भारतीय मानक

IS/ISO 7240-17 : 2020

Indian Standard

अग्नि संसूचन एवं संचेतक तंत्र

भाग 17 संचरण पथ विच्छेदक

(पहला पुनरीक्षण)

Fire Detection and Alarm Systems

Part 17 Transmission Path Isolators

(First Revision)

ICS 13.220.10

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NATIONAL FOREWORD

This Indian Standard (Part 17) (First Revision) which is identical to ISO 7240-17 : 2020 'Fire detection and fire alarm systems — Part 17: Transmission path isolators' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Fire Fighting Sectional Committee and approval of the Civil Engineering Division Council.

This standard was first published in 2018 as IS/ISO 7240-17 : 2009. The first revision of this standard has been undertaken to align it with the latest version of ISO 7240-17 to make pace with the latest international practices.

This Indian Standard is published in various parts. The other parts in this series are:

Part 2	Fire detection control and indicating equipment
Part 3	Audible alarm devices
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 8	Point-type fire detectors using a carbon monoxide sensor in combination with a heat sensor
Part 10	Point-type flame detectors
Part 11	Manual call points
Part 12	Line type smoke detectors using a transmitted optical beam
Part 13	Compatibility assessment of system components
Part 15	Point-type fire detectors using smoke heat sensors
Part 16	Sound system control and indicating equipment
Part 18	Input/output devices
Part 20	Aspirating smoke detectors
Part 21	Routing equipment
Part 22	Smoke-detection equipment for ducts
Part 23	Visual alarm devices
Part 24	Fire alarm loudspeakers
Part 25	Components using radio transmission paths
Part 27	Point-type fire detectors using a smoke sensor in combination with a carbon monoxide sensor and, optionally, one or more heat sensors
Part 29	Video fire detectors
Part 31	Resettable line-type heat detectors

Short-circuit isolators have been renamed transmission path isolators reflecting that the isolators considered are intended to limit the consequences of low parallel resistance faults between the lines of the transmission path(s) of a fire detection and fire alarm system. This is normally achieved by connecting the transmission path in a loop configuration, separating sections of the loop with transmission path isolators and introducing a means of detecting the presence of a fault if its consequences (for example, reduction in the line voltage) jeopardises the correct operation of components on the transmission path. The faulty section of the loop can then be switched out, between a pair of transmission path isolators, allowing the rest of the loop to continue to function correctly.

It is recognised that it is not possible for this component standard to specify all of the requirements for the function of a transmission path isolator in a system. The requirements for the functioning of a transmission path isolator are dependent on the system operation, the other components associated with the transmission path (for example, the control and indicating equipment and detectors) and the transmission path parameters (for example, line impedance and line loads), and they will have to be verified in a system test.

However, this Indian Standard includes:

a) a requirement that the manufacturer gives all of the specifications, for the transmission path isolator, needed by system designers to use the device correctly, in accordance with the system requirements;

   NOTE — It is recognised that the system designer needs to ensure that only those transmission path isolators having the necessary performance are chosen to meet the specific requirements of a given system design.

b) the tests to verify that the transmission path isolator functions in accordance with these manufacturer's specifications; and

c) the tests to verify the stability of the transmission path isolator with respect to environmental and electromagnetic compatibility (EMC) conditions.

Due to the many different concepts that can be used for the operation of transmission path isolators, it is not possible to define a precise functional test procedure applicable to all types. Instead, this standard requires that a functional test procedure is developed to verify the manufacturer's specification and lists the most important points that have to be verified. To assist in developing such test procedures, some example procedures are given in an informative Annex A.

The text of ISO standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions and terminologies are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'; and

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places, are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 209 Aluminium and aluminium alloys — Chemical composition	IS 6051 : 1970 Code for designation of aluminium and its alloys	Technically Equivalent
IEC 60068-1 Environmental testing — Part 1: General and guidance	IS/IEC 60068-1 : 2013 Environmental testing: Part 1 General and guidance	Identical
IEC 60068-2-1 Environmental testing — Part 2-1: Tests — Tests A: cold	IS/IEC 60068-2-1 : 2007 Environmental testing: Part 2 Tests, Section 1 Test A: Cold	Identical
IEC 60068-2-6 Environmental testing — Part 2-6: Tests — Test Fc: vibration (sinusoidal)	IS/IEC 60068-2-6 : 2007 Environmental testing: Part 2 Tests, Section 6 Test Fc: Vibration (sinusoidal)	Identical

International Standard	Corresponding Indian Standard	Degree of Equivalence
IEC 60068-2-27 Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock	IS 9000 (Part 7/Sec 1) : 2018/ IEC 60068-2-27 : 2008 Basic environmental testing procedures for electronic and electrical items: Part 7 Impact test, Section 1 Shock (test Ea) (*second revision*)	Identical
IEC 60068-2-30 Environmental testing — Part 2-30: Tests — Test Db and guidance: Damp heat, cyclic (12 h + 12 h cycle)	IS/IEC 60068-2-30 : 2005 Environmental testing: Part 2 Tests, Section 30 Test Db: Damp heat cyclic (12 h + 12 h cycle)	Identical
IEC 60068-2-42 Environmental testing — Part 2-42: Tests — Test Kc: Sulphur dioxide test for contacts and connections	IS/IEC 60068-2-42 : 2003 Environmental testing: Part 2 Tests, Section 42 Test Kc: Sulphur dioxide test for contacts and connections	Identical

The Committee has reviewed the provisions of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

International Standard	*Title*
ISO 7240-1	Fire detection and alarm systems — Part 1: General and definitions
IEC 62599-2	Alarm systems — Part 2: Electromagnetic compatibility — Immunity requirements for components of fire and security alarm systems

This standard also makes a reference to the BIS Certification Marking of the product, details of which are given in National Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Introduction

Short-circuit isolators have been renamed transmission path isolators reflecting that the isolators considered are intended to limit the consequences of low parallel resistance faults between the lines of the transmission path(s) of a fire detection and fire alarm system. This is normally achieved by connecting the transmission path in a loop configuration, separating sections of the loop with transmission path isolators and introducing a means of detecting the presence of a fault if its consequences (e.g. reduction in the line voltage) jeopardises the correct operation of components on the transmission path. The faulty section of the loop can then be switched out, between a pair of transmission path isolators, allowing the rest of the loop to continue to function correctly.

It is recognised that it is not possible for this component standard to specify all of the requirements for the function of a transmission path isolator in a system. The requirements for the functioning of a transmission path isolator are dependent on the system operation, the other components associated with the transmission path (e.g. the control and indicating equipment and detectors) and the transmission path parameters (e.g. line impedance and line loads), and they will have to be verified in a system test.

However, this document includes:

— a requirement that the manufacturer gives all of the specifications, for the transmission path isolator, needed by system designers to use the device correctly, in accordance with the system requirements;

NOTE It is recognized that the system designer needs to ensure that only those transmission path isolators having the necessary performance are chosen to meet the specific requirements of a given system design.

— the tests to verify that the transmission path isolator functions in accordance with these manufacturer's specifications;

— the tests to verify the stability of the transmission path isolator with respect to environmental and electromagnetic compatibility (EMC) conditions.

Due to the many different concepts that can be used for the operation of transmission path isolators, it is not possible to define a precise functional test procedure applicable to all types. Instead, this document requires that a functional test procedure is developed to verify the manufacturer's specification and lists the most important points that have to be verified. To assist in developing such test procedures, some example procedures are given in an informative annex (Annex A).

In view of the above, it is important that, in addition to meeting the requirements of this document, transmission path isolators are shown to operate correctly within the types of systems with which they are intended to be used.

Indian Standard

FIRE DETECTION AND ALARM SYSTEMS

PART 17 TRANSMISSION PATH ISOLATORS

(First Revision)

1 Scope

This document specifies the requirements, test methods and performance criteria for transmission path isolators for use in fire detection and fire alarm systems for buildings (for general requirements and definitions, see ISO 7240-1).

