phase to earth may be lower than the STRAIGHT VOLTAGE RATING if the earth connection of the PDS/CDM/BDM, and the wire mesh cage (if used), are connected to the supply circuit pole least at risk of arcing to ground.

b) For BDCM/CDM/PDS intended for connection only to systems according to 4.3.6.1.4DV.3, the source shall have a measured r.m.s. working voltage from phase to earth equal to or greater than the rated phase to earth voltage. If the source is a three phase, four wire, center earthed system (TN), the test circuit shall also be able to deliver not less than 90% of the rated high fault current into a single-phase short circuit between each phase and "S". The single-phase power factor shall comply with 5.2.3.6.2.1DV.3.

5.2.3.6.2DV.3 D2 *Modification to add the following:*

5.2.3.6.2DV.3.1 Mounting

5.2.3.6.2DV.3.1.1 Each drive shall be mounted as described in the manufacturer's INSTALLATION instructions.

5.2.3.6.2DV.4 D2 *Modification to add the following:*

5.2.3.6.2DV.4.1 Branch circuit short circuit protection

5.2.3.6.2DV.4.1.1 Drives shall always be tested with fuses, circuit breakers, and Type E combination motor controllers unless the drive is marked to identify that branch circuit short circuit protection shall be provided in compliance with one of the following:

a) Branch circuit short circuit protection shall be provided by fuses only (either semiconductor or non-semiconductor types), then testing with circuit breakers and Type E combination motor controllers is not required.

b) Branch circuit short circuit protection shall be provided by fuses (either semiconductor or non-semiconductor types) or circuit breakers only, then testing with Type E combination motor controllers is not required.

c) Branch circuit short circuit protection shall be provided by fuses (either semiconductor or non-semiconductor types) or Type E combination motor controllers only, then testing with circuit breakers is not required.

d) Branch circuit short circuit protection shall be provided by circuit breakers only, then testing with fuses and Type E combination motor controllers is not required.

5.2.3.6.2DV.4.1.2 The overcurrent protective device used for this test shall be suitable for branch circuit protection in accordance with the National Electrical Code, NFPA 70 (fuses shall comply with the series of UL 248 standards, circuit breakers shall comply with the Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, UL 489, and Type E combination motor controllers shall comply with the Standard for Industrial Control Equipment, UL 508) and shall be in accordance with the marking of the drive specified in 6.3.7DV.1. When the drive is marked with a high fault current rating, the overcurrent protective device shall also comply with 5.2.3.6.2.1DV.5.5 through 5.2.3.6.2.1DV.5.7.

5.2.3.6.2DV.4.1.3 Testing with non-semiconductor types fuses shall not be used in lieu of testing with circuit breakers (either inverse-time or instantaneous trip types) or Type E combination motor controllers unless it can be shown that the let-through energy (I^2t) and peak let-through current (I_p) of the required inverse-time current-limiting circuit breaker and Type E combination motor controller will be less than that of the non-semiconductor type fuses with which the drive has been tested; or if the equipment under test is provided with solid-state short circuit protection circuitry per 5.2.3.6.1DV and it can be shown by test that this circuitry operates prior to the branch circuit protection operating.

5.2.3.6.2DV.4.1.4 Testing with semiconductor type fuses shall not be used in lieu of testing with circuit breakers (either inverse-time or instantaneous trip types) or Type E combination motor controllers.

5.2.3.6.2DV.4.1.5 Even though the operation of SOLID STATE SHORT CIRCUIT PROTECTION circuitry may serve as the ultimate result to discontinue the short circuit test (see 5.2.3.6.5), the presence of this circuitry shall not replace the requirement for the fuses, breakers or Type E combination motor controllers.

