White Paper

UL 1008

Withstand and Closing Rating Requirements

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It’s time for engineers, contractors and facility managers.

UL 1008 - Standard for Transfer Switch Equipment specifies qualification testing requirements for transfer switch equipment. The 7th Edition, effective November 1, 2014, specified revised requirements for evaluating the short-circuit ratings that must be shown on transfer switch products. These requirements remain in effect in the current 8th edition of the standard.

UL 1008 was first issued by UL in 1972 to help ensure the safety of personnel who install, operate and maintain transfer switch equipment. This standard was approved as an American National Standard in 1976 and adopted by the Department of Defense in 1983.

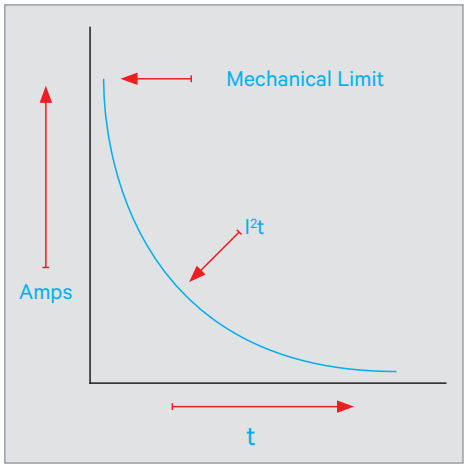
Short-circuit events in electrical equipment can have catastrophic consequences for operations and maintenance personnel and for other equipment. As a result, UL issued revisions to the standard to ensure transfer switches are adequately tested to safely withstand and close on the short-circuit ratings shown on their labels.

Optional “Any” Breaker WCR

The Fourth Edition which became effective in 1989 added an optional withstand and closing rating (WCR) which allows the transfer switch to be used with any manufacturer’s circuit breaker within its rating. As the description of this rating implies, it was called the “Any” circuit breaker rating on the WCR label. The test time durations for both the withstand and closing tests are 1-1/2 cycles for short-circuit currents up to 10 kA on switch ratings of 400 amp or less and 3 cycles for most other short-circuit levels.

This “umbrella rating” gave the specifying engineer more flexibility when selecting and coordinating the transfer switch and the over current protective devices. If the transfer switch manufacturer did not test using this optional method, the WCR label must be marked to show the specific circuit manufacturer’s breaker or breakers which can be coordinated with the switch. Specific circuit breaker ratings are usually beneficial on most transfer switch products since they generally enable higher kA ratings to be applied to the switch.

The higher ratings are possible because there is a large population of breakers with instantaneous clearing times shorter than .05 seconds (3 cycles for 60Hz) or .025 seconds for switches 400A and under. Of course, the specific breaker markings can limit the product’s application and acceptance by the Authority Having Jurisdiction (AHJ) for approval, if the breaker ahead of transfer switch is not listed on the WCR label.



Short-Time Current Rating Test

Another significant change regarding short-circuit testing was made to UL 1008 in June of 2002. Since the requirement for selective coordination was added to articles 700, 701 and 708 of the NEC, UL recognized there would be situations where transfer switches are required to withstand and close on short-circuit currents for time durations greater than 0.1 seconds (6 cycles for 60Hz systems). Consequently, UL added test criteria for a new optional short-circuit test called "Short-Time Current Rating Test".

The criteria for a successful short-time test is the same as the short-circuit test in the UL standard, except the tested sample must pass a temperature rise test at the conclusion of this new test. This meant the main contacts on the transfer switch had to be virtually "like new" condition. This requirement is imposed to minimize the increase in contact resistance during testing and keep the transfer switch temperature rise within the test limits required by UL.

The time duration of the short-time test was up to the discretion of the manufacturer and could range from 0.1 to 0.5 seconds. The amount of energy a transfer switch can withstand and close on is a function of I^2t, which is a measurement of the energy and stress withstood by the switch. Because the short time test requires the switch to withstand more energy for a longer time duration and also pass the temperature rise limits following this event; an identical test sample's short-time ratings will be lower than the short-circuit ratings obtained under the requirements in UL 1008 prior to 2002.

