

8.8.3.2 Sequence starting of pumping units

Subclause [8.6.5.2](#) applies.

8.8.3.3 Manual electric remote control

The requirements of [8.5.2.1](#) apply. In addition, when remote control is used, the following requirements apply:

- a) the controller shall be equipped to start the engine upon operation of remote push-button stations;
- b) when the controller is arranged for automatic shutdown, remote stations shall not be capable of stopping the unit except through the established operation of the running period timer (see [8.6.8.1](#)).

8.8.3.3DV DR Modification of 8.8.3.3 by adding the following:

Controllers with provision to supply special water control equipment (deluge valves, dry pipe valves, etc.) may start the motor before the pressure-activated switch(es) would do so. The controller shall be equipped to start the engine upon operation of the fire protection equipment. The starting sequence of the controller shall be initiated by the opening of the control circuit loop containing the remote equipment.

8.8.4 Batteries and battery chargers

8.8.4.1 Battery chargers

Battery chargers shall comply with the following:

- a) the rectifier shall be a semiconductor type;
- b) the charger for a battery unit shall be a type that automatically reduces the charging rate to a rate suitable for the battery with which the charger is intended to be used;
- c) the battery charger at its rated voltage shall be capable of delivering energy into a fully discharged battery in such a manner that it will not damage the battery. It shall restore to the battery 100 % of the battery's ampere-hour or reserve capacity rating within 24 h;
- d) the charger shall be marked with the ampere-hour or reserve capacity rating of the largest capacity battery unit that it can recharge;
- e) an ammeter with a scale not exceeding 250 % of rated charging current and an accuracy of ± 5 % of full scale shall be provided for each battery bank to indicate the charging current;
- f) the charger shall be designed so that it will not be damaged or open fuses during the cranking cycle of the engine when operated by an automatic or manual controller;
- g) the charger shall automatically charge at the maximum rate whenever required by the state of charge of the battery unit;
- h) the total discharge current shall not exceed 50 mA.

8.8.4.1DV D2 Modification of 8.8.4.1 by adding the following:

8.8.4.1DV.1 The dc power supplies for starting the engine shall be two separate battery banks requiring two independent charging circuits complying with Annex [DVA](#), item 13.

8.8.4.1DV.2 Essential loads, including the engine, controller, and all pump equipment combined, shall not exceed 0.5 ampere each for a total of 1.5 amperes, on a continuous basis.

8.8.4.2 Voltage measurement

A voltmeter with a scale not exceeding 250 % of rated battery voltage and an accuracy of ± 5 % of full scale shall be provided for each battery bank to indicate the voltage during cranking.

8.9 Automatic operation of a diesel engine drive controller – pressure-actuated**8.9.1 Requirements for the controller**

Subclause [8.6.5.1](#) applies.

8.9.1DV D2 Modification of 8.9.1 by adding the following:

8.9.1DV.1 The pressure-activated device and solenoid valve are not required to be provided on a non-pressure-activated controller.

8.9.1DV.2 The requirements of [8.6.5.3DV](#) apply.

8.9.1DV.3 Pressure sensors used with multistage multiport pumps shall comply with 12.7.2.1.1.2 of Annex [DVA](#), item 1.

8.9.2 Requirements for the pressure recorder

Subclause [8.6.5.3](#) applies.

8.9.2DV DR Modification of 8.9.2 by adding the following:

8.9.2DV.1 The controller shall be equipped with a pressure recording device to sense and record the pressure in each fire pump controller pressure sensing line at the input to the controller. The pressure recording device shall operate continuously for at least 7 d without resetting or rewinding. The pressure recording device shall not be solely dependent upon ac electric power as a power source. Upon loss of ac electric power, the pressure recording device shall be capable of at least 24 h of additional operation.

8.9.2DV.2 This device shall be responsive to water pressure in the fire protection system. The pressure sensing element of the device shall be capable of a momentary surge pressure of 2,758 kPa (400 psi) or 133 percent of fire pump controller rated operating pressure, whichever is higher, without losing its accuracy.

8.9.2DV.3 Pressure recorders used with multistage multiport pumps shall comply with 12.7.2.1.1.3 of Annex [DVA](#), item 1.

8.10 Automatic operation of a diesel engine drive controller – non-pressure-actuated

8.10.1 General

Automatic starting of a non-pressure-actuated automatic controller shall be accomplished by the opening of a contact in the external sensing device. When the controller provides a means for the remote starting of the fire pump, this means shall comply with the requirements of [8.8.3.3](#).