5.2.3.6.2DV.4.1.6 Non-semiconductor fuse types are able to be rated any Class that is evaluated for branch circuit protection and shall have a voltage rating at least equal to the input voltage rating of the drive. These fuses shall have a current rating that is one of the following standard values – 1, 3, 6, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110, 125, 150, 175, 200, 225, 250, 300, 350, 400, 450, 500, 600, 601, 700, 800, 1 000, 1 200, 1 600, 2 000, 2 500, 3 000, 4 000, 5 000 or 6 000 A – and shall comply with one of the following:

a) For drives with rated full-load output motor currents of 600 A or less, the current rating of the fuses shall be four times the maximum full-load motor output current rating;

b) For drives with rated full-load motor output currents of more than 600 A, the current rating of the fuses shall be three times the maximum full-load motor output current rating;

c) For a drive of any full-load motor output current rating, the current rating of the fuse is able to be less than that specified in (a) or (b) above when the drive is marked in accordance with 6.3.7DV.1.

When the calculated value of the fuse is between two standard ratings, the nearest standard rating less than the calculated value shall apply.

5.2.3.6.2DV.4.1.7 Semiconductor fuse types shall have a voltage rating at least equal to the input voltage rating of the drive and are able to have any current rating. Drives using semiconductor fuse types shall be marked in accordance with 6.3.7DV.1.

5.2.3.6.2DV.4.1.8 Inverse-time circuit breakers shall have a voltage rating at least equal to the voltage rating of the drive. These breakers shall have a current rating that is one of the following standard values – 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110, 125, 150, 175, 200, 225, 250, 300, 350, 400, 450, 500, 600, 700, 800, 1 000, 1 200, 1 600, 2 000, 2 500, 3 000, 4 000, 5 000 or 6 000 A – and that complies with one of the following:

a) For drives with rated full-load motor output currents of 100 A or less, the current rating of the breaker shall be four times the maximum full-load motor output current rating; or

b) For drives with rated full-load motor output currents of more than 100 A, the current rating of the breaker shall be three times the maximum full-load motor output current rating; or

c) For drives of any full-load motor output current rating, the current rating of the breaker is not prohibited from being less than that specified in (a) or (b) above when the drive is marked in accordance with 6.3.7DV.1.

When the calculated value of the circuit breaker is between two standard ratings, the nearest standard rating less than the calculated value shall apply. When the calculated value of the breaker is less than 15 A, a breaker rated 15 A shall be used.

5.2.3.6.2DV.4.1.9 Instantaneous trip type circuit breakers shall have a voltage rating at least equal to the input voltage rating of the drive, and are able to have any current rating, when the drive is marked in accordance with 6.3.7DV.1.

5.2.3.6.2DV.4.1.10 A drive utilizing non-semiconductor type fuses or inverse-time type circuit breakers sized, in accordance with 5.2.3.6.2DV.4.1.6 (a), 5.2.3.6.2DV.4.1.6 (b), 5.2.3.6.2DV.4.1.8 (a), or 5.2.3.6.2DV.4.1.8 (b) require no marking to indicate the manufacturer, model number or rating of the fuse or breaker.

5.2.3.6.2DV.4.1.11 Type E combination motor controllers are rated in volts and horsepower. To determine the current rating of the Type E combination motor controller, refer to Table DVE.1 and read the full load current rating at the intersection of the appropriate voltage and phase columns and the applicable horsepower row. If the overload setting of the Type E combination motor controller is adjustable, the full load current rating of the Type E combination motor controller is defined as the maximum current setting to which the controller may be adjusted.

5.2.3.6.2DV.4.1.12 The full load current rating of the Type E combination motor controller shall not be less than the rated input current of the drive controller.

5.2.3.6.2DV.4.1.13 When conducting the short circuit tests with a Type E combination motor controller, the tests are to be conducted with the controller at its maximum settings.

5.2.3.6.2DV.4.1.14 The short circuit interrupting rating of the fuse, the inverse-time circuit breaker or the Type E combination motor controller shall not be less than the short circuit rating of the drive controller.

5.2.3.6.2DV.4.1.15 It is not required to monitor the voltages of accessible SELV and PELV CIRCUITS if the PDS complies with the ac or dc voltage requirements in accordance with 5.2.3.2 at the conclusion of the test.

5.2.3.6.2DV.5 D2 *Modification to add the following:*

5.2.3.6.2DV.5.1 Input/output wiring connection

5.2.3.6.2DV.5.1.1 Each drive is to be tested with 4 ft (1,2 m) of wire, or less, attached to each input and output terminal. The input/output test wiring is not prohibited from exceeding 4 ft (1,2 m) in length when the wiring is in the test circuit during its calibration.

5.2.3.6.2DV.5.1.2 The wire size of the input and output wiring shall be in accordance with Table 4.3.8.8.2DV.1 with the required ampacity of the wiring being based on the marked wire temperature rating (either 60°C or 75°C) and each of the following:

a) The main input power wiring shall be sized for 125 percent of the rated full-load output motor current;

b) All other input wiring shall be sized for 100 percent of the maximum intended full-load current;

c) The main output power wiring shall be sized for 125 percent of the rated full-load current or shall be sized for 125 percent of the full-load output motor current specified in Table DVE.1 or Table DVE.2, based on the rated horsepower rating; and

d) All other output wiring shall be sized for 100 percent of the maximum intended full-load current.

5.2.3.6.2DV.5.1.3 The type of wire insulation shall be T or TW for 60°C wiring and shall be THW or THWN for 75°C wiring.

5.2.3.6.2DV.5.1.4 For drives rated more than 200 hp (150 kW), the main input/output power connections shall be in accordance with 5.2.3.6.2DV.5.1.1 – 5.2.3.6.2DV.5.1.3, or may be made with bus bars equivalent in cross-sectional area to the required wiring. The bus bars are to be in the test circuit during its calibration.

5.2.3.6.2DV.5.1.5 Input and output wiring may then be routed through 10 – 12 in (250 – 305 mm) lengths of conduit installed on the enclosure. If conduit is not used then the wire shall be routed through a bushing appropriate for the size of the conductors.

5.2.3.6.2DV.5.1.6 The ends of the conduit, the bushing opening, or the openings around the bus bars are to be plugged with surgical cotton.

5.2.3.6.2.1 Supply voltage and current

PDS rated for d.c. input shall be tested using a d.c. source. PDS rated for a.c input shall be tested at their rated input frequency.

The open-circuit voltage of the supply shall be 100 % – 105 % of the rated input voltage. The open-circuit voltage may exceed 105 % of the rated input voltage at the request of the manufacturer.

For the Short-circuit test, the supply shall be capable of delivering the specified PROSPECTIVE SHORT-CIRCUIT CURRENT (see 4.3.9) at the connection to the PDS, unless circuit analysis demonstrates that a lesser value may be used.

For the Breakdown of components test, the supply shall be capable of delivering a PROSPECTIVE SHORT-CIRCUIT CURRENT of between 1 kA and 5 kA, unless the analysis of 4.2 shows that a different value is required.

5.2.3.6.2.1DV.1 D2 *Modification to add the following – Test circuit voltage:*

5.2.3.6.2.1DV.1.1 Drives rated for alternating current within the range of 50-60 Hz are to be tested using a sinusoidal current source at a frequency in the range of 48-62 Hz.

5.2.3.6.2.1DV.2 D2 *Modification to add the following – PROSPECTIVE SHORT-CIRCUIT CURRENT:*

5.2.3.6.2.1DV.2.1 The Breakdown of Components and Short-circuit tests shall be conducted at the Standard Fault Current test values in accordance with Table 5.2.3.6.2.1DV.1. When assigned a short-circuit rating higher than the Standard fault current test value, the drive must also comply with 5.2.3.6.2.1DV.2.2 and 5.2.3.6.2.1DV.2.4. The circuit capability for all of the tests shall be verified in accordance with the Calibration of Short Circuit Test Circuit, 5.2.3.6.2.1DV.3.

Table 5.2.3.6.2.1DV.1
Standard fault current test values for devices rated 600 V or less

Ratings		Test current
hp[a]	(kW)[a]	A
0 – 50	(0 – 37,3)	5 000
51 – 200	(39 – 149)	10 000
201 – 400	(150 – 298)	18 000
401 – 600	(299 – 447)	30 000
601 – 900	(448 – 671)	42 000
901 – 1 600	(672 – 1 193)	85 000
1 601 or more	(1 194 or more)	100 000

[a] For drives rated only in current and not in horsepower or kilowatts, the equivalent horsepower rating shall be determined from Table DVE.1 or Table DVE.2 as appropriate.