Some manufacturers have either had to develop a separate transfer switch design to provide short time ratings or they have been unable to offer these ratings at all. Other manufacturers who already had robust transfer switch designs were able to offer short-time ratings on their standard product line along with a separate product design to cover the longer 0.5 second (formerly 30 cycle) rating. The WCR label on both product designs would have a short-circuit rating and a short-time rating both listed with the appropriate current, voltage and time durations.

Regardless of the manufacturer, the cost of providing a short-time rated transfer switch will be substantially higher due to the cost of the more robust electrical as well as mechanical structure required to carry heavy currents for 0.5 seconds. As a result, it is important for the electrical design engineer or contractor to complete the short-circuit coordination study prior to the bidding stage to avoid unnecessary cost increases to the project.

Changes Effective November 1, 2014

The 7th Edition of UL 1008 has resulted in significant changes to short-circuit testing and the ratings shown on the transfer switch. The format and appearance of the WCR labels were impacted as follows:

1. The "Any" circuit breaker ratings were replaced with short-circuit amperes, volts and time duration markings shown in seconds rather than cycles. Generally, these are time durations of 0.025 seconds for short-circuit currents up to 10 kA on switch ratings of 400 amp or less and 0.050 seconds for most other short-circuit levels.

2. Short-time ratings (where applicable) which were added in 2002 as another optional short-circuit rating, are still shown as short-circuit amperes, volts, and time duration markings shown in seconds.

3. Specific circuit breakers will continue to be shown as short-circuit amperes, volts, manufacturer, and type, but may be reduced in count for some manufacturer's previous markings due to the new requirements in the 7th Edition. These new requirements for qualifying additional circuit breakers shown on the label are explained below.

4. Fuse ratings will continue to be shown as short-circuit amperes, volts, fuse class and maximum ampere rating markings.

5. More descriptive statements have been added regarding how the ratings should be applied in selecting appropriate over-current protection.

Qualification of Specific Circuit Breakers

The most significant change in the 7th Edition is the method for qualifying additional circuit breakers shown on the label markings. Any circuit breaker to be listed must either be short-circuit tested with the transfer switch per UL 1008 requirements or they can be added to the WCR label based on the following requirements from 9.13.3.7(c) in UL 1008:

c) An externally connected circuit breaker or fuses, as marked on the transfer switch. The ampere rating of such circuit breakers or fuses shall not be less than 125 percent of the transfer switch ampere rating unless the circuit breaker is listed for operation at 100 percent of its rating, in which case its rating shall not be less that the transfer switch rating.

Additional, externally connected circuit breakers may be added to the markings as specified in 5.2.5.1 based on an evaluation using the data from the short-circuit withstand test specified in 9.13.3.1 and the short-circuit closing test specified in 9.13.2. The investigation shall be conducted in compliance with items (1) – (3) below:

1. ***The duration of time that current passes through the contacts of the switch shall be measured from the short-circuit withstand and short-circuit closing test data. The shortest duration shall be selected from the evaluation.***

2. ***The circuit breaker(s) intended for addition the markings, as selected at the transfer switch manufacturer's discretion, shall be evaluated by use of the published time-current curve for each submitted circuit breaker.***

3. ***The circuit breaker time-current characteristic shall be evaluated in the instantaneous trip region at the current measured for the short-circuit withstand and short-circuit closing tests. If the circuit breaker maximum clearing time, at this current on the time-current characteristic, is less than or equal to the shortest test duration as determined in (1), the circuit breaker is acceptable for addition to the markings as specified in 5.2.5.1.e***

Notice the rule for qualifying additional breakers must now be done by comparing circuit breaker "published" maximum instantaneous clearing times to the actual time durations of short-circuit tests conducted on the transfer switch. UL made this change to ensure all manufacturers use the criteria described in the 7th edition of UL 1008 to qualify circuit breakers for use with transfer switches during short-circuit testing of their products.