8.10.1DV D2 Modification of 8.10.1 by adding the following:

No other means of stopping the fire pump motor shall be provided except for those on the controller.

8.10.2 Method of starting

The power supplies for starting the engine shall be two separate battery units. The controller shall be arranged so that manual and automatic starting of the engine can be accomplished with either battery unit. The controller shall alternate between the first battery unit and the second battery unit during successive attempts to start the engine. The changeover shall be made automatically, except for manual start. The “starting sequence” shall be a series of six “on-load” to “off-load” cycles set for equal periods of 15 s duration. Other starting sequences can be accepted as alternatives and shall be subject to agreement between manufacturer and user (which may be an authority). If the starting sequence is expired, and if the controller does not receive a signal that the engine is running, then the controller shall stop all further starting and operate a visible indicator and audible alarm on the controller. If one battery unit is not operative or is missing, then the controller shall lock-in to the remaining battery unit during the starting sequence.

8.10.2DV DR Modification of 8.10.2 by adding the following:

8.10.2DV.1 The controller shall be in a fully functional state within 10 s upon application of dc power.

8.10.2DV.2 Terminal 1 (see [Table 25DV](#) and [Figure 9DV](#)) power shall be energized any time the engine is operating from manual or automatic from the controller.

8.10.2DV.3 Manual crank buttons shall only be operable in manual modes.

8.11 Methods of stopping diesel engine fire pump controllers

8.11.1 Manual stopping

Manual stopping shall be accomplished by either one of the following methods:

- a) operation of the main switch located inside the controller, or
- b) operation of a stop push button located on the outside of the controller enclosure.

Manual stopping shall cause the engine to shut down only when all starting causes have been returned to normal. The controller shall then return to the full automatic position.

NOTE 1 The 30 min minimum run time for diesel engines is to boil off any water in the oil pan, and to prevent build-ups of water in the exhaust system.

NOTE 2 See [8.6.8.2](#) for automatic shutdown time after automatic start of electric fire pump controllers.

8.11.1DV DR Modification of 8.11.1 by adding the following:

8.11.1DV.1 When the controller has a means for connection of a circuit for the remote starting of the fire pump, this means shall be such that the fire pump engine is not capable of being stopped from the remote station.

8.11.1DV.2 A controller intended for use with a sprinkler or standpipe system where an automatically controlled pumping unit constitutes the sole supply shall be arranged for manual shutdown in accordance with [8.6.8.2DV.1](#).

8.11.1DV.3 Manual stopping shall be accomplished by either of the following:

- a) operation of the main switch to the off position as located in [8.8.2.2](#); or
- b) operation of a stop button located on the outside of the controller enclosure.

8.11.2 Automatic shutdown after automatic start

When the controller is set for automatic engine stopping, the controller shall stop the engine only after all starting causes have returned to normal and a total of 30 min minimum run time has elapsed.

When the engine overspeed device operates, the controller shall remove power from the engine running devices, prevent cranking and energize the overspeed alarm until manually reset. Resetting of the overspeed circuit shall be required at the engine and by resetting the controller. The controller shall not be capable of being reset until the engine overspeed stopping device is manually reset.

The engine shall not stop automatically on high water temperature or low oil pressure when any starting cause exists. When no other starting cause exists during engine test, stopping shall be permitted.

8.11.2DV DR Modification of 8.11.2 by adding the following:

8.11.2DV.1 Means shall be provided to disable automatic stopping. A visible indicator shall be provided to indicate that automatic stopping is disabled or enabled.

8.11.2DV.2 The engine shall not shut down automatically on high engine temperature, low oil pressure, or high cooling water temperature when any automatic starting or running cause exists. If no other starting or running cause exists during engine test, the engine shall shut down automatically on high water temperature, or low oil pressure, or high cooling water temperature. If after shutdown a starting cause occurs, the controller shall restart the engine and override the high engine temperature, low oil pressure, or high cooling water temperature shutdowns for the remainder of the test period.

8.11.2DV.3 Automatic shutdown shall be permitted only during the conditions described in 12.7.5.2.1 of Annex [DVA](#), item 1.