5.2.3.6.2.1DV.2.2 Other than as noted in 5.2.3.6.2.1DV.2.3, a drive series with an assigned short circuit rating higher than the standard fault current test value shown in Table 5.2.3.6.2.1DV.1 shall comply with the short-circuit test requirements of this clause for the Standard Fault Currents and the Short Circuit Test – High Fault Currents, 5.2.3.6.2.1DV.5.

5.2.3.6.2.1DV.2.3 A drive series is in compliance with the Short Circuit Test – High Fault Currents, 5.2.3.6.2.1DV.5, without additional testing when:

a) The drive series uses SOLID STATE SHORT CIRCUIT PROTECTION circuitry for compliance with the standard fault current short circuit test; and

b) The SOLID STATE SHORT CIRCUIT PROTECTION circuitry is used in accordance with 5.2.3.6.1DV.

5.2.3.6.2.1DV.2.4 A drive series with an assigned short circuit rating higher than the standard fault current test value shown in Table 5.2.3.6.2.1DV.1 shall comply with the breakdown of components test requirements of this clause at the Standard Fault Current and the Breakdown of Components Test – High Fault Currents, 5.2.3.6.2.1DV.5.

5.2.3.6.2.1DV.2.5 Where circuit analysis demonstrates that the available short-circuit energy (based on the marked short-circuit rating) has no greater impact on the results of the breakdown of components testing than a lower available short-circuit energy, the breakdown of components test may be conducted at the lower energy level. The circuit analysis shall consider:

- **Bursting I^2t of conductors and components;**
- **Identification of fault current path in the equipment;**

• Possibility and extent of cascading failures;

• Nature of failure with respect to physical location (e.g. proximity to other critical components, barriers, clearances, creepage distances, vent openings);

• Identification of all energy sources (mains, capacitors, batteries, motor, etc.) in the circuit;

• For main supply, consider power circuit configuration and grounding (wye, delta, IT, etc.);

• Enclosure (size, material, structure, openings, etc.);

• Types and ratings of OCPD specified to be used with the PDS/CDM/BDM;

• Specified linearity of current limiting components (external & internal) with respect to available fault current;

• Effect of multiple ratings of the PDS (relationship of power rating and voltage);

• Variation in components within family of drives;

• Maximum variation of mains impedance, frequency, voltage with respect to specified/published product applications (use of transformer, etc.);

• Testing may be necessary to validate portions of the circuit analysis.

5.2.3.6.2.1DV.2.6 BDM/CDM/PDS supplied by photovoltaic (PV) modules

5.2.3.6.2.1DV.2.6.1 A BDM/CDM/PDS which receives power from PV modules or panels shall be tested by connecting the equipment to a power source that is representative of a PV power system with regard to maximum power voltage and current levels.

5.2.3.6.2.1DV.2.6.2 Tests involving an input for connection to a PV source shall use a source which complies with one of the following:

a) When the BDM/CDM/PDS requires the use of a source having specific V/I characteristics (such as PV modules provided with integrated electronics), the test shall be conducted with the source intended for use with the input, or with a source with V/I characteristics as close as practicable to the intended source.

b) If the BDM/CDM/PDS is required to be used with PV modules which are provided with the product, or is marked only for use with specific models of PV modules where the V/I characteristic curves are known, the test source shall be a PV simulator which can provide:

1) A minimum open circuit voltage greater than or equal to the PV module rated operating voltage multiplied by 1.5.

2) A minimum available short circuit current greater than or equal to the PV module nameplate short circuit current (Isc) multiplied by 1.5.

c) If the BDM/CDM/PDS is rated for general use with PV modules which comply with NEC cl. 690.8 and 690.9, the test source shall be a PV input source (PV array or PV simulator) which can provide:

1) A minimum open circuit voltage greater than or equal to the products' rated input operating voltage multiplied by 1.25.