Unfortunately, this change creates a challenge for many transfer switch manufacturers in retaining a suitable population of listed circuit breakers on their WCR labels, because of the manner in which UL previously allowed additional circuit breakers to be evaluated and included in manufacturer's markings.

In the past, the listing of specific breakers was based on a comparison of the "published" maximum instantaneous clearing time between the tested breaker and non-tested circuit breakers. If the non-tested circuit breakers published clearing time at the tested short-circuit current level was equal to or less than the tested circuit breakers' published clearing time, the non tested breaker could be listed on the WCR label.

For example, a breaker used for short-circuit testing that cleared the circuit in 11mS at 42kA, may have a manufacturer's published clearing time of 25mS or longer. The published clearing time of 25mS would be used to qualify other non-tested circuit breakers based on similar published trip curve values at 42kA and then added to the WCR product label.

This method ignored the fact the tested circuit breaker cleared the short-circuit, during the test, in a significantly faster time than the published clearing time. This comparison method allowed transfer switch manufacturers to select breakers for short-circuit testing that cleared much quicker than their published clearing time and still be able to extend the same short-circuit rating to a substantial list of additional breakers.

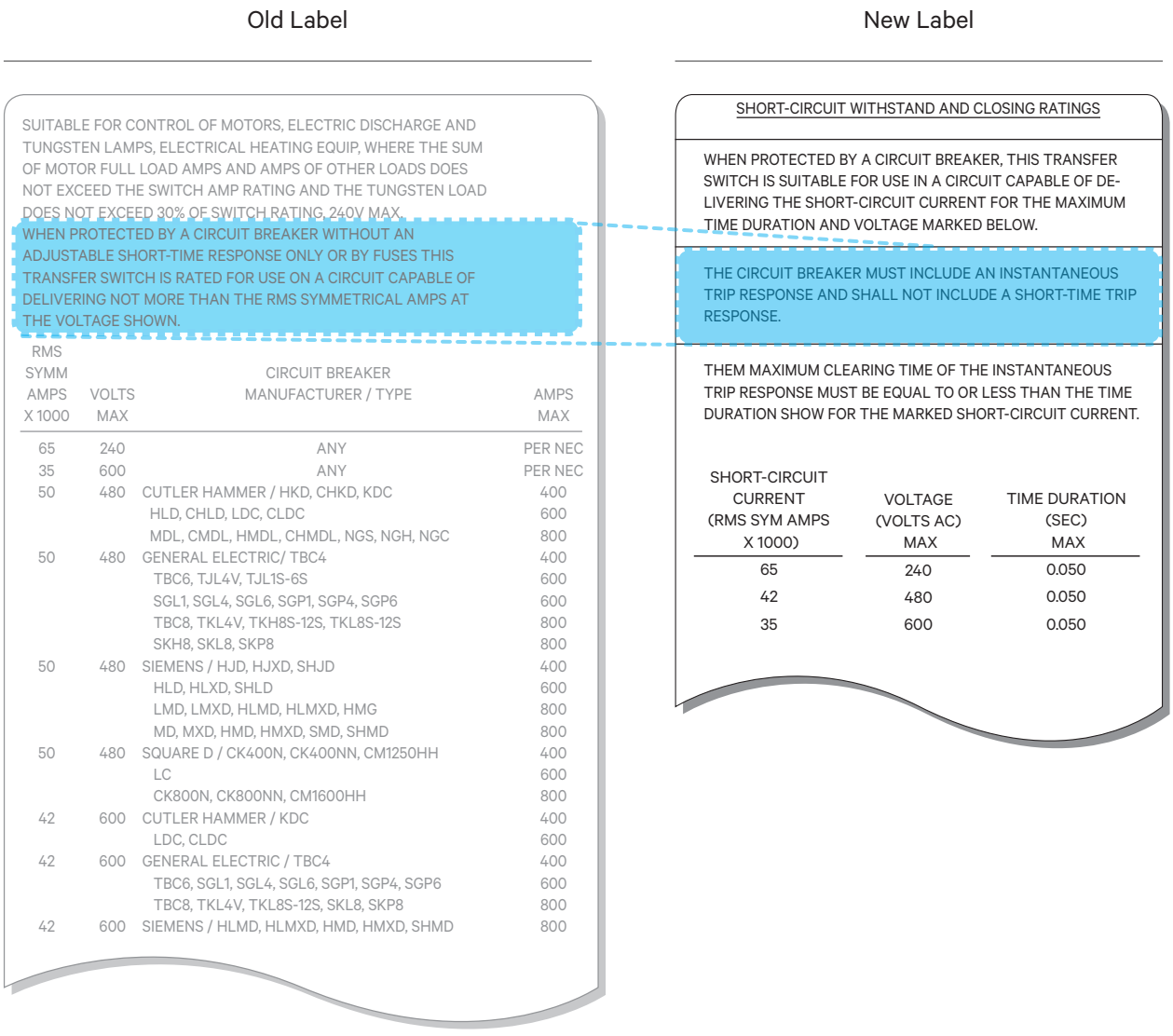
The 7th Edition of UL 1008 requires a comparison of a short-circuit test's duration to the published maximum instantaneous clearing time of the circuit breaker at that same short circuit current level for inclusion in the specific breaker ratings.