8.12 Testing of diesel engine fire pump controllers

8.12.1 Manual testing of automatic operation

The controller shall be arranged to manually initiate automatic starting of the engine by opening the solenoid valve drain. In a non-pressure-actuated controller, the start shall be initiated by means other than a solenoid valve.

8.12.1DV D2 Modification of 8.12.1 by adding the following:

8.12.1DV.1 The fire pump controller shall monitor the pressure sensor and provide a signal in accordance with 12.7.2.1.3.2 of Annex [DVA](#), item 1.

8.12.1DV.2 During automatic testing, the fire pump controller shall activate a signal that complies with 12.7.2.1.3.1 of Annex [DVA](#), item 1.

8.12.1DV.3 The fire pump controller shall monitor for and provide a signal any time the transducer output is more or less than 10 percent of rated span or below its rated zero pressure output.

8.12.1DV.4 The controller equipment shall be capable of automatically starting, running, and shutting down the motor for a minimum of 30 min.

8.12.2 Periodic (e.g. weekly) program timer

The equipment in the controller shall be arranged so it is possible to automatically start and run the engine periodically (e.g. weekly) for a duration agreed by the manufacturer and the user, but not less than 30 min. Means shall be permitted within the controller to manually terminate the periodic (e.g. weekly) test with the provision that a minimum time of 30 min has expired. A solenoid valve drain on the pressure control line shall be the initiating means. In a non-pressure-actuated controller, the periodic (e.g. weekly) test may be initiated by means other than a solenoid valve.

8.12.2DV DR Modification of 8.12.2 by adding the following:

Means shall be permitted within the controller to manually terminate the weekly test, provided a minimum of 30 min has expired.

8.13 Additional functional and performance requirements for foam pump controllers

8.13.1 Automatic starting

Automatic starting shall be accomplished by the opening of a remote contact.

NOTE The pressure-actuated device described in [8.6.5.1](#) is not required.

8.13.1DV D2 Modification of 8.13.1 by adding the following:

In lieu of the pressure-activated switch described in [8.6.5.4DV.1.3](#), an additive pump controller shall be provided with means for automatic activation by either a remote normally open contact or a remote normally closed contact.

8.13.2 Method of stopping

Manual stopping shall be the only method of stopping.

8.13.3 Lockout feature

The controller shall contain a lockout feature that shall be indicated by a visible indicator and annunciation at a remote location.

8.13.3DV D2 Modification of 8.13.3 by adding the following:

8.13.3DV.1 An additive pump controller shall comply with the requirements in Clauses [1](#) – [9](#) and with the requirements specified in Clauses [8.13.3DV.2](#) – [8.13.3DV.3](#).

8.13.3DV.2 When the additive pump controller contains a lockout feature to stop the additive pump motor, the lockout shall be indicated by a visible indicator and shall be provided with means to annunciate the condition at a remote location.

8.13.3DV.3 The controller shall provide a timing means to actuate and then close the dump valve after engine start is finished. The timing means shall actuate upon crank disconnect.

8.13.3DV.4 When the pressure-activated switch described in [8.6.5.4DV.1.3](#) is provided, the controller shall comply with [8.6.5.4DV.1.8](#) and [8.6.5.4DV.1.9](#).

8.13.3DV.5 When a diesel driver is used in conjunction with a positive displacement pump having an electrically operated dump valve, the controller shall provide a means to activate and then close the dump valve after successful engine start has been attained.

8.13.3DV.6 The means shall consist of circuitry and terminals for connecting the dump valve solenoid coil.

8.13.3DV.7 The dump valve solenoid shall be energized by engine battery power.

8.13.3DV.8 The controller circuitry shall cause the dump valve to open to unload the pump, prior to or concurrent with the first engine cranking cycle.

8.13.3DV.9 When an electric motor driver is used in conjunction with a positive displacement pump having an electrically operated dump valve, the controller shall provide a means to activate and then close the dump valve after the motor has full voltage.

8.13.3DV.10 The means shall consist of circuitry and terminals for connecting the dump valve solenoid coil.

8.13.3DV.11 The controller shall provide suitable voltage for the dump valve solenoid. The voltage shall not exceed 240 V a.c.

8.13.3DV.12 The controller circuitry shall cause the dump valve to open to unload the pump, prior to or concurrent with motor power being applied.

8.13.3DV.13 The controller circuitry shall allow the motor to reach full speed and full power capability before closing the dump valve.