2) A minimum available short circuit current greater than or equal to the products' rated input short circuit current multiplied by 1.25.

5.2.3.6.2.1DV.2.6.3 If an input is rated for use with multiple source types, the source with the most severe characteristic shall be used to characterize the test source.

5.2.3.6.2.1DV.2.6.4 During testing using a PV simulator, V_{oc}, I_{sc}, and the other controllable quantities such as Irradiance, Vmp, Imp and FF (fill factor) shall be set at levels which cause the product to operate at a V/I input level which provides the required voltage and current for the test being conducted, however V_{oc} and I_{sc} shall be set no higher than the products' maximum rated open circuit voltage and short circuit respectively.

5.2.3.6.2.1DV.2.6.5 During the temperature rise test, the PV source shall be set to operate at the operating point which creates the highest PV output voltage and the operating point which creates the highest DC current prior to a protective device or circuit operating. The recorded temperatures shall be the highest of those between the highest voltage and highest current operating points.

5.2.3.6.2.1DV.2.6.6 If the equipment is designed to utilize multiple types of sources which can be connected simultaneously, then all sources which may be connected simultaneously shall be utilized during the test, and a test source shall be provided in accordance with the above description if a PV type, or with 5.2.3.6.2.1DV.2.1 or 5.2.3.6.2.1DV.2.2 as appropriate.

5.2.3.6.2.1DV.2.6.7 The circuit capability for all of the tests shall be verified in accordance with the Calibration of Short Circuit Test Circuit, 5.2.3.6.2.1DV.3. The equipment shall be marked in accordance with 6.3.6.8DV.2.

5.2.3.6.2.1DV.3 D2 *Modification to add the following – Calibration of short circuit test circuits 10 000 A or less:*

5.2.3.6.2.1DV.3.1 For an AC circuit intended to deliver 10 000 A or less, the current is to be determined in accordance with one of the following:

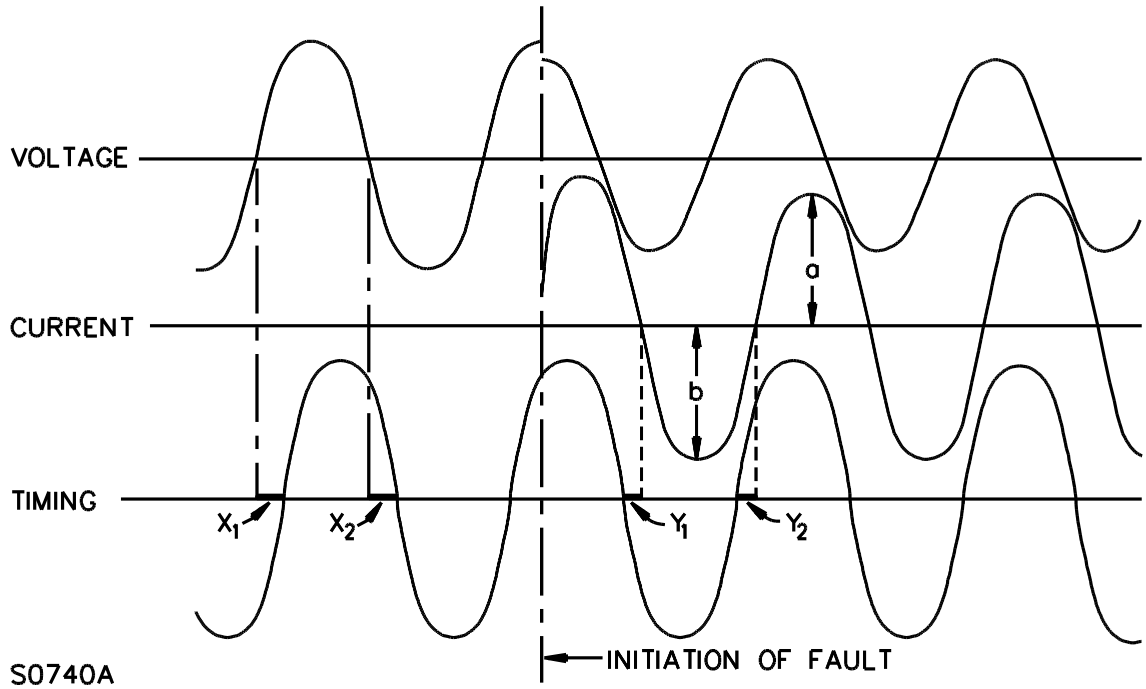
a) For a 3-phase test circuit, the current is to be determined by averaging the rms values of the first complete cycle of current in each of the three phases;

b) For a single phase test circuit, the current is to be the rms value of the first complete cycle (see Figure 5.2.3.6.2.1DV.1) when the circuit is closed to produce symmetrical current waveform. The direct current component is not to be added to the value obtained when measured as illustrated. In order to obtain the required symmetrical waveform of a single phase circuit, controlled closing is most often used although random closing methods are not prohibited from being used; or

c) For a single or 3 phase test circuit, an analytical evaluation that suitably demonstrates the available current is able to be used.

Figure 5.2.3.6.2.1DV.1

Determination of current for circuits of 10 000 A and less



Current = [(a+b)/2] (rms calibration of instrument element)

5.2.3.6.2.1DV.4 D2 *Modification to add the following – Calibration of short circuit test circuits more than 10 000 A:*

5.2.3.6.2.1DV.4.1 For an AC circuit intended to deliver more than 10 000 A, the current is to be determined in accordance with one of the following:

a) In accordance with the requirements in 5.2.3.6.2.1DV.4.2 – 5.2.3.6.2.1DV.4.6. Instrumentation used to measure these test circuits of more than 10 000 A is to comply with the requirements in 5.2.3.6.2.1DV.4.7 – 5.2.3.6.2.1DV.4.17; or

b) For a single or 3 phase test circuit, an analytical evaluation that suitably demonstrates the available current is able to be used.

5.2.3.6.2.1DV.4.2 The rms symmetrical current is to be determined, with the supply terminals short-circuited by measuring the alternating-current component of the wave at an instant 1/2 cycle – on the basis of the test frequency timing wave – after the initiation of the short circuit. The current is to be calculated in accordance with Figure 7 in the Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis, ANSI/IEEE C37.09-1989.

5.2.3.6.2.1DV.4.3 For a 3-phase test circuit, the rms symmetrical current is to be the average of the currents in the three phases. The rms symmetrical current in any one phase is not to be less than 90 percent of the required test current.

5.2.3.6.2.1DV.4.4 The test circuit and its transients are to be such that:

a) 3 cycles after initiation of the short circuit, the symmetrical alternating component of current is not less than 90 percent of the symmetrical alternating component of current at the end of the first 1/2 cycle; or

b) The symmetrical alternating component of current at the time at which the overcurrent protective device interrupts the test circuit is at least 100 percent of the rating for which the controller is being tested. In 3-phase circuits, the symmetrical alternating component of current of all three phases is to be averaged.

5.2.3.6.2.1DV.4.5 The recovery voltage is to be at least equal to the rated voltage of the controller. The peak value of the recovery voltage within the first complete half cycle after clearing and for the next five successive peaks is to be at least equal to 1,414 times the rms value of the rated voltage of the controller. Each of the peaks is not to be displaced by more than ±10 electrical degrees from the peak values of the open-circuit recovery voltage – that is, the displacement of the peak from its normal position on a sinusoidal wave. The average of the instantaneous values of recovery voltage each of the first six, half cycles measured at the 45 degree and 135 degree points on the wave is to be not less than 85 percent of the rms value of the rated voltage of the controller. The instantaneous value of recovery voltage measured at the 45 degree and 135 degree points of each of the first six, half cycles is in no case to be less than 75 percent of the rms value of the rated voltage of the controller.

5.2.3.6.2.1DV.4.6 When there is no attenuation or phase displacement of the first full cycle of the recovery voltage wave when compared with the open-circuit secondary voltage wave before current flow in a circuit that employs secondary closing, the detailed measurement of recovery voltage characteristics as indicated in 5.2.3.6.2.1DV.4.5 is not required.

5.2.3.6.2.1DV.4.7 The galvanometers in a magnetic oscillograph employed for recording voltage and current during circuit calibration and while testing are to be of a type having a flat (±5 percent) frequency response from 50 – 1 200 Hz. For fast acting fuses, current limiters, or motor-short-circuit protectors, a galvanometer is often required to have a flat frequency response from 50 – 9 000 Hz or an oscilloscope is required to be used to obtain accurate values of peak current, (I_p), and energy let-through, (I^2t).

5.2.3.6.2.1DV.4.8 Galvanometers are to be calibrated as described in 5.2.3.6.2.1DV.4.9 – 5.2.3.6.2.1DV.4.12.

5.2.3.6.2.1DV.4.9 When a shunt is used to determine the circuit characteristics, a direct-current calibrating voltage is normally used. The voltage applied to the oscillograph galvanometer circuit is to result in a deflection of the galvanometer equivalent to that which is expected when the same galvanometer circuit is connected to the shunt and the nominal short-circuit current is flowing. The voltage is to be applied so as to result in the galvanometer deflecting in both directions. Additional calibrations are to be made using 50 percent and 150 percent of the voltage used to obtain the deflection indicated above, except that when the anticipated maximum deflection is less than 150 percent, such as a symmetrically closed single-phase circuit, any other usable calibration point is to be chosen. The sensitivity of the galvanometer circuit in volts per inch (or millimeter) is to be determined from the deflection measured in each case, and the results of the six trials averaged. The peak amperes per inch (or millimeter) is obtained by dividing the sensitivity by the resistance of the shunt. This multiplying factor is to be used for the determination of the rms current as described in 5.2.3.6.2.1DV.4.2.

5.2.3.6.2.1DV.4.10 A 60 Hz sine-wave potential is able to be used for calibrating the galvanometer circuit, using the same general method described in 5.2.3.6.2.1DV.4.9. The resulting factor is to be multiplied by 1,414.

5.2.3.6.2.1DV.4.11 When a current transformer is used to determine the circuit characteristics, an alternating current is to be used to calibrate the galvanometer circuit. The value of current applied to the galvanometer circuit is to result in a deflection of the galvanometer equivalent to that which is expected when the same galvanometer is connected to the secondary of the current transformer and nominal short circuit current is flowing in the primary. Additional calibrations are to be made at 50 percent and 150 percent of the current used to obtain the deflection indicated above except that when the anticipated maximum deflection is less than 150 percent, such as in a symmetrically closed single-phase circuit, any other usable calibration point is to be chosen. The sensitivity of the galvanometer circuit in rms amperes per inch (or millimeter) is to be determined in each case and the results averaged. The average sensitivity is to be multiplied by the current-transformer ratio and by 1,414 to obtain peak amperes per inch. This constant is to be used for the determination of the rms current as described in 5.2.3.6.2.1DV.4.2.

5.2.3.6.2.1DV.4.12 All the galvanometer elements employed are to line-up properly in the oscillograph, or the displacement differences are to be noted and used as required.

5.2.3.6.2.1DV.4.13 The sensitivity of the galvanometers and the recording speed are to be such that the values of voltage, current, and power factor are accurately determined. The recording speed is to be at least 60 in (1,5 m) per second.

5.2.3.6.2.1DV.4.14 With the test circuit adjusted to provide the specified values of voltage and current and with a noninductive (coaxial) shunt that has been found to provide the intended function for use as a reference connected into the circuit, the tests described in 5.2.3.6.2.1DV.4.15 and 5.2.3.6.2.1DV.4.16 are to be conducted to verify the accuracy of the manufacturer's instrumentation.

5.2.3.6.2.1DV.4.15 With the secondary open-circuited, the transformer is to be energized and the voltage at the test terminals observed to see when rectification is occurring making the circuit unusable for test purposes because the voltage and current are not sinusoidal. Six random closings are to be made to demonstrate that residual flux in the transformer core does not result in rectification. When testing is done by closing the secondary circuit, this check is able to be omitted when testing is not commenced before the transformer has been energized for 2 s, or longer and when an investigation of the test equipment shows that a longer time is required.

5.2.3.6.2.1DV.4.16 With the test terminals connected together by means of a copper bar, a single-phase circuit is to be closed as nearly as possible at the moment that produces a current wave with maximum offset. The short circuit current and voltage are to be recorded. The primary voltage is to be recorded when primary closing is used. The current measured by the reference shunt is to be within 5 percent of that measured using the manufacturer's instrumentation and there is to be no measurable variation in phase relationship between the traces of the same current. Controlled closing is not required for polyphase circuits.

5.2.3.6.2.1DV.4.17 When the verification of the accuracy of the manufacturer's instrumentation is completed, the reference coaxial shunt is to be removed from the circuit. The reference coaxial shunt is not to be used during the final calibration of the test circuit nor during the testing of controllers.

5.2.3.6.2.1DV.5 D2 ***Modification to add the following – Short circuit test and breakdown of components test – high fault currents***

5.2.3.6.2.1DV.5.1 When any models within a drive series are intended to be rated with high fault current values in excess of the standard current values required by Table 5.2.3.6.2.1DV.1, then they shall comply with both a) and b) below, or shall comply with 5.2.3.6.2.1DV.5.2 through 5.2.3.6.2.1DV.5.10.

a) The drive series uses SOLID STATE SHORT CIRCUIT PROTECTION circuitry for compliance with the Short Circuit Test, 5.2.3.6.3; and

b) The SOLID STATE SHORT CIRCUIT PROTECTION circuitry is used in accordance with 5.2.3.6.1DV.2.

5.2.3.6.2.1DV.5.2 One representative model from those intended to be rated with high fault current values shall be used for testing. This representative model shall be subjected to only one high fault current short circuit test.

5.2.3.6.2.1DV.5.3 The criteria for samples to test for a drive series that uses fuses for compliance with this test is based on comparing the fuse ratings to the Silicon Controlled Rectifier (SCR) or transistor output device ratings for each model within the series (specific ratings to evaluate are the I^2t and I_p values).

5.2.3.6.2.1DV.5.4 The high fault current values for which a drive is able to be tested are not required to be one of the same values detailed in Table 5.2.3.6.2.1DV.1.

5.2.3.6.2.1DV.5.5 The requirements for conducting the high fault current short circuit test shall be in accordance with 5.2.3.6.2 except for the following differences:

a) For drives rated over 10 000 A, the branch circuit short circuit protection fuses shall be limited to high-interrupting capacity, current limiting types such as Class CC, CF, G, J, L, R, T, etc.

b) For drives rated 50 hp (37 kW) or less and tested at 10 000 A, the branch circuit short circuit protection fuses are able to be Class H or K.

c) A drive that is intended to be used with Class RK1 or RK5 fuses shall be tested with fuses having I^2t and I_p characteristics for Class RK5 fuses. All references to Class R fuses are intended to mean fuses with energy let-through (I^2t) characteristics of Class RK5 fuses.

d) For noncombination controllers, the circuit breaker to be used is to be from commercially available units of the molded-case type having the same characteristics with respect to opening time and without current-limiting features.

e) For circuit breakers with current limiters provided as part of the controller, the current limiter shall have a peak let-through current and a clearing I^2t not less than the maximum value established for the current limiter intended to be used with the controller being tested, when tested on a single-phase circuit.

f) A Class CC, CF, G, J, L, R, or T fuse, or motor short-circuit protector shall have a peak let-through current and clearing I^2t not less than the maximum value established for the fuse (see the UL 248 series of standards for fuses), or motor short-circuit protector rating that is intended to be used with the controller being tested, when tested on a single-phase circuit. For a fuse with I_p and I^2t limits established for several different short-circuit current levels, the test fuse is to have