This makes the challenge significantly tougher because most published clearing times are very conservative and typically 2-3 times the actual clearing times. This change also forces transfer switch manufacturers to either test their switch with every specific breaker listed on the WCR label, or conduct longer time duration tests which will encompass the published clearing times of all the breakers to be listed.

Label Marking Changes - Transfer Switches Without A Short-Time Rating

As mentioned earlier, the 7th Edition also added more descriptive statements regarding how the transfer ratings are applied in selecting over-current protection. The original text in UL 1008, as shown highlighted on the sample label below, sometimes caused confusion with local electrical inspectors in interpreting the coordination of the transfer switch short circuit ratings to the overcurrent protective devices:

The new statements in paragraph 5.2.4.4 of the 7th Edition replace the highlighted text from the label on the left and more clearly define the transfer switch short circuit ratings in relation to both the circuit breaker's instantaneous and short-time response. This revised text is reflected in the sample transfer switch label below:



Label Marking Changes - Transfer Switches With A Short-Time Rating

The original text was also the same on the WCR label even if the switch had a short-time rating. This again caused confusion in interpreting the short circuit ratings.

With the 7th Edition, the text is different for a switch with a short-time rating. Note the switch must have a short-time rating, which must be coordinated with the short-time rating of the breaker.

Old Label

SUITABLE FOR CONTROL OF MOTORS, ELECTRIC DISCHARGE AND TUNGSTEN LAMPS, ELECTRICAL HEATING EQUIP, WHERE THE SUM OF MOTOR FULL LOAD AMPS AND AMPS OF OTHER LOADS DOES NOT EXCEED THE SWITCH AMP RATING AND THE TUNGSTEN LOAD DOES NOT EXCEED 30% OF SWITCH RATING. 240V MAX.

WHEN PROTECTED BY A CIRCUIT BREAKER WITHOUT AN ADJUSTABLE SHORT-TIME RESPONSE ONLY OR BY FUSES THIS TRANSFER SWITCH IS RATED FOR USE ON A CIRCUIT CAPABLE OF DELIVERING NOT MORE THAN THE RMS SYMMETRICAL AMPS AT THE VOLTAGE SHOWN.

