27 Abnormal operation

This clause of Part 1 is applicable.

27.101DV D2 *Addition of the following clauses:*

27.101DV.1 Overvoltage

27.101DV.1.1 The following is applicable to controls classified under 6.7.103BDV.

27.101DV.1.2 Three SHTPs are to be subjected to an overvoltage test. Each SHTP is to be connected to a supply circuit that has been adjusted to 10 percent above the rated nominal voltage of the device. The SHTP is to be operated for 7-1/2 hours and is to be caused to cycle (by an external heat source if necessary) 5 times during the 7-1/2 hours. During each cycle, the SHTP is to be de-energized no more than 5 minutes.

27.101DV.1.3 After the conclusion of the test, the resistance of the heater shall be within 5 percent of its value before the test, and the cutout temperature of the device shall not rise above the initial cutout temperature by more than 5°C (9°F), or more than 5 percent of the rated Fahrenheit cutout temperature, whichever is greater.

27.102DV D2 *Addition of the following clauses:*

27.102DV.1 Thermal Cycling

27.102DV.1.1 The following is applicable to controls classified under 6.7.103BDV.

27.102DV.1.2 Three SHTPs are to be subjected to a thermal cycling test. Each SHTP is to be connected to a source of supply adjusted to rated voltage and connected to a rated load. The supply is to be cycled on and off such that the device is energized for one hour and then de-energized for the next hour and repeated for a total of 1000 hours.

27.102DV.1.3 At the conclusion of the test, the resistance of the internal heater shall be within 5 percent of its value before the test; and the cutout time of the device shall be within 5 minutes of the initial cutout time as determined by subjecting the SHTP tested to the initial time calibration-verification, 15.5.6EDV.1.5 to 15.5.6EDV.1.7.

27.103DV D2 *Addition of the following clauses:*

27.103DV.1 Short Circuit

27.103DV.1.1 The following is applicable to controls classified under 6.7.103BDV.

27.103DV.1.2 Three thermal protective devices are to be subjected to a short circuit test. Each device is to be connected to a branch circuit supply with a power factor of 0.9 - 1.0, available current as specified in Table 27.103DV.1, and adjusted to the maximum rated voltage for the device. A nonrenewable fuse that is rated for the maximum intended branch circuit amperes, 10,000 amperes fault current, and voltage rating equal to or greater than the maximum rated voltage of the thermal protective is to be connected in series between the supply and the thermal protective device. The fuse shall be such that it will not open in less than 12 seconds while carrying twice its rated current. The conductor between each

side of the branch circuit supply and the thermal protective device are to be 8 AWG (3.3 mm) and are to be 4 feet (1.2 m) long. That part of a device that could protrude into the concealed space of a building and any openings in the device are to be wrapped with a layer of surgical cotton. The device is to be operated with the output of the device connected to the grounded supply conductor, until the fuse opens or some part of the thermal protective device is permanently open-circuited. The test setup is illustrated in Figure 27.103DV.1.

Table 27.103DV.1
Short-circuit currents

Branch circuit capacity at which device is intended to be used (amperes)	Circuit capacity (amperes)
20	200
30	1000
40	3500
50	5000