Means of isolation or protection incorporated within control and indicating equipment are not covered by this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 209, *Aluminium and aluminium alloys — Chemical composition*

ISO 7240-1, *Fire detection and alarm systems — Part 1: General and definitions*

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

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

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

IEC 60068-2-27, *Environmental testing — Part 2-27: Tests. Test Ea and guidance: Shock*

IEC 60068-2-30, *Environmental testing — Part 2-30: Tests. Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)*

IEC 60068-2-42, *Environmental testing — Part 2-42: Tests — Test Kc: Sulphur dioxide test for contacts and connections*

IEC 62599-2, *Alarm systems — Part 2: Electromagnetic compatibility — Immunity requirements for components of fire and security alarm systems*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
transmission path isolator
device, which may be inserted into a transmission path of a fire detection and fire alarm system, to limit the consequences of low parallel resistance faults between the lines of this transmission path

Note 1 to entry: A transmission path isolator may be a physically separate device or it may be incorporated into another device (e.g. integrated into a smoke detector or detector base).

3.2
closed condition
condition of the transmission path isolator which allows the normal signals and the supply currents to pass through the transmission path isolator

Note 1 to entry: This is the correct condition for the transmission path isolator when there is no short circuit.

3.3
open condition
condition of the transmission path isolator which prevents the passage of short circuit currents through the transmission path isolator

Note 1 to entry: This is the correct condition for the transmission path isolator when it is protecting part of a circuit from the effects of a short circuit.

3.4
field device
device, which is located remotely from the CIE and may be subject to a more severe environmental condition

Note 1 to entry: Detectors, MCP, and alarm devices are always considered as field devices whereas PSE, input/output module, and routing equipment may be field devices.

3.5
non-field device
device which is specified to be located in the same conditions as the CIE

4 General requirements

4.1 Compliance

In order to comply with this document, the transmission path isolator shall meet the requirements of:

a) Clause 4, which shall be verified by visual inspection or engineering assessment, shall be tested as described in Clause 5 and shall meet the requirements of the tests;

b) Clauses 7 and 8, which shall be verified by visual inspection.

4.2 Integral status indication

If the transmission path isolator incorporates an integral visual indication of its status, then this indication shall not be red.

4.3 Connection of ancillary devices

Where the transmission path isolator provides for connections to ancillary devices (e.g. remote indicators), open or short circuit failures of these connections shall not prevent the correct operation of the transmission path isolator.

4.4 Monitoring of detachable transmission path isolators

If a transmission path isolator is detachable (i.e. it is attached to a mounting base), then a means shall be provided for a remote monitoring system (e.g. the control and indicating equipment) to detect the removal of the device from the base, in order to give a fault signal.

4.5 Manufacturer's adjustments

It shall not be possible to change the manufacturer's settings except by special means (e.g. the use of a special code or tool) or by breaking or removing a seal.

4.6 On-site adjustments

If there is provision for on-site adjustment of the transmission path isolator, then for each setting, the transmission path isolator shall comply with the requirements of this document. Access to the means of adjustment shall only be possible using a code or special tool.

4.7 Requirements for software-controlled transmission path isolators

4.7.1 General

The requirements of 4.7.2 and 4.7.3 shall apply to transmission path isolators that rely on software control in order to fulfil the requirements of this document.

4.7.2 Software design

To ensure the reliability of the transmission path isolator, the following requirements for software design shall apply.

— The software shall have a modular structure.

— The design of the interfaces for manually and automatically generated data shall not permit invalid data to cause error in the program operation.

— The software shall be designed to avoid the occurrence of deadlock of the program flow.

4.7.3 Storage of programs and data

The program necessary to comply with this document and any pre-set data, such as manufacturer's settings, shall be held in non-volatile memory. Writing to areas of memory containing this program and data shall be possible only using some special tool or code and shall not be possible during normal operation of the transmission path isolator.

Site-specific data shall be held in memory that will retain data for at least two weeks without external power to the transmission path isolator, unless provision is made for the automatic renewal of such data, following loss of power, within 1 h of power being restored.

5 Tests

5.1 General

5.1.1 Atmospheric conditions for tests

Unless otherwise stated in a test procedure, carry out 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:

a) temperature: (15 to 35) °C;

b) relative humidity: (25 to 75) %;

c) air pressure: (86 to 106) kPa.

If variations in these parameters have a significant effect on a measurement, then such variations need to be kept to a minimum during a series of measurements carried out as part of one test on one specimen.

5.1.2 Operating conditions for tests

If a test method requires a specimen to be operational, then connect the specimen to suitable supply and monitoring equipment with characteristics as required by the manufacturer's data. Unless otherwise specified in the test method, apply the supply parameters to the specimen within the manufacturer's specified range(s) so that it remains substantially constant throughout the tests. For each parameter, choose the value that is normally the nominal value, or the mean of the specified range. If a test procedure requires a specimen to be monitored to detect any alarm or fault signals, then connect it to any necessary ancillary devices.

EXAMPLE To an end-of-line device for conventional detectors to allow a fault signal to be recognised.

5.1.3 Mounting arrangements

Mount the specimen by its normal means of attachment in accordance with the manufacturer's instructions. If these instructions describe more than one method of mounting, then choose the method considered to be most unfavourable for each test.

5.1.4 Tolerances

Unless otherwise stated, use the tolerances for the environmental test parameters as given in the basic reference standards for the test (e.g. the relevant part of IEC 60068).

If a specific tolerance or deviation limit is not specified in a requirement or test procedure, then use a deviation limit of ±5 %.

5.1.5 Functional test

5.1.5.1 Object

The object is to confirm the correct operation of the transmission path isolator, in accordance with the manufacturer’s specification, and to verify their stability after and, where required, during the environmental and EMC tests.

5.1.5.2 Test procedure

The functional test is intended to verify that the isolator operates within the manufacturer's specification, including the parameters that characterise the transmission path isolator. The functional test verifies at least the following parameters:

a) each stimulus, which the manufacturer claims will cause the isolator to change from the closed to the open condition;

   EXAMPLE Stimulus such as current, voltage, and protocol.

b) each stimulus, which the manufacturer claims will cause the isolator to change from the open to the closed condition;

c) the response to a direct short circuit applied to the isolator.

NOTE Some examples of functional tests are given in Annex A but these are not exhaustive.

5.1.6 Provision for tests

Provide the following for testing compliance with this document:

a) 14 specimens required to conduct the tests as indicated in the test schedule (see 5.1.7) and number these specimens 1 to 14 arbitrarily;

b) the technical data required in Clause 8.

NOTE The specimens submitted are expected to be representative of the manufacturer's normal production regarding their construction and calibration.

5.1.7 Test schedule

Test the specimen according to the following test schedule (see Table 1):

Table 1 — Test schedule

Test	Subclause of this document	Stand-alone isolator Specimen number(s)	Combined with other functions Specimen number(s)	Remarks
Reproducibility	5.2	all specimens	all specimens	
Variation in supply voltage	5.3	1	1	
Dry heat (operational)	5.4	2	2[a,b,d]	
Dry heat (endurance)	N/A	N/A	5[c]	refer to other applicable part(s)
Cold (operational)	5.5	3	3[a]	
Damp heat, cyclic (operational)	5.6	4	4[a,b]	
Damp heat, steady state (endurance)	5.7	5	5[a,b]	
Damp heat, steady state (operational)	N/A	N/A	5[c]	refer to other applicable part(s)
Sulfur dioxide, SO_2, corrosion (endurance)	5.8	6	6[a,d]	
Shock (operational)	5.9	7	7[a,d]	
Impact (operational)	5.10	8	8	
Vibration, sinusoidal (operational)	5.11	9	9[c]	
Vibration, sinusoidal (endurance)	5.12	9	9[c]	
Enclosure protection (IP test)	N/A	N/A	7	
Electrostatic discharge (operational)	5.13	10[e]		
Radiated electromagnetic fields (operational)	5.13	11[e]		
Conducted disturbances induced by electromagnetic fields (operational)	5.13	12[e]		
Fast-transient bursts (operational)	5.13	13[e]		
Slow, high-energy voltage surge (operational)	5.13	14[e]		

[a] If the other parts of ISO 7240 do not call up this test, then the test in this document shall be applied.

[b] If the other function reacts to its normal operation due to the conditioning, then this is acceptable (e.g. [1] heat detector class A1 may alarm at a temperature of 55 ± 2 °C, [2] smoke detector may go into alarm or fault due to condensation).

[c] If the other parts of ISO 7240 call up these tests, then it shall be applied, and the functional test of the isolator shall be applied before, after, and during where applicable.

[d] If the other function is exclusively installed as a non-field device as specified in the manufacturer's data sheet, then this test will not be applicable (e.g. if a routing equipment is installed as a field device on a loop, the test will apply but if it is installed in the same condition as CIE then the test will not apply).

[e] In the interests of test economy, it is permitted to use the same specimen for more than one EMC test. In this case, intermediate functional test(s) on the specimen(s) used for more than one test may be deleted, and the functional test may conducted at the end of the sequence of tests. However, it should be noted that in the event of a failure, it might not be possible to identify which test exposure caused the failure; see IEC 62599-2.

5.2 Reproducibility

5.2.1 Object

The object is to show that each specimen meets the manufacturer's specification.

5.2.2 Test procedure

Conduct the functional test as described in 5.1.5 on each specimen.

5.2.3 Requirements

Each specimen shall function correctly within the manufacturer's specification.

5.3 Variation in supply voltage

5.3.1 Object

The object is to show that the transmission path isolator meets the manufacturer's specification for the specified range of supply voltage.

5.3.2 Test procedure

Conduct the functional test as described in 5.1.5 at the upper and lower limits of the supply voltage range specified by the manufacturer.

NOTE In the examples given in Annex A, this would mean replacing V_{nom} by V_{max} and V_{min}.

5.3.3 Requirements

The specimen shall function correctly within the manufacturer's specification.

5.4 Dry heat (operational)

5.4.1 Object

The object is to demonstrate the ability of the transmission path isolator to function correctly at high ambient temperatures appropriate to the anticipated service environment.

5.4.2 Test procedure

5.4.2.1 Reference

Use the test apparatus and procedure as described in IEC 60068-2-2, test Bb and the procedure indicated below.

Where the isolator is combined with other parts of ISO 7240 functions in a component, apply the apparatus and test procedure described in the part of ISO 7240 for that other function.

Where the isolator is combined with other function(s) in a component and the test is not in other parts of the ISO 7240 series, then apply the test, in this document, unless the other function(s) is exclusively a non-field device as specified in the manufacturer's data sheet., in which case, no test needs to be applied.

The dry heat (operational) clause in ISO 7240-7 is not equivalent to this test, hence a combined transmission path isolator and smoke detection component shall be tested in accordance with this procedure.

5.4.2.2 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 and connect it to the supply and monitoring equipment as described in 5.1.2.

5.4.2.3 Conditioning

Apply the following conditioning unless the transmission path isolator is combined with other function(s) in a component that specifies different conditioning in which case, apply the conditioning specified in the part of ISO 7240 for that other function:

a) indoor environmental type

— temperature: (55 ± 2) °C, and

— duration: 16 h;

b) outdoor environmental type

— temperature: (70 ± 2) °C, and

— duration: 16 h.

5.4.2.4 Measurements during conditioning

During the conditioning period, monitor the specimen to detect any change from the transmission path isolator closed condition.

During the last hour of the conditioning period, conduct the functional test as described in 5.1.5.

5.4.2.5 Final measurements

After a recovery period of at least 1 h at the standard laboratory conditions, conduct the functional test as described in 5.1.5.

5.4.3 Requirements

The specimen shall remain in the closed condition during the conditioning period except when required to change during the functional test.

The specimen shall function correctly within the manufacturer’s specification during the functional tests.

5.5 Cold (operational)

5.5.1 Object

The object is to demonstrate the ability of the transmission path isolator to function correctly at low ambient temperatures appropriate to the anticipated service environment.

5.5.2 Test procedure

5.5.2.1 Reference

Use the test apparatus and procedure as described in IEC 60068-2-1, Test Ab and the procedure described below.

Where the isolator is combined with other ISO 7240 function(s) in a component, use the apparatus and test procedure specified in the part of ISO 7240 for that other function(s).

Where the isolator is combined with other function(s) in a component and the test is not in any other part of ISO 7240, then apply the test in this document.

5.5.2.2 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 and connect it to the supply and monitoring equipment as described in 5.1.2.

5.5.2.3 Conditioning

Apply the following conditioning unless the transmission path isolator is combined with other function(s) in a component that specifies different conditioning in which case, apply the conditioning specified in the part of ISO 7240 for that other function:

a) indoor environmental type

— temperature: (−10 ± 3) °C, and

— duration: 16 h;

b) outdoor environmental type

— temperature: (−25 ± 3) °C, and

— duration: 16 h.

NOTE In countries with very cold temperatures, specific requirements can apply.

5.5.2.4 Measurements during conditioning

During the conditioning period, monitor the specimen to detect any change from the transmission path isolator closed condition.

During the last hour of the conditioning period, conduct the functional test as described in 5.1.5.

5.5.2.5 Final measurements

After a recovery period of at least 1 h at the standard laboratory conditions, conduct the functional test as described in 5.1.5.

5.5.3 Requirements

The specimen shall remain in the closed condition during the conditioning period except when required to change during the functional test.

The specimen shall function correctly within the manufacturer's specification during the functional tests.

5.6 Damp heat, cyclic (operational)

5.6.1 Object

The object is to demonstrate the ability of the transmission path isolator to function correctly at high relative humidity (with condensation), which can occur for short periods in the anticipated service environment.

5.6.2 Test procedure

5.6.2.1 Reference

Use the test apparatus and procedure as described in IEC 60068-2-30, Test Db using the Variant 1 test cycle and controlled recovery conditions and the procedure described below.

Where the isolator is combined with other ISO 7240 function(s) in a component, use the apparatus and test procedure specified in the part of ISO 7240 for that other function(s).

Where the isolator is combined with other function(s) in a component and the test is not in any other part of ISO 7240, then apply the test in this document.

5.6.2.2 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 and connect it to the supply and monitoring equipment as described in 5.1.2.

5.6.2.3 Conditioning

Apply the following conditioning unless the transmission path isolator is combined with other function(s) in a component that specifies different conditioning in which case, apply the conditioning specified in the part of ISO 7240 for that other function:

a) indoor environmental type

— lower temperature: (25 ± 3) °C,

— relative humidity (lower temperature): ≥95 %,

— upper temperature: (40 ± 3) °C,

— relative humidity (upper temperature): (93 ± 3) %, and

— number of cycles: 2;

b) outdoor environmental type

— lower temperature: (25 ± 3) °C,

— relative humidity (lower temperature): ≥95 %,

— upper temperature: (55 ± 3) °C,

— relative humidity (upper temperature): (93 ± 3) %, and

— number of cycles: 2.

5.6.2.4 Measurements during conditioning

During the conditioning period, monitor the specimen to detect any change from the transmission path isolator closed condition.

During the last hour of the conditioning period, conduct the functional test as described in 5.1.5.2 c).

5.6.2.5 Final measurements

After the recovery period, conduct the functional test as described in 5.1.5.

5.6.3 Requirements

The specimen shall remain in the closed condition during the conditioning period.

The specimen shall function correctly within the manufacturer's specification during the functional test.

5.7 Damp heat, steady state (endurance)

5.7.1 Object

The object is to demonstrate the ability of the transmission path isolator to withstand the long-term effects of humidity in the service environment (e.g. changes in electrical properties of materials, chemical reactions involving moisture or galvanic corrosion).

5.7.2 Test procedure

5.7.2.1 Reference

Use the test apparatus and procedure as described in IEC 60068-2-30, Test Db using the Variant 1 test cycle and controlled recovery conditions and as described below.

Where the isolator is combined with other ISO 7240 function(s) in a component, use the apparatus and test procedure described in the part of ISO 7240 for that other function(s).

Where the isolator is combined with other function(s) in a component and the test is not in any other part of ISO 7240, then apply the test in this document.

5.7.2.2 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 but do not supply it with power during the conditioning.

5.7.2.3 Conditioning

Apply the following conditioning unless the transmission path isolator is combined with other function(s) in a component that specifies different conditioning, in which case apply the conditioning in the part of ISO 7240 corresponding to that function:

— temperature: (40 ± 2) ºC;

— relative humidity: (93 ± 3) %;

— duration: 21 days.

5.7.2.4 Final measurements

After a recovery period of at least 1 h at the standard laboratory conditions, conduct the functional test as described in 5.1.5.

5.7.3 Requirements

The specimen shall function correctly within the manufacturer's specification during the functional test.

5.8 Sulfur dioxide (SO_2) corrosion (endurance)

5.8.1 Object

The object is to demonstrate the ability of the transmission path isolator to withstand the corrosive effects of sulfur dioxide as an atmospheric pollutant.

5.8.2 Test procedure

5.8.2.1 Reference

Use the test apparatus and procedure as described in IEC 60068-2-42, Test Kc and the procedure described below.

Where the isolator is combined with other ISO 7240 function(s) in a component, use the apparatus and test procedure described in the part of ISO 7240 for that other function(s).

5.8.2.2 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 but do supply it with power during the conditioning and connect it with un-tinned copper wires of the appropriate diameter, connected to sufficient terminals to allow the final measurement to be made, without making further connections to the specimen.

5.8.2.3 Conditioning

Apply the following conditioning unless the transmission path isolator is combined with other function(s) in a component that specifies different conditioning in which case apply the conditioning in the part of ISO 7240 corresponding to that function:

— temperature: (25 ± 2) °C;

— relative humidity: (93 ± 3) %;

— SO_2 concentration: (25 ± 5) $\times 10^{-6}$ l/l;

— duration: 21 days.

5.8.2.4 Final measurements

Immediately after the conditioning, subject the specimen to a drying period of 16 h at (40 ± 2) °C, ≤50 % RH, followed by a recovery period of at least 1 h at the standard laboratory conditions. After this, the functional test as described in 5.1.5 shall be conducted.

5.8.3 Requirements

The specimen shall function correctly within the manufacturer's specification during the functional test.

5.9 Shock (operational)

5.9.1 Object

The object is to demonstrate the immunity of the transmission path isolator to mechanical shocks, which are likely to occur, albeit infrequently, in the anticipated service environment.

5.9.2 Test procedure

5.9.2.1 Reference

Use the test apparatus and procedure as described in IEC 60068-2-27, Test Ea and as described below.

Where the isolator is combined with other ISO 7240 function(s) in a component, use the apparatus and test procedure described in the part of ISO 7240 for that other function(s).

5.9.2.2 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 to a rigid fixture and connect it to its supply and monitoring equipment as described in 5.1.2.

5.9.2.3 Conditioning

For specimens with a mass ≤4,75 kg, apply the following conditioning unless the transmission path isolator is combined with other function(s) in a component that specifies different conditioning, in which case apply the conditioning in the part of ISO 7240 for that function:

— shock pulse type: half sine;

— pulse duration: 6 ms;

— peak acceleration: 10 × (100 − 20M) m/s^2 (where M is the specimen's mass in kg);

— number of directions: 6;

— pulses per direction: 3.

NOTE No test is applied to specimens with a mass >4,75 kg.

5.9.2.4 Measurements during conditioning

Monitor the specimen during the conditioning period and for a further 2 min to detect any change from the closed condition.

5.9.2.5 Final measurements

After the conditioning and the further 2 min, conduct the functional test as described in 5.1.5.

5.9.3 Requirements

The specimen shall remain in the closed condition during the conditioning period and the additional 2 min.

The specimen shall function correctly within the manufacturer's specification during the functional test.

5.10 Impact (operational)

5.10.1 Object

The object is to demonstrate the immunity of the transmission path isolator to mechanical impacts upon its surface, which it may sustain in the normal service environment, and which it can reasonably be expected to withstand.

5.10.2 Test procedure

5.10.2.1 Apparatus

Use the test apparatus and procedures described below unless the transmission path isolator is combined with other function(s) in a component, in which case use the apparatus and test procedure as described in the part of ISO 7240 corresponding to that function.

For ceiling mounted transmission path isolators use the swinging hammer test apparatus, incorporating a rectangular-section aluminium alloy head – aluminium alloy $AlCu_4SiMg$ complying with ISO 209, solution treated and precipitation treated condition – with the plane impact face chamfered to an angle of 60° to the horizontal, when in the striking position (i.e. when the hammer shaft is vertical). The hammer head shall be (50 ± 2,5) mm high, (76 ± 3,8) mm wide and (80 ± 4) mm long at mid height as shown in Figure B.1. A suitable apparatus is described in Annex B.

For wall mounted transmission path isolators, use the test apparatus and procedure as described in IEC 60068-2-75.

5.10.2.2 State of the specimen during conditioning

For ceiling mounted transmission path isolators, fix the specimen rigidly to the apparatus by its normal mounting means and position it so that it is struck by the upper half of the impact face when the hammer is in the vertical position (i.e. when the hammerhead is moving horizontally). Choose the azimuthal direction and position of impact, relative to the specimen as that most likely to impair the normal functioning of the specimen. Connect the specimen to its supply and monitoring equipment as described in 5.1.2.

For wall mounted transmission path isolators, mount the specimen as described in 5.1.3 to a rigid structure and connect to its supply and monitoring equipment as described in 5.1.2.

5.10.2.3 Conditioning

Depending on the mounting, apply the following conditioning unless the transmission path isolator is combined with other function(s) in a component that specifies different conditioning in which case apply the conditioning in the part of ISO 7240 for that function:

a) for ceiling mounted specimens, apply the following conditioning

- impact energy: (1,9 ± 0,1) J,
- hammer velocity: (1,5 ± 0,13) m/s, and
- number of impacts: 1;

b) for wall mounted specimens, apply the following conditioning

- impact energy: (0.5 ± 0,04) J, and
- number of impacts per point: 3.

Apply the impacts to all accessible surfaces of the specimen. For all such surfaces, apply three impacts to any point(s) considered likely to cause damage or to impair the operation of the specimen. Take care to ensure that the results from a series of three blows do not influence subsequent series. In case of doubt, disregard the defective specimen and apply a further three blows to the same position on a new specimen.

5.10.2.4 Measurements during conditioning

Monitor the specimen during the conditioning period and for a further 2 min to detect any change from the closed condition.

5.10.2.5 Final measurements

After the conditioning and the further 2 min, conduct the functional test as described in 5.1.5.

5.10.3 Requirements

The specimen shall remain in the closed condition during the conditioning period and the additional 2 min.

The specimen shall function correctly within the manufacturer’s specification during the functional test.

5.11 Vibration, sinusoidal (operational)

5.11.1 Object

The object is to demonstrate the immunity of the transmission path isolator to vibration at levels considered appropriate to the normal service environment.

5.11.2 Test procedure

5.11.2.1 Reference

Use the test apparatus and procedure as described in IEC 60068-2-6, Test Fc and as described below.

Where the transmission path isolator is combined with other function(s) in a component, use the apparatus and test procedure as described in the part of ISO 7240 for that function.

5.11.2.2 State of the specimen during conditioning

Mount the specimen on a rigid fixture as described in 5.1.3 and connect it to its supply and monitoring equipment as described in 5.1.2.

Apply the vibration in each of three mutually perpendicular axes, in turn. Mount the specimen so that one of the three axes is perpendicular to its normal mounting plane.

5.11.2.3 Conditioning

Apply the following conditioning unless the transmission path isolator is combined with other function(s) in a component that specifies different conditioning in which case apply the conditioning in the part of ISO 7240 for that function:

— frequency range: (10 to 150) Hz;

— acceleration amplitude: 5 m/s^2 (≈0,5 gn);

— number of axes: 3;

— sweep rate: 1 octave min^{-1};

— number of sweep cycles: 1 per axis.

NOTE The vibration operational and endurance tests can be combined such that the specimen is subjected to the operational test conditioning followed by the endurance test conditioning in one axis before changing to the next axis. Only one final measurement needs to be made.

5.11.2.4 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any change from the closed condition.

5.11.2.5 Final measurements

After the conditioning, conduct the functional test as described in 5.1.5.

NOTE If the vibration operational and endurance tests are combined, the final measurements are made after the vibration endurance test and only need be made here if the operational test is conducted in isolation.

5.11.3 Requirements

The specimen shall remain in the closed condition during the conditioning period.

If the final measurement, as specified in 5.11.2.5, has been conducted, the specimen shall function correctly within the manufacturer's specification during the functional test.

5.12 Vibration, sinusoidal (endurance)

5.12.1 Object

The object is to demonstrate the ability of the transmission path isolator to withstand the long-term effects of vibration at levels appropriate to the service environment.

5.12.2 Test procedure

5.12.2.1 Reference

Use the test apparatus and procedure as described in IEC 60068-2-6 Test Fc, and as described below.

Where the transmission path isolator is combined with other function(s) in a component, use the apparatus and test procedure in the part of ISO 7240 for that other function(s).

5.12.2.2 State of the specimen(s) during conditioning

Mount the specimen on a rigid fixture as described in 5.1.3 but do not connect to the power supply during the conditioning.

Apply the vibration in each of three mutually perpendicular axes, in turn, mounting the specimen so that one of the three axes is perpendicular to its normal mounting axis.

5.12.2.3 Conditioning

Apply the following conditioning unless the transmission path isolator is combined with other function(s) in a component that specifies different conditioning in which case apply the conditioning in the part of ISO 7240 for that function:

— frequency range: (10 to 150) Hz;

— acceleration amplitude: 10 m/s^2 (1,0 gn);

— number of axes: 3;

— sweep rate: 1 octave min^{-1};

— number of sweep cycles: 20 per axis.

NOTE The vibration operational and endurance tests can be combined such that the specimen is subjected to the operational test conditioning followed by the endurance test conditioning in one axis before changing to the next axis. Only one final measurement is required.

5.12.2.4 Final measurements

After the conditioning, conduct the functional test as described in 5.1.5.

5.12.3 Requirements

The specimen shall function correctly within the manufacturer's specification during the functional test.

5.13 Electromagnetic Compatibility (EMC), Immunity tests (operational)

5.13.1 Object

The object is to demonstrate the immunity of the transmission path isolator to electromagnetic interference.

5.13.2 Test procedure

5.13.2.1 Reference

The test apparatus and procedure shall be as described in IEC 62599-2 and as described below.

5.13.2.2 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 and connect it to the supply and monitoring equipment as described in 5.1.2.

5.13.2.3 Conditioning

Apply the following conditioning as described in IEC 62599-2:

a) electrostatic discharge;

b) radiated electromagnetic fields;

c) conducted disturbances induced by electromagnetic fields;

d) fast transient bursts (100 KHz repetition rate);

e) slow high-energy voltage surges.

5.13.2.4 Measurements during conditioning

During the conditioning, monitor the specimen to detect any change of state or faulty operation.

5.13.2.5 Final measurements

After the conditioning, conduct the functional test as described in 5.1.5.

5.13.3 Requirements

The specimen shall remain in the closed condition without any faulty operation during conditioning.

The specimen shall function correctly within the manufacturer's specification during the functional test.

6 Test report

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

a) an identification of the specimen tested;

b) a reference to this document (i.e. ISO 7240-17:2020);

c) the results of the test – the individual response values and the minimum, maximum, and arithmetic mean values where appropriate;

d) the conditioning period and the conditioning atmosphere;

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

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

g) the details of any deviation from this document or from the international standards to which reference is made, and the details of any operations regarded as optional.

7 Marking

Each transmission path isolator shall be clearly marked with the following information:

a) the number of this document (i.e. ISO 7240-17);

b) the name or trademark of the manufacturer or supplier;

c) the model designation (type number);

d) the environmental capability when used outdoor;

e) the wiring terminal designations;

f) some mark(s) or code(s) (e.g. serial number or batch code), by which the manufacturer can identify, at least, the date or batch and place of manufacture, and the version number(s) of any software, contained within the transmission path isolator.

For detachable transmission path isolator, the detachable part shall be marked with a), b), c), d) and f), and the base shall be marked with, at least c) (i.e. its own model designation) and e).

Where any marking on the device uses symbols or abbreviated terms not in common use then these should be explained in the data supplied with the device.

The marking shall be visible during the installation of the transmission path isolator and shall be accessible during the maintenance.

The markings shall not be placed on screws or other easily removable parts.

8 Data

8.1 Technical documentation for installation

8.1.1 Transmission path isolators shall either be supplied with sufficient technical, installation and maintenance data to enable their correct installation and operation or, if all of this data is not supplied with each transmission path isolator, reference to the appropriate data sheet(s) shall be given on, or with each transmission path isolator.

8.1.2 Installation and maintenance data shall include reference to an in situ test method to ensure that transmission path isolators operate correctly when installed.

NOTE Additional information can be required by organizations certifying that the transmission path isolator produced by a manufacturer conforms to the requirements of this document.

8.2 Software documentation

8.2.1 The manufacturer shall submit documentation that gives an overview of the software design. This documentation shall be in sufficient detail for the design to be inspected for compliance with this document and shall include at least the following:

a) a functional description of the main program flow (e.g. as a flow diagram or schema) including

   1) a brief description of the modules and the functions that they perform,

   2) the way in which the modules interact,

   3) the overall hierarchy of the program,

   4) the way in which the software interacts with the hardware of the transmission path isolator, and

   5) the way in which the modules are called, including any interrupt processing;

b) a description of which areas of memory are used for the various purposes (e.g. the program, sites-specific data, and running data);

c) a designation, by which the software and its version can be uniquely identified.

8.2.2 The manufacturer shall prepare and maintain detailed design documentation. This shall be available for inspection in a manner that respects the manufacturers' rights for confidentiality. It shall comprise at least the following:

a) an overview of the whole system configuration, including all software and hardware components;

b) a description of each module of the program, containing at least

   1) the name of the module,

   2) a description of the tasks performed,

   3) a description of the interfaces, including the type of data transfer, the valid data range, and the checking for valid data;

c) the full source code listings, as hard copy or in machine-readable form (e.g. ASCII-code), including global and local variables, constants and labels used, and sufficient comment for the program flow to be recognized;

d) the details of any software tools used in the design and implementation phase (e.g. CASE-tools, compilers).

NOTE This detailed design documentation can be reviewed at the manufacturers' premises.

Annex A
(informative)

Examples for the functional test procedure

A.1 General

This annex gives some examples of functional test procedures (see 5.1.5) for some hypothetical transmission path isolators. For these examples, the following simplistic and not necessarily practical types of isolators were envisaged:

a) a simple autonomous voltage sensing isolator;

b) a simple autonomous current sensing isolator;

c) a simple controllable isolator that can be instructed to open and close by the control and indicating equipment; it will also open if the voltage falls so low that the control and indicating equipment cannot command the device;

d) an autonomous data only isolator;

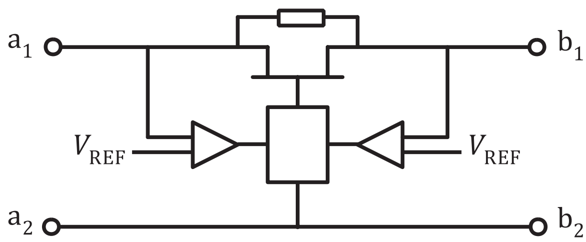
e) a simple autonomous protocol sensing isolator.

For each example, a typical block diagram and list of the parameters that need to be specified and verified is given. Examples of test circuits and test procedures for making the necessary tests and measurements are then given.

A.2 Example 1: Simple autonomous voltage sensing isolator

A.2.1 General

The stimulus that the isolator measures and detects is the voltage at either side of the isolator. An example of this type of a configuration is shown in Figure A.1.



Key

V_{REF} reference voltage

a_1, a_2, b_1, b_2 exchange connections

Figure A.1 — Typical block diagram for simple autonomous voltage sensing isolator

A.2.2 Parameter specification

V_{max} maximum line voltage

V_{nom} nominal line voltage

V_{min} minimum line voltage

V_{REF} reference voltage

$V_{SO,max}$ maximum voltage at which the device isolates (i.e. switches from closed to open)

$V_{SO,min}$ minimum voltage at which the device isolates (i.e. switches from closed to open)

$V_{SC,max}$ maximum voltage at which the device reconnects (i.e. switches from open to closed)

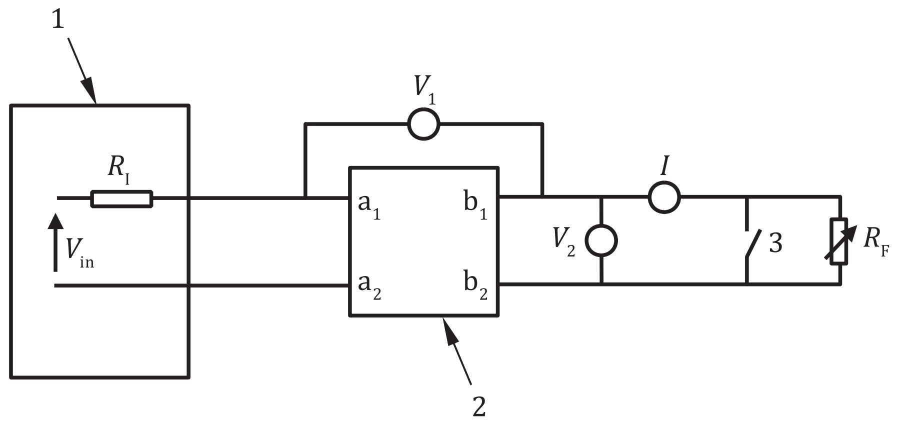
$V_{SC,min}$ minimum voltage at which the device reconnects (i.e. switches from open to closed)

$I_{C,max}$ maximum rated continuous current with the switch closed

$I_{S,max}$ maximum rated switching current (e.g. under short circuit conditions)

$I_{L,max}$ maximum leakage current with the switch open (isolated state)

$Z_{C,max}$ maximum series impedance with the switch closed



Key

1 power supply
2 equipment under test (EUT)
3 switch
I current
R_F parallel resistance
R_I power supply internal resistance
V_{in} entry voltage
V_1, V_2 voltage
a_1, a_2, b_1, b_2 exchange connections

Figure A.2 — Test circuit for simple autonomous voltage sensing isolator

A.2.3 Test procedure

A.2.3.1 Connect the transmission path isolator (EUT) to a test circuit as shown in Figure A.2 above with the switch open and R_F set to infinity (i.e. an open circuit).

A.2.3.2 Set V_{in} to the nominal line voltage, unless otherwise stated in a test procedure and limit the power supply current to $I_{S,max}$ as declared by the manufacturer. Apply an instantaneous short circuit by closing the switch. Measure the current I and record this as the leakage current I_L. Check that $I_L \leq I_{L,max}$.

A.2.3.3 Open the switch and monitor V_2 to check that the device reconnects.

A.2.3.4 Reduce R_F until $I = I_{C,max}$. Then measure V_1 and I and hence calculate the effective switch impedance Z_C. Check that $Z_C \leq Z_{C,max}$.

A.2.3.5 Increase R_F to infinity (i.e. an open circuit) and adjust current limitation to $I_{C,max}$ as declared by the manufacturer.

A.2.3.6 Reduce R_F and measure the voltage V_2 at the moment that the device isolates (i.e. the switch opens) and record this voltage as V_{SO}. Check that $V_{SO,max} \geq V_{SO} \geq V_{SO,min}$.

A.2.3.7 Continue to reduce R_F to zero and then measure the current I and record this as the leakage current I_L. Check that $I_L \leq I_{L,max}$.

A.2.3.8 Increase R_F and measure the voltage V_2 at the moment that the device reconnects (i.e. the switch closes) and record this voltage as V_{SC}. Check that $V_{SC,max} \geq V_{SC} \geq V_{SC,min}$. Then measure V_1 and I and hence calculate the effective switch impedance Z_C. Check that $Z_C \leq Z_{C,max}$.

A.2.3.9 Repeat steps 1 to 9 with the EUT supplied from the other side (i.e. exchange connections a_1 and a_2 with b_1 and b_2).

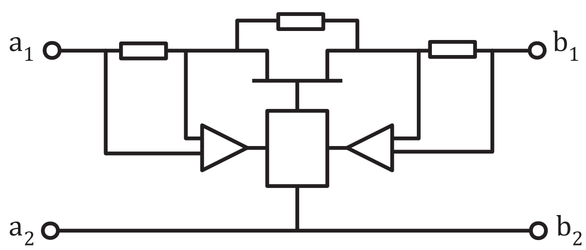
NOTE It can be necessary to attach a recording device (e.g. a chart recorder) to measure V_2 in order to correctly determine the values of V_{SO} and V_{SC}.

The isolator may not work without the protocol, in which case a simulator or CIE may be used.

A.3 Example 2: Simple autonomous current sensing isolator

A.3.1 General

The stimulus that the isolator measures and detects is the current flowing in the isolator. An example of this type of configuration is shown in Figure A.3.



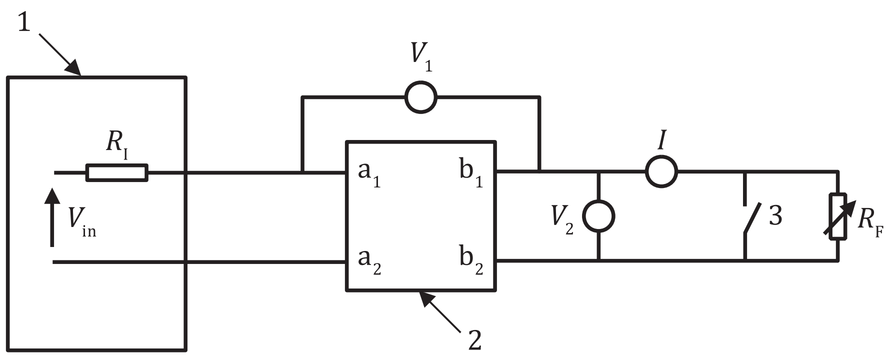
Key

a_1, a_2, b_1, b_2 exchange connections

Figure A.3 — Typical block diagram for simple autonomous current sensing isolator

A.3.2 Parameter specifications

V_{max}	maximum line voltage
V_{nom}	nominal line voltage
V_{min}	minimum line voltage
$I_{SO,max}$	maximum current at which the device isolates (i.e. switches from closed to open)
$I_{SO,min}$	minimum current at which the device isolates (i.e. switches from closed to open)
$I_{SC,max}$	maximum current at which the device reconnects (i.e. switches from open to closed)
$I_{SC,min}$	minimum current at which the device reconnects (i.e. switches from open to closed)
$I_{S,max}$	maximum rated switching current (e.g. under short circuit conditions)
$I_{L,max}$	maximum leakage current with the switch open (isolated state)
$Z_{C,max}$	maximum series impedance with the switch closed



Key

1	power supply
2	equipment under test (EUT)
3	switch
I	current
R_F	parallel resistance
R_I	power supply internal resistance
V_{in}	entry voltage
V_1, V_2	voltage
a_1, a_2, b_1, b_2	exchange connections

Figure A.4 — Test circuit for simple autonomous current sensing isolator

A.3.3 Test procedure

A.3.3.1 Connect the transmission path isolator (EUT: equipment under test) to a test circuit as shown in Figure A.4 with the switch open and R_F set to infinity (i.e. an open circuit).