RMS SYMM AMPS X 1000	VOLTS MAX	CIRCUIT BREAKER MANUFACTURER / TYPE	AMPS MAX
65	240	ANY	PER NEC
35	600	ANY	PER NEC
50	480	CUTLER HAMMER / HKD, CHKD, KDC	400
		HLD, CHLD, LDC, CLDC	600
		MDL, CMDL, HMDL, CHMDL, NGS, NGH, NGC	800
50	480	GENERAL ELECTRIC/ TBC4	400
		TBC6, TJL4V, TJL1S-6S	600
		SGL1, SGL4, SGL6, SGP1, SGP4, SGP6	600
		TBC8, TKL4V, TKH8S-12S, TKL8S-12S	800
		SKH8, SKL8, SKP8	800
50	480	SIEMENS / HJD, HJXD, SHJD	400
		HLD, HLXD, SHLD	600
		LMD, LMXD, HLMD, HLMXD, HMG	800
		MD, MXD, HMD, HMXD, SMD, SHMD	800
50	480	SQUARE D / CK400N, CK400NN, CM1250HH	400
		LC	600
		CK800N, CK800NN, CM1600HH	800
42	600	CUTLER HAMMER / KDC	400
		LDC, CLDC	600
42	600	GENERAL ELECTRIC / TBC4	400
		TBC6, SGL1, SGL4, SGL6, SGP1, SGP4, SGP6	600
		TBC8, TKL4V, TKL8S-12S, SKL8, SKP8	800
42	600	SIEMENS / HLMD, HLMXD, HMD, HMXD, SHMD	800

New Label

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SUITABLE FOR CONTROL OF MOTORS, ELECTRIC DISCHARGE AND TUNGSTEN LAMPS, ELECTRICAL HEATING EQUIP, WHERE THE SUM OF MOTOR FULL-LOAD AMPS AND AMPS OF OTHER LOADS DOES NOT EXCEED THE SWITCH AMP RATING AND THE TUNGSTEN LOAD DOES NOT EXCEED 30 PERCENT OF THE SWITCH RATING.

SHORT-CIRCUIT WITHSTAND/CLOSING AND SHORT-TIME CURRENT RATING

WHEN PROTECTED BY A CIRCUIT BREAKER, THIS TRANSFER SWITCH IS SUITABLE FOR USE IN A CIRCUIT CAPABLE OF DELIVERING THE SHORT-CIRCUIT CURRENT FOR THE MAXIMUM TIME DURATION AND VOLTAGE MARKED BELOW.

THE CIRCUIT BREAKER MUST INCLUDE AN INSTANTANEOUS TRIP RESPONSE UNLESS THE AVAILABLE SHORT-CIRCUIT CURRENT IS LESS THAN OR EQUAL TO THE SHORT-TIME RATING OF THE TRANSFER SWITCH AND THE CIRCUIT BREAKER INCLUDES A SHORT TIME TRIP RESPONSE.

THE MAXIMUM CLEARING TIME OF THE INSTANTANEOUS TRIP RESPONSE MUST BE LESS THAN OR EQUAL TO THE TIME DURATION SHOWN FOR THE MARKED SHORT-CIRCUIT RESPONSE.

WHEN PROTECTED BY A CIRCUIT BREAKER WITH A SHORT-TIME TRIP RESPONSE, THE SHORT-TIME RESPONSE OF THE CIRCUIT BREAKER MUST BE COORDINATED WITH THE SHORT-TIME CURRENT RATING OF THE TRANSFER SWITCH AS MARKED BELOW.

SHORT-CIRCUIT CURRENT (RMS SYM AMPS X 1000)	VOLTAGE (VOLTS AC) MAX	TIME DURATION (SEC) MAX
50	600	0.050

SHORT-CIRCUIT CURRENT (RMS SYM AMPS X 1000)	VOLTAGE (VOLTS AC) MAX	TIME DURATION (SEC) MAX
36	600	0.3

Two major things have changed with the specific breaker information and format of the time duration ratings shown on the WCR labels based on the 7th Edition of UL 1008.

SPECIFIC CIRCUIT BREAKER MANUFACTURER AND TYPE LISTING

WHEN PROTECTED BY A CIRCUIT BREAKER OF THE SPECIFIC MANUFACTURE, TYPE, AND AMPERE RATING AS MARKED BELOW, THIS TRANSFER SWITCH IS SUITABLE FOR USE IN CIRCUITS CAPABLE OF DELIVERING THE SHORT-CIRCUIT CURRENT AT THE MAXIMUM VOLTAGE MARKED.