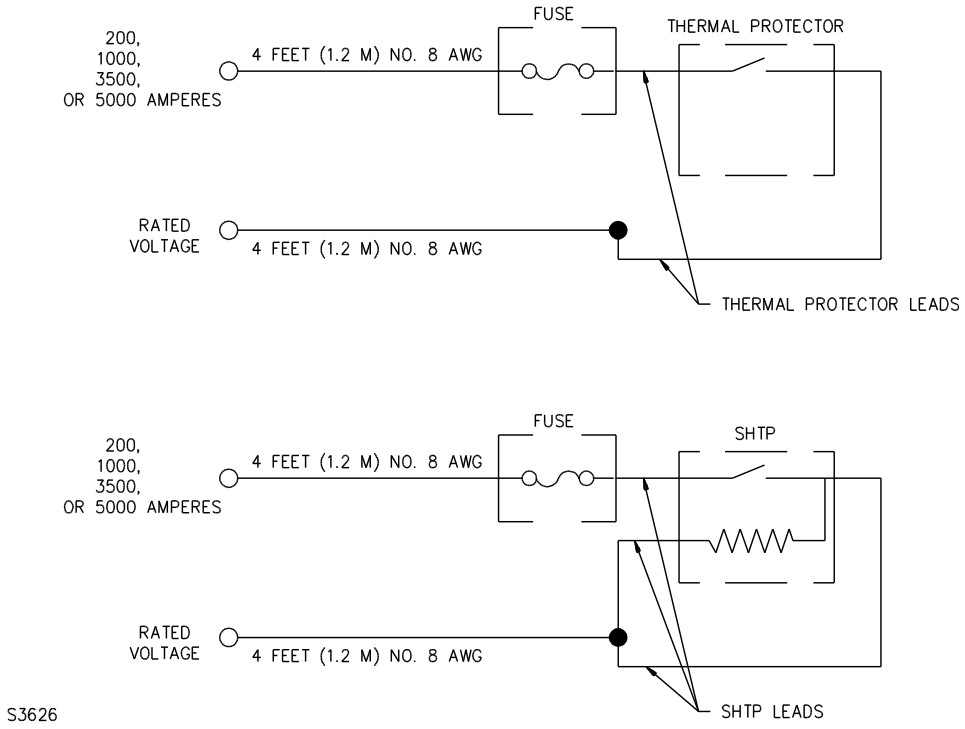

Figure 27.103DV.1

Short circuit test setup

27.103DV.1.3 During and after the test, there shall be no ignition of the cotton. After the test, the thermal protective device shall be permanently open-circuited; or if still functional, the cutout temperature shall not rise above the initial cutout temperature by more than 10°C (18°F).

28 Guidance on the use of electronic disconnection

This clause of Part 1 is applicable.

Annexes

The annexes of Part 1 are applicable except as follows:

Annex G
(normative)

Heat and fire resistance tests

This annex of Part 1 is applicable except as follows:

G.5.1 Ball pressure test 1

Replace the first line and first dashed item as follows:

Where the whole control has been declared as the SENSING ELEMENT, the temperature in the heating oven is the highest of:

– 20 K ± 2 K in excess of the MAXIMUM TEMPERATURE measured during the tests of Clause 14, or Clause 17.14, if the heating test of Clause 14 is not conducted,

G.5.2 Ball pressure test 2

Replace the first line as follows:

Where the whole CONTROL has been declared as the SENSING ELEMENT, the ball pressure test is carried out as described in G.5.1 except that the temperature in the heating oven shall be T_b ± 2 °C where T_b is equal to the higher of:

Replace the fourth dashed item as follows:

– 20 K in excess of the MAXIMUM TEMPERATURE recorded during the heating test of Clause 14, or 17.14, if the heating test of Clause 14 is not conducted,

Annex H
(normative)

Requirements for electronic controls

Replacement:

This annex of Part 1 is applicable except as follows:

H.2 Terms and definitions

Additional definitions:

H.2.101.1
PERMANENT OPERATION
continuous monitoring of the protective function during the OPERATION of the appliance or system for longer than 24 h

Note 1 to entry: 24 h is considered the typical time interval between a first and a second FAULT.

H.2.101.2
NON-PERMANENT OPERATION
continuous monitoring of the protective function during the OPERATION of the appliance or system for less than 24 h

Note 1 to entry: 24 h is considered the typical time interval between a first and a second FAULT.

H.6 Classification

H.6.18 According to classes of control functions

H.6.18.2 *Addition:*

NOTE 101: In general, THERMAL CUT-OUTS perform CLASS B CONTROL FUNCTIONS or CLASS C CONTROL FUNCTIONS.

H.6.18.3 *Addition:*

NOTE 101: In general, THERMAL CUT-OUTS used on closed water heater systems perform CLASS C CONTROL FUNCTIONS.

H.6.18.3DV D2 *Add the following explanatory paragraph:*

H.6.18.3DV.1 In general, thermal cut-outs used on closed water heater systems will have functions classified as software class C and thermostats used on closed water heater systems will have functions classified as software class B.

H.7 Information

Additional requirements to Table 1:

	Information	Clause or subclause	Method
58a	See footnote c of Table H.101	H.26.2.104	X
109	The output condition of THERMAL CUT-OUTS, type 2 THERMOSTATS and type 2 TEMPERATURE LIMITERS after OPERATION[104]	H.26.2.103 H.26.2.106	
118	Conditions of test when requested by the manufacturer for integrated and incorporated ELECTRONIC CONTROLS.	H.23.1.2	X
119	Frequency of the DEFINED STATE test function	H.27.1.2.2.2, H.27.1.2.3.2, H.27.1.2.3.3	X
120	The CONTROL is for PERMANENT OPERATION or NON-PERMANENT OPERATION	H.2.101.1, H.2.101.2, H.27.1.2.2.2, H.27.1.2.3.2	X
Additional note: [104] For example, conducting or non-conducting, as applicable.			

H.11 Constructional requirements

H.11.12 Controls using software

H.11.12.2.6 *Replace the second paragraph by the following:*

NOTE The values declared in Table 1, requirement 71 may be given in the applicable appliance standard.

H.11.12.2.7 *Addition, at the end of this subclause:*

NOTE 101 The values declared in Table 1, requirement 72 may be given in the applicable appliance standard.

H.23 Electromagnetic compatibility (EMC) requirements – Emission

H.23.1.2 Radio frequency emission

Addition:

INTEGRATED CONTROLS and INCORPORATED CONTROLS are not subjected to the tests of H.23.1.2, as the results of these tests are influenced by the incorporation of the control into the equipment and the use of measures to control emissions used therein. They may, however, be carried out under declared conditions if so requested by the manufacturer.

H.26 Electromagnetic compatibility (EMC) requirements – Immunity

H.26.2 *Additional subclauses:*

H.26.2.101 After each test, one or more of the following criteria shall apply, as permitted in Table H.101.

H.26.2.102 The CONTROL shall remain in its current condition and thereafter shall continue to operate as declared within the limits verified in Clause 15, if applicable.

H.26.2.103 The CONTROL shall assume the condition declared in Table 7.2, requirement 109 and thereafter shall operate as in H.26.2.102.

H.26.2.104 The CONTROL shall assume the condition declared in Table 1, requirement 109, such that it cannot be reset automatically or manually. The output waveform shall be sinusoidal or as declared in Table 1, requirement 53 for normal OPERATION.

H.26.2.105 The CONTROL shall remain in the condition declared in Table 1, requirement 109. A non-self-resetting CONTROL shall be such that it can only reset manually. After the temperature which caused cut-out to occur is removed, it shall operate as in H.26.2.102 or shall remain in the declared condition as in H.26.2.104.

H.26.2.106 The CONTROL may return to its initial state and thereafter shall operate as in H.26.2.102.

If a control is in the condition declared in Table 1, requirement 109, it may reset but shall resume the declared condition again if the temperature which caused it to operate is still present.

H.26.2.107 The output and functions shall be as declared in Table 1, requirement 58a or requirement 58b and the control shall comply with the requirement of 17.5.

Table H.101
Compliance criteria

Applicable Clause H.26 tests	Compliance criteria permitted					
THERMAL CUT-OUTS, type 2 THERMOSTATS and type 2 TEMPERATURE LIMITERS	H.26.2.102	H.26.2.103	H.26.2.104	H.26.2.105	H.26.2.106	H.26.2.107[c]
H.26.4 to H.26.14 inclusive	b	b	b	a	a	x
Other temperature SENSING CONTROLS	H.26.2.102	H.26.2.103	H.26.2.104	H.26.2.105	H.26.2.106	H.26.2.107[c]
H.26.8, H.26.9	x				x	x

[x] = Permitted for other than THERMAL CUT-OUTS

[a] = Permitted when the disturbance is applied after OPERATION

[b] = Permitted when the disturbance is applied before OPERATION

[c] =This compliance criterion is permitted only for INTEGRATED CONTROLS or INCORPORATED CONTROLS, since the acceptability of the output must be judged in the appliance.

H.26.5 Voltage dips, voltage interruptions and voltage variations in the power supply network

H.26.5.2 Voltage variation test

H.26.5.2.2 Test procedure

Replacement of last paragraph:

The CONTROL is subjected to each of the specified voltage test cycles three times with 10 s intervals between each test cycle. For a CONTROL declared under Table 1, requirement 109, each test cycle is performed three times when the control is in the declared condition and three times when it is not.

H.26.8 Surge immunity test

H.26.8.3 Test procedure

Additional subclause:

H.26.8.3.101 For CONTROLS declared under Table 1, requirement 109, the tests are performed when the CONTROL is in the declared condition and when it is not.

H.26.8.3.101DV D2 *National Difference Deleted*

H.26.9 Electrical fast transient/burst immunity test

H.26.9.3 Test procedure

Additional subclause:

H.26.9.3.101 The CONTROL is subjected to five tests. For CONTROLS declared under Table 1, requirement 109, the tests are performed when the CONTROL is in the declared condition and when it is not.

H.26.9.3.101DV D2 *National Difference Deleted*

H.26.10 Ring wave immunity test

H.26.10DV D2 *Deletion of the explanatory paragraph, "In the USA..." from the Part 1.*

H.26.10.5 Test procedure

Additional subclause:

H.26.10.5.101 For CONTROLS declared under Table 1, requirement 109, the tests are performed when the CONTROL is in the declared condition and when it is not.

H.26.10.5.101DV D2 *National Difference Deleted*

H.26.12 Radio-frequency electromagnetic field immunity

H.26.12.2 Immunity to conducted disturbances

H.26.12.2.2 Test procedure

Additional subclause:

H.26.12.2.2.101 For CONTROLS declared under Table 1, requirement 109, sweeping is performed when the CONTROL is in the declared condition and when it is not.

H.26.12.3 Immunity to radiated disturbances

H.26.12.3.2 Test procedure

Additional subclause:

H.26.12.3.2.101 For CONTROLS declared under Table 1, requirement 109, sweeping is performed when the CONTROL is in the declared condition and when it is not.

H.26.13 Test of influence of supply frequency variations

H.26.13.3 Test procedure

Additional subclause:

H.26.13.3.101 For CONTROLS declared under Table 1, requirement 109, the test shall be performed when the CONTROL is in the declared condition and when it is not.

H.26.14 Power frequency magnetic field immunity test

H.26.14.3 Test procedure

Additional subclause:

H.26.14.3.101 For CONTROLS declared under Table 1, requirement 109, the test shall be performed when the CONTROL is in the declared condition and when it is not.

H.26.15 Evaluation of compliance

H.26.15.2

Addition:

See Table H.101 for compliance criteria.

H.26.15.4

Addition:

See Table H.101 for compliance criteria.

H.27 Abnormal operation

This clause of Part 1 is applicable except as follows:

H.27.1.1.2 *Replace the first line by:*

The CONTROL shall be operated under the following conditions. In addition, CONTROLS declared under Table 1, requirement 109 shall be tested when the CONTROL is in the declared condition and when it is not.

H.27.1.1.3

This clause of Part 1 is applicable except item c).

H.27.1.2.2 Class B control function

This clause of Part 1 is applicable except as follows:

H.27.1.2.2.2 First fault

Replace item b) as follows:

b) the CONTROL shall react within the FAULT REACTION TIME (see Table 1, requirement 91) by proceeding to the DEFINED STATE provided that a subsequent restart under the same FAULT conditions results in the SYSTEM returning to the same DEFINED STATE condition;

Replace item c) as follows:

c) for SYSTEMS with NON-PERMANENT OPERATION, the CONTROL shall continue to operate as intended, the FAULT shall be detected during the next start-up sequence. The compliance criteria shall be a) or b);

NOTE Requirements for SYSTEMS with PERMANENT OPERATION are under consideration.

Replace item d) as follows:

d) the CONTROL shall continue to operate as intended.

Replace the last two paragraphs as follows:

The FAULT REACTION TIME shall be declared by the manufacturer (see Table 1, requirement 91).

For PERMANENT OPERATION as declared by the manufacturer (see Table 1, requirement 120), item c) is under consideration.

For the CONTROL function where a mechanical actuator is part of the DEFINED STATE a test up to but not including the switching contacts is sufficient. If the test of the DEFINED STATE fails, the CONTROL shall initiate the SAFETY SHUT-DOWN. Frequency of test is as declared by the manufacturer (see Table 1, requirement 119). Internal FAULTS of the components of the checking circuits are not considered.

H.27.1.2.2.3 Fault introduced during defined state

Not applicable.

H.27.1.2.2.3DV D2 *Clause H.27.1.2.2.3 is applicable.*

H.27.1.2.3 Class C control function

This clause of Part 1 is applicable except as follows:

H.27.1.2.3.2 First fault

Replace item b) as follows:

b) the CONTROL reacting within the FAULT REACTION TIME (see Table 1, requirement 91) by proceeding to DEFINED STATE provided that subsequent reset from the lock-out condition under the same FAULT condition results in the SYSTEM returning to the DEFINED STATE condition;

Replace item c) as follows:

c) for SYSTEMS with NON-PERMANENT OPERATION, the CONTROL shall continue to operate as intended, the FAULT shall be detected during the next start-up sequence. The compliance criteria shall be a) or b).

NOTE 101 Requirements for SYSTEMS with PERMANENT OPERATION are under consideration.

Replace item d) as follows: