in the routing equipment (see ISO 7240-4), or if the routing equipment includes other mains inputs for which these tests are applicable;

b) Mains supply voltage dips and interruptions: These tests are included as they should be applied to power supply equipment housed in the routing equipment (see ISO 7240-4), or if the routing equipment includes other mains inputs for which these tests are applicable;

c) Electrostatic discharge;

d) Radiated electromagnetic fields;

e) Conducted disturbances induced by electromagnetic fields;

f) Fast transient bursts;

g) Slow high-energy voltage surges.

15.8.2 For the tests of 15.8.1, the criteria for compliance specified in EN 50130-4 and the following shall apply.

a) The functional test called for in the initial and final measurements shall be the functional test described in 15.2.

b) The required operating condition shall be as described in 15.1.4 and the equipment shall be tested in the quiescent condition.

c) The connections to the various inputs and outputs shall be made with unscreened cables, unless the manufacturer's installation data specifies that only screened cables shall be used.

d) In the electrostatic discharge test, the discharges shall be applied to parts of the equipment accessible at access level 2.

e) In the fast transient burst test, the transients shall be applied to the a.c. mains lines by the direct injection method and to the other inputs, signal, data and control lines by the capacitive clamp method.

f) If the equipment has a number of identical types of inputs or outputs, then the tests of 15.8.1 e), f), and g), and if applicable a) and b), shall be applied to one of each type.

15.9 Supply voltage variation (operational)

15.9.1 Object of the test

To demonstrate the ability to function correctly over the anticipated range of supply voltage conditions.

15.9.2 Test procedure

15.9.2.1 General

No reference can be made to an International Standard at present.

Subject the specimen to each of the specified power supply conditions until temperature stability is reached and the functional test has been conducted.

15.9.2.2 Initial examination

Before conditioning, subject the specimen to the functional test.

15.9.2.3 State of the specimen during conditioning

Mount the specimen as specified in 15.1.3 and connect it to suitable power supply, monitoring and loading equipment (see 15.1.4).

The specimen shall be in the quiescent condition.

15.9.2.4 Conditioning

Apply the following conditions:

a) supply of maximum input voltage as specified by the manufacturer;

b) supply of minimum input voltage as specified by the manufacturer.

NOTE Compatibility between the routing equipment and any specific type of power supply equipment requires that the range of input voltages specified for the routing equipment includes the range of output voltages recorded for the power supply equipment in the tests of ISO 7240-4.

15.9.2.5 Measurements during conditioning

Monitor the specimen at the supply voltage conditions until temperature stability is reached and subject the specimen to the functional test at each voltage condition.

15.9.2.6 Final measurements

After the conditioning, subject the specimen to the functional test.

15.10 Damp heat, steady state (endurance)

15.10.1 Object of the test

To demonstrate the ability of the equipment to withstand the long-term effects of humidity in the service environment (e.g. changes in electrical properties due to absorption, chemical reactions involving moisture, galvanic corrosion etc.).

15.10.2 Test procedure

15.10.2.1 General

Use the test procedure described in IEC 60068-2-78.

15.10.2.2 Initial examination

Before conditioning, subject the specimen to the functional test.

15.10.2.3 State of the specimen during conditioning

Mount the specimen as required in 15.1.3 and connect it to suitable power supply, monitoring and loading equipment (see 15.1.4). The specimen shall not be supplied with power during the conditioning.

15.10.2.4 Conditioning

Apply the following severity of conditioning:

— temperature: 40 °C ± 2 °C;

— relative humidity: 93 % $^{+2}_{-3}$ %;

— duration: 21 days.

Pre-condition the specimen at the condition temperature (40 °C ± 2 °C) until temperature stability has been reached, to prevent the formation of water droplets on the specimen.

15.10.2.5 Final measurements

After the recovery period, subject the specimen to the functional test and inspect it visually for mechanical damage both externally and internally.

15.11 Vibration, sinusoidal (endurance)

15.11.1 Object of the test

To demonstrate the ability of the equipment to withstand the long-term effects of vibration at levels appropriate to the environment.

15.11.2 Test procedure

15.11.2.1 General

Use the test procedure described in IEC 60068-2-6.

The vibration endurance test may be combined with the vibration operational test, so that the specimen is subjected to the operational test conditioning followed by the endurance test conditioning in each axis in turn.

15.11.2.2 Initial examination

Before conditioning, subject the specimen to the functional test.

15.11.2.3 State of the specimen during conditioning

Mount the specimen as required in 15.1.3 and in accordance with IEC 60068-2-47 and connect it to a suitable power supply, monitoring and loading equipment (see 15.1.4). The specimen shall not be supplied with power during the conditioning.

15.11.2.4 Conditioning

Subject the specimen to vibration in each of the three mutually perpendicular axes in turn, one of which shall be perpendicular to the plane of mounting of the specimen.

Apply the following severity of conditioning:

— frequency range: 10 Hz to 150 Hz

— acceleration amplitude: 4,905 m/s^2 (0,5 g_n)

— number of axes: 3

— number of sweep cycles: 20 per axis.

15.11.2.5 Final measurements

After conditioning, subject the specimen to the functional test and inspect it visually for mechanical damage both externally and internally.

16 Test report

The test report shall contain as a minimum the following information:

a) identification of the test specimen;

b) reference to this part of ISO 7240 (e.g. 7240-21:2005);

c) results of the tests: the individual response times, and any other data, such as specimen orientation, as specified in the individual tests;

d) conditioning period and the conditioning atmosphere;

e) temperature and the relative humidity in the test room throughout the test;

f) details of the supply and monitoring equipment and the response criteria;

g) details of any deviation from this part of ISO 7240 or from the International Standards to which reference is made, and details of any operations regarded as optional.

Annex A
(informative)

Explanation of access levels

This annex defines access levels for the indications and controls relating to mandatory functions. In some cases alternatives are offered (e.g. access level 1 or 2). This is because either can be appropriate in different operational circumstances. The purpose of the different access levels is not defined in this part of ISO 7240; however, in general they are expected to be used as follows.

Access level 1: by members of the general public, or persons having a general responsibility for safety supervision, who might be expected to investigate and initially respond to a fire alarm or a fault warning.

Access level 2: by persons having a specific responsibility for safety, and who are trained and authorized to operate the routing equipment in the

— quiescent condition,

— fire alarm condition,

— fault-warning condition,

— disabled condition,

— test condition.

Access level 3: by persons who are trained and authorized to

— re-configure the site-specific data held within the routing equipment or controlled by it (e.g. labelling, zoning, alarm organization),

— maintain the routing equipment in accordance with the manufacturer's published instructions and data.

Access level 4: by persons who are trained and authorized by the manufacturer either to repair the routing equipment, or to alter its firmware, thereby changing its basic mode of operation.

See 12.6 for the minimum requirements for accessibility. Only Access Levels 1 and 2 have a strict hierarchy. Examples of special procedures for entry to access level 2 and/or to access level 3 are the use of

— mechanical keys,

— a keyboard and codes,

— access cards.

Examples of special means for entry to Access Level 4 are the use of

— mechanical keys,

— tools,

— an external programming device.

It may be acceptable that the entry to Access Level 4 requires only a simple tool, such as a screwdriver, after Access Level 2 or 3 has been reached. For example, the manufacturer may declare in his documentation which parts of the routing equipment are not user-serviceable, and the entry to Access Level 4 may then be controlled by management of the user. It is also considered acceptable to use external tools to carry out certain functions at Access Level 3, e.g. to program site-specific data.

It may be desirable in certain circumstances that the routing equipment has additional access levels within Access Level 2, or Access Level 3 (e.g. 2A and 2B), which would permit different classes of authorized users to have access to a selected group of controls or functions. This is not prohibited by this part of ISO 7240. The exact configuration will depend on the type of installation, the way the routing equipment is used, and complexity of the functions provided.

Annex B
(informative)

Design requirements for software-controlled routing equipment

The routing equipment may incorporate software-controlled elements, which are required to fulfil mandatory requirements of ISO 7240-21, but which are supplied to the manufacturer. A good example is an alphanumeric display module, but there are many possibilities, including both physical modules and embedded software (e.g. operating systems). Such elements are often traded worldwide as commodity items, and detailed software documentation (and, for that matter, details of the hardware design) are sometimes not available to the routing equipment manufacturer. It is not the intention of ISO 7240-21 to forbid the use of appropriate technology, and in such cases the detailed requirements for documentation and design of 12.2 and 12.3 may be relaxed, at the discretion of the testing authority. However, it is expected that products from third parties that are designed and produced exclusively for routing equipment are fully documented and fulfil the requirements. The manufacturer should ensure that the element is of proven reliability and is suitable for the application. Proven reliability can be assumed if the components under question are freely available on the market and there is sufficient field experience (e.g. $\geqslant$ one year). The interface with the main application should be clearly and comprehensively specified, and this documentation should be available to the testing authority.

13.4 deals with program monitoring. The program is the software necessary for the routing equipment to carry out mandatory functions (including any declared options with requirements). The execution of the entire program should be monitored, and this may include software that runs in more than one processor and software in elements supplied to manufacturer. It is up to the manufacturer and the testing authority to agree how comprehensive the degree of monitoring needs to be, but in the case of an alphanumeric display module, it is considered to be sufficient to routinely check that data written to the module may be read back from it.

13.5.1 requires that all executable code and data necessary to comply with this part of ISO 7240 are held in memory that is capable of continuous, non-maintained, reliable operation for a period of at least 10 years. In the existing state of the art, memory with moving mechanical parts is not believed to be sufficiently reliable. The use of tapes, or magnetic or optical data discs for the storage of programs and data is, therefore, not considered to be acceptable at the time of drafting of ISO 7240-21.

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