SHORT-CIRCUIT CURRENT (RMS SYMMETRICAL AMPERES X 1000)	VOLTAGE (VOLTS AC, MAXIMUM)	MANUFACTURER	TYPE	RATING (AMPERES)
65	480	MFG. A	X1	1600
65	480	MFG. B	A1	1600

First, the number of specific breakers listed on the transfer switch product labels may be reduced for some manufacturers due to the qualification extension rules specified in the 7th edition. The numbers of breakers on this list will vary from manufacturer to manufacturer depending on a number of factors related to past UL test report records and also new qualification testing conducted for specific breaker listings. Transfer switch manufacturers who have either made the investment to test their switches with a variety of circuit breakers types and sizes or have robust designs allowing them to conduct longer time duration tests which will encompass the publish clearing times of all the breakers to be listed offer more flexibility to the design engineer or contractor.

SHORT-CIRCUIT WITHSTAND/CLOSING AND SHORT-TIME CURRENT RATINGS

WHEN PROTECTED BY A CIRCUIT BREAKER, THIS TRANSFER SWITCH IS SUITABLE FOR USE IN A CIRCUIT CAPABLE OF DELIVERING THE SHORT-CIRCUIT CURRENT FOR THE MAXIMUM TIME DURATION AND VOLTAGE MARKED BELOW.

THE CIRCUIT BREAKER MUST INCLUDE AN INSTANTANEOUS TRIP RESPONSE UNLESS THE AVAILABLE SHORT-CIRCUIT CURRENT IS LESS THAN OR EQUAL TO THE SHORT-TIME RATING OF THE TRANSFER SWITCH AND THE CIRCUIT BREAKER INCLUDES A SHORT-TIME RESPONSE.

THE MAXIMUM CLEARING TIME OF THE INSTANTANEOUS TRIP RESPONSE MUST BE LESS THAN OR EQUAL TO THE TIME DURATION SHOWN FOR THE MARKED SHORT-CIRCUIT CURRENT.

WHEN PROTECTED BY A CIRCUIT BREAKER WITH A SHORT-TIME TRIP RESPONSE, THE SHORT-TIME RESPONSE OF THE CIRCUIT BREAKER MUST BE COORDINATED WITH THE SHORT-TIME CURRENT RATING OF THE TRANSFER SWITCH AS MARKED BELOW.

SHORT-CIRCUIT CURRENT (RMS SYMMETRICAL AMPERES X 1000)	VOLTAGE (VOLTS, AC, MAXIMUM)	TIME DURATION (Sec, MAXIMUM)
65	240	0.050
50	480	0.050
42	600	0.050
35	480	0.067

SHORT-CIRCUIT CURRENT (RMS SYMMETRICAL AMPERES X 1000)	VOLTAGE (VOLTS, AC, MAXIMUM)	TIME DURATION (Sec, MAXIMUM)

Second, the “Any Breaker” listing has been replaced in the 7th edition by a time based rating of .05 seconds or .025 seconds for switches rated 400A and less. This forces the decision maker to determine the instantaneous clearing time of the specified breaker from the corresponding published trip curves to confirm it is less than or equal to the time based rating shown on the transfer switch label.

Typically .05 seconds will be adequate to cover most breakers available today, but if not, then the short-time rating would be used which is typically at a much lower kA level. If the transfer switch selected has no short-time rating, either current limiting fuses with faster clearing times may have to be installed ahead of the transfer switch for coordination purposes or a larger switch with a higher WCR will be required. Either of these solutions will result in added cost and physical size for the transfer switch.

What Now?

The question now is, what do these various UL revisions mean to the specifying engineer who is selecting circuit breakers or the contractor who is trying to source acceptable alternate breakers on a project? Prior to Edition 7, most transfer switch manufacturers provided a formidable list of specific breaker types on the WCR label that could be selected from multiple manufacturers to obtain the short-circuit ratings shown on the label. If the breaker being used or specified was not shown on the list, the “Any Breaker” rating would be the default rating, but at a lower short-circuit level.

For example, if the breaker specified for a project was not listed on the WCR label to obtain a 65kA rating for the transfer switch, the lower