A.3.3.2 Set V_{in} to the nominal line voltage, unless otherwise stated in a test procedure and limit the power supply current to $I_{S,max}$ as declared by the manufacturer. Apply an instantaneous short circuit by closing the switch. Measure the current I and record this as the leakage current I_L. Check that $I_L \leq I_{L,max}$.

A.3.3.3 Open the switch and monitor V_2 to check that the device reconnects.

A.3.3.4 Reduce R_F until $I = I_{C,max}$. Then measure V_1 and I and hence calculate the effective switch impedance Z_C. Check that $Z_C \leq Z_{C,max}$.

A.3.3.5 Continue to reduce R_F to zero, then measure the current I, and record this as the leakage current I_L. Check that $I_L \leq I_{L,max}$.

A.3.3.6 Increase R_F and measure the current I at the moment that the device reconnects (i.e. the switch closes) and record this current as I_{SC}. Check that $I_{SC,max} \geq I_{SC} \geq I_{SC,min}$. Then measure V_1 and I and hence calculate the effective switch impedance Z_C. Check that $Z_C \leq Z_{C,max}$.

A.3.3.7 Repeat steps 1 to 7 with the EUT supplied from the other side (i.e. exchange connections a_1 and a_2 with b_1 and b_2).

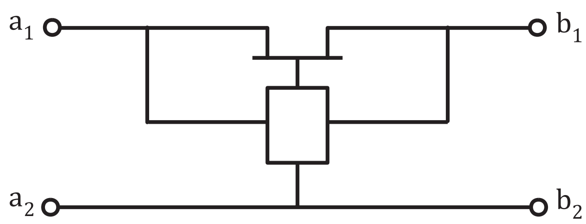
NOTE It can be necessary to attach a recording device (e.g. a chart recorder) to measure I to correctly determine the values of I_{SO} and I_{SC}.

The isolator may not work without the protocol in which case, a simulator or CIE may be used.

A.4 Example 3: Simple controllable isolator

A.4.1 General

A simple controllable isolator can be instructed to open and close by the control and indicating equipment and will open if the voltage falls so low that the control and indicating equipment cannot command the device. An example of this type of configuration is shown in Figure A.5. A possible test circuit is given in Figure A.6.



Key

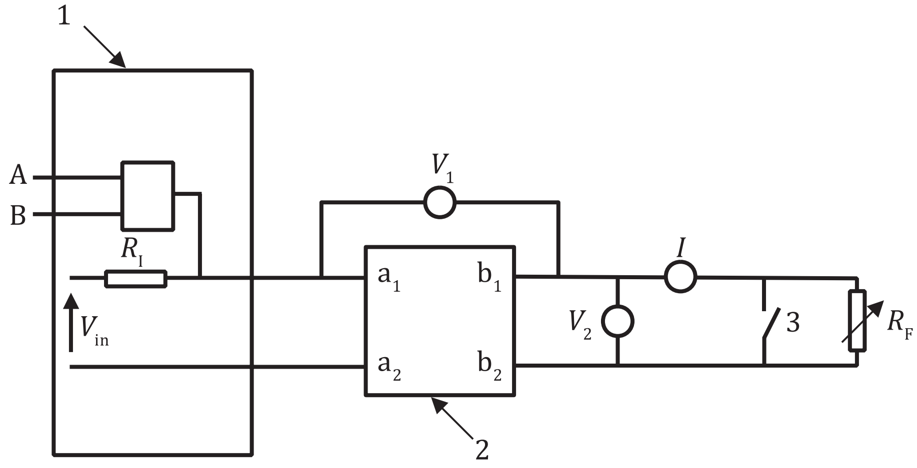
a_1, a_2, b_1, $b_2$exchange connections

Figure A.5 — Typical block diagram for simple controllable isolator

A.4.2 Parameter specification

Isolate command	command that causes the device to switch from closed to open
Reconnect command	command that causes the device to switch from open to closed
V_{max}	maximum line voltage
V_{nom}	nominal line voltage
V_{min}	minimum line voltage
$V_{SO,max}$	maximum voltage at which the device isolates (i.e. switches from closed to open)

$V_{SO,min}$	the minimum voltage at which the device isolates (i.e. switches from closed to open)
$I_{C,max}$	maximum rated continuous current with the switch closed
$I_{S,max}$	maximum rated switching current (e.g. under short circuit conditions)
$I_{L,max}$	maximum leakage current with the switch open (isolated state)
$Z_{C,max}$	maximum series impedance with the switch closed



Key

1	power supply
2	equipment under test (EUT)
3	switch
A	input for the isolate command
B	input for the reconnect command
I	current
R_F	parallel resistance
R_I	power supply internal resistance
V_{in}	entry voltage
V_1, V_2	voltage
a_1, a_2, b_1, b_2	exchange connections

Figure A.6 — Test circuit for simple controllable isolator

The manufacturer may have to provide suitable power supply and control equipment and indicating equipment.

A.4.3 Test procedure

A.4.3.1 Connect the transmission path isolator (EUT) to a test circuit as shown above with the switch open and R_F set to infinity (i.e. an open circuit).

A.4.3.2 Set V_{in} to the nominal line voltage, unless otherwise stated in a test procedure, and limit the power supply current to $I_{S,max}$ as declared by the manufacturer. Operate the isolate, reconnect commands, and monitor V_2 to check that the device isolates and reconnects.

A.4.3.3 Apply an instantaneous short circuit by closing the switch. Measure the current I and record this as the leakage current I_L. Check that $I_L \leq I_{L,max}$.

A.4.3.4 Open the switch, operate the reconnect command and monitor V_2 to check that the device reconnects.

A.4.3.5 Reduce R_F until $I = I_{C,max}$. Then measure V_1 and I and hence calculate the effective switch impedance Z_C. Check that $Z_C \leq Z_{C,max}$. Operate the isolate and reconnect commands and monitor V_2 to check that the device isolates and reconnects.

A.4.3.6 Increase R_F to infinity (i.e. an open circuit) and adjust current limitation to $I_{C,max}$ as declared by the manufacturer.

A.4.3.7 Reduce R_F and measure the voltage V_2 at the moment that the device isolates (i.e. the switch opens) and record this voltage as V_{SO}. Check that $V_{SO,max} \geq V_{SO} \geq V_{SO,min}$.

A.4.3.8 Continue to reduce R_F to zero, then measure the current I, and record this as the leakage current I_L. Check that $I_L \leq I_{L,max}$.

A.4.3.9 Increase R_F until the reconnect command can be correctly applied and apply the reconnect command. Then measure V_1 and I and hence calculate the effective switch impedance Z_C. Check that $Z_C \leq Z_{C,max}$.

A.4.3.10 Repeat steps 1 to 9 with the EUT supplied from the other side (i.e. exchange connections a_1 and a_2 with b_1 and b_2).

NOTE It can be necessary to attach a recording device (e.g. a chart recorder) to measure V_2 in order to correctly determine the value of V_{SO}.

The isolator may not work without the protocol in which case, a simulator or CIE may be used.

A.5 Example 4: Autonomous data only isolator (heart beat signal sensing isolator)

A.5.1 General

An autonomous data only isolator is a simple autonomous isolator that receives the heart beat signal. With a lack of heart beat signal, it starts a routine to test each side of the isolator. It opens on one side and listens on the other side and vice versa.

A.5.2 Parameter specification

$D_{amp\ max}$ maximum data packet/heart beat amplitude

$D_{amp\ nom}$ nominal data packet/heart beat amplitude

$D_{amp\ min}$ minimum data packet/heart beat amplitude

A.5.3 Test procedure

A.5.3.1 Vary the stimulus (amplitude) by applying an attenuator to the input such that the amplitude of the heart beat is reduced to its specified minimum and verify the isolation function as declared by the manufacturer.

A.5.3.2 Apply parallel resistance R_F on the transmission line until it isolates.

A.5.3.3 Apply an instantaneous short circuit by closing the switch. Check that the isolator has operated by checking, e.g. control panel or support equipment.

Annex B
(informative)

Apparatus for impact test

B.1 The apparatus (see Figure B.1) consists essentially of a swinging hammer comprising a rectangular section head (striker), with a chamfered impact face, mounted on a tubular steel shaft. The hammer is fixed into a steel boss, which runs on ball bearings on a fixed steel shaft mounted in a rigid steel frame, so that the hammer can rotate freely about the axis of the fixed shaft. The design of the rigid frame is such as to allow complete rotation of the hammer assembly when the specimen is not present.

B.2 The striker is of dimensions 76 mm wide, 50 mm high, and 94 mm long (overall dimensions) and is manufactured from aluminium alloy ($AlCu_4SiMg$ to ISO 209) solution treated and precipitation treated conditions. It has a plane impact face chamfered at (60 ± 1) ° to the long axis of the head. The tubular steel shaft has an outside diameter of (25 ± 0,1) mm with walls (1,6 ± 0,1) mm thick.

B.3 The striker is mounted on the shaft so that its long axis is at a radial distance of 305 mm from the axis of rotation of the assembly, the two axes being mutually perpendicular. The central boss is 102 mm in outside diameter and 200 mm long and is mounted coaxially on the fixed steel pivot shaft, which is approximately 25 mm in diameter, however the precise diameter of the shaft will depend on the bearings used.

B.4 Diametrically opposite the hammer shaft are two steel counter balance arms, each 20 mm in outside diameter and 185 mm long. These arms are screwed into the boss so that the length of 150 mm protrudes. A steel counter balance weight is mounted on the arms so that its position can be adjusted to balance the weight of the striker and arms, as in Figure B.1. On the end of the central boss is mounted a 12 mm wide × 150 mm diameter aluminium alloy pulley and around this an inextensible cable is wound, one end being fixed to the pulley. The other end of the cable supports the operating weight.

B.5 The rigid frame also supports the mounting board on which the specimen is mounted by its normal fixings. The mounting board is adjustable vertically so that the upper half of the impact face of the hammer will strike the specimen when the hammer is moving horizontally, as shown in Figure B.1.

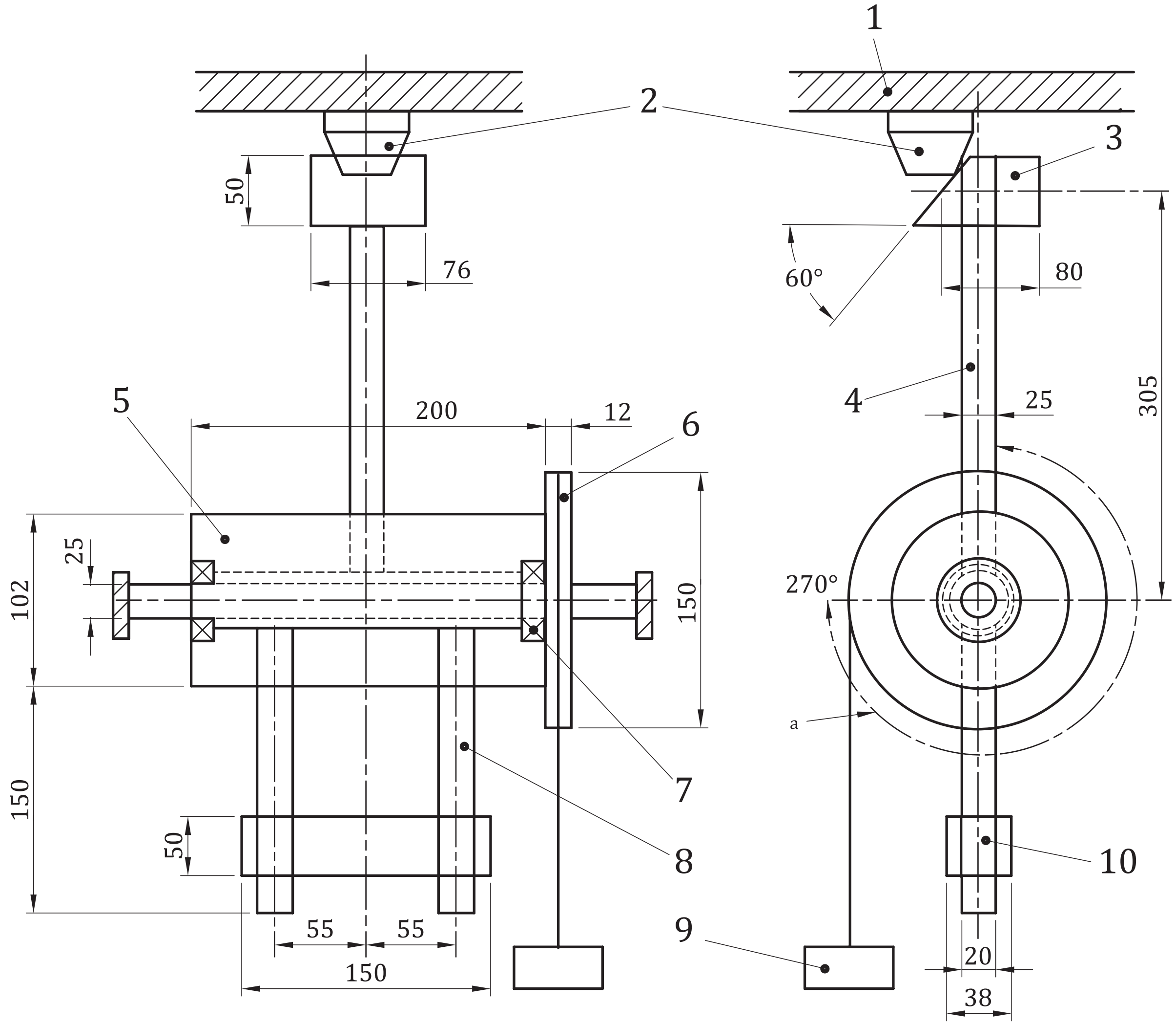
B.6 To operate the apparatus the position of the specimen and the mounting board is first adjusted as shown in Figure B.1 and the mounting board is then secured rigidly to the frame. The hammer assembly is then balanced carefully by adjustment of the counter balance weight with the operating weight removed. The hammer arm is then drawn back to the horizontal position ready for release and the operating weight is reinstated. On release of the assembly, the operating weight will spin the hammer and arm through an angle of 3π/2 radians to strike the specimen. The mass of the operating weight to produce the required impact energy of 1,9 J equals is:

$$\frac{0,388}{3\pi r}\text{kg}$$

where r is the effective radius of the pulley in metres. This equals approximately 0,55 kg for a pulley radius of 75 mm.

B.7 As this document calls for a hammer velocity at impact of (1,5 ± 0,13) m/s, the mass of the hammer head will need to be reduced by drilling the back face sufficiently to obtain this velocity. It is estimated that a head of mass of about 0,79 kg will be required to obtain the specified velocity, but this will have to be determined by trial and error.

Dimensions in millimetres



Key

1	mounting board	7	ball bearings
2	transmission path isolator	8	counter balance arms
3	striker	9	operating weight
4	striker shaft	10	counter balance weight
5	boss	a	270° angle of movement.
6	pulley		

NOTE The dimensions shown are for guidance, apart from those relating to the hammer head.

Figure B.1 — Impact apparatus

Bibliography

[1] ISO 7240-7, *Fire detection and alarm systems — Part 7: Point-type smoke detectors using scattered light, transmitted light or ionization*

NATIONAL ANNEX C

(*National Foreword*)

C-1 BIS CERTIFICATION MARKING

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

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