8.13.3DV.14 When a controller is arranged for automatic stopping as described in [8.6.8.2DV.2](#), the timer shall be set to less than 10 min but not less than 1 min for an additive pump controller.

8.13.3DV.15 Means shall be provided at the controller to ensure dump valve operation during manual start.

8.14 EMC requirements

8.14.1 General

Subclause 7.3.1 of IEC 60947-1 applies.

Fire pump controllers are complex devices which must be interconnected with other equipment such as motors, cables, etc. to form a system. Because the other equipment may not be under the control of the manufacturer of the fire pump controller, fire pump controllers shall be characterized as stand-alone devices by the tests described herein.

EMC requirements shall be verified by the tests of [9.4](#).

8.14.2 Immunity

Subclauses 7.3.2.1 and 7.3.2.2 of IEC 60947-1 apply with the following clarifications and modifications.

Power frequency magnetic field tests are not required because a fire pump controller is naturally submitted to such fields. Immunity is demonstrated by the successful completion of functional tests.

NOTE The careful application of decoupling practices during installation helps to minimize the external transient influences. For example, control circuit wiring should be separated from power circuit wiring. Where closely coupled wiring cannot be avoided, twisted pairs or shielded wiring should be used for control circuit connections.

The test results are specified using the performance criteria described in [Table 6](#).

8.14.3 Emission

Subclauses 7.3.3.1 and 7.3.3.2 of IEC 60947-1 apply with the following modifications regarding limits for low-frequency emission with reference to main power frequency.

Where fire pump controllers are rated greater than 16 A but less than 75 A and connected to the public low voltage distribution network, the requirements of IEC 61000-3-12 apply. However, where controllers operate continuously in the FULL-ON state after an initial starting ramp, as in semiconductor motor controllers and starters (i. e. any power semiconductors in the main power circuits are conducting for complete cycles or half-cycles of the power wave or are bypassed after ramping), no low-frequency emission testing is required.

9 Tests

9.1 Kinds of test

9.1.1 Type tests

Type tests are intended to verify compliance of the design of fire pump controllers with the requirements of Clause 8. The type tests comprise the verification of:

- a) the temperature rise;
- b) dielectric properties;
- c) functional and performance requirements;
- d) performance under normal load and overload conditions;
- e) operating limits;
- f) performance under short-circuit conditions;
- g) degree of protection of enclosure;
- h) capability of battery chargers (diesel engine fire pump controllers only);
- i) EMC.

9.1.1DV D2 Modification of 9.1.1 to add the following items after item (i):

jDV) Wire flex test

Controllers in North America shall comply with the test contained in [DVE.2](#).

kDV) Phase loss detection test

Controllers in North America shall comply with the test contained in [DVE.3](#).

lDV) Pressure switch transducer tests

Controllers in North America shall comply with the test contained in [DVE.4](#).

Type tests shall be carried out on a sample of a fire pump controller or on such parts of fire pump controllers manufactured to the same or a similar design of a fire pump controller, containing both type-tested and non-type-tested arrangements, provided that the latter are derived from type-tested arrangements which have complied with the relevant tests in accordance with the relevant IEC standard.

9.1.2 Routine tests

Routine tests for fire pump controllers include the verification of:

- a) operating limits,

b) dielectric properties.

9.2 Compliance with construction requirements

Subclause 8.2 of IEC 60947-1 and Clause 8 of IEC 60439-1 apply.

9.3 Compliance with performance requirements

9.3.1 Test sequences

Each test sequence is performed on a new sample. More than one test sequence may be conducted on one sample at the discretion of the manufacturer. The tests shall be conducted in the order given for each sample.

The test sequences shall be as follows.

a) Test sequence I

- verification of temperature rise;
- verification of dielectric properties;
- verification of functional and performance requirement;
- verification of performance under normal load and overload conditions;
- verification of operating limits;
- verification of performance of the electromagnetic contactor.

b) Test sequence II

Verification of performance under short-circuit conditions.

c) Test sequence III

Verification of degree of protection of enclosure (Annex C of IEC 60947-1).

d) Test sequence IV

Verification of capability of battery chargers (for diesel engine fire pump controllers only).

e) Test sequence V

Verification of EMC.

9.3.2 General test conditions

Subclause 8.3.2 of IEC 60947-1 applies.

9.3.3 Performance under no load, normal load, and overload conditions

9.3.3.1 Temperature rise

9.3.3.1.1 General

Subclause 8.2.1 of IEC 60439-1 applies.

9.3.3.1.2 Ambient air temperature

Subclause 8.3.3.3.1 of IEC 60947-1 applies.

9.3.3.1.3 Measurement of the temperature of parts

Subclause 8.3.3.3.2 of IEC 60947-1 applies.

9.3.3.1.4 Temperature rise of a part

Subclause 8.3.3.3.3 of IEC 60947-1 applies.

9.3.3.1.5 Temperature rise of the main circuit

Subclause 8.3.3.3.4 of IEC 60947-1 applies, with the following additions:

- a) the main circuit shall be loaded with 115 % rated operational current as stated in [8.4.3](#);
- b) if suitable for two sources, one heat test with primary power circuit and one heat test with alternative source circuit shall be carried out.

9.3.3.1.6 Temperature rise of the control circuits

Subclause 8.3.3.3.5 of IEC 60947-1 applies, with the following addition.

The temperature rise shall be measured during the test according to 8.3.3.3.4 of IEC 60947-1.

9.3.3.1.6DV D2 Modification of 9.3.3.1.6 by adding the following:

9.3.3.1.6DV.1 As tested under the conditions described in [9.3.3.1.6DV.2](#) – [9.3.3.1.6DV.30](#), fire pump controllers and associated equipment shall:

- a) not attain a temperature at any point so high as to constitute a risk of fire or fire hazard or adversely affect any materials employed in the equipment;
- b) not exceed the temperature limit for any individual component within the equipment; and
- c) not exceed the temperature rise above the test ambient at specific points greater than those specified in [Table 21DV](#) and [Table 23DV](#).

9.3.3.1.6DV.2 To determine whether a fire pump controller complies with the temperature test requirements, it shall be tested as specified in [9.3.3.1.6DV.3](#) – [9.3.3.1.6DV.37](#).

9.3.3.1.6DV.3 Fire pump controllers shall be operated under normal conditions as described in the manufacturer's installation instructions.

9.3.3.1.6DV.4 Equipment shall carry its rated current continuously.

9.3.3.1.6DV.5 The test current for a horsepower rated device shall be as specified in [Table 8DV](#) and [Table 9DV](#).

9.3.3.1.6DV.6 An auxiliary device for controlling a contactor, a relay, or another magnetically operated device shall carry a test current that corresponds to the maximum break current consistent with the switch rating.

9.3.3.1.6DV.7 The test conditions shall be established so that each current-carrying component carries the maximum rated current of the controller. Three-phase controllers shall be tested on a three-phase current source.

9.3.3.1.6DV.8 A low-voltage source of supply may be used for temperature tests on parts other than voltage rated coils.

9.3.3.1.6DV.9 The temperature test shall be conducted with the fire pump controller mounted as intended in use.

9.3.3.1.6DV.10 The fire pump controller, or associated equipment, shall be tested in the enclosure provided by the manufacturer.

9.3.3.1.6DV.11 External field connections to the fire pump controller shall be made by one of the methods described in [9.3.3.1.6DV.12](#) – [9.3.3.1.6DV.16](#).

9.3.3.1.6DV.12 Fire pump controllers shall be tested with 1.2 m (4 ft) of copper wire attached to each field-wiring terminal.

9.3.3.1.6DV.13 The wire shall be of the smallest size having an ampacity of at least 125 percent of the maximum full-load motor-current in accordance with [9.3.3.1.6DV.5](#).

9.3.3.1.6DV.14 The wire size shall in accordance with [Table 11DV](#) based on the wire temperature rating marked on the equipment.

9.3.3.1.6DV.15 If the equipment is marked to limit the size of the wire, the maximum allowable wire size shall be used.

9.3.3.1.6DV.16 When there is only provision for the connection of bus bars to equipment rated at 450 A or more, 6.4 mm (1/4 inch) thick copper bus bars of the width specified in [Table 24DV](#) and at least 1.2 m (4 ft) in length shall be used.

9.3.3.1.6DV.17 The temperature test shall be conducted with plated bus bars. Black-painted bus bars shall not be used.

9.3.3.1.6DV.18 The spacing between multiple bus bars shall be 6.4 mm (1/4 inch) with no intentional wider spacing except as necessary at the individual terminals of the equipment.

9.3.3.1.6DV.19 The temperature test shall be conducted with the equipment placed in one of the following locations. The ambient temperature for the temperature test shall be based on one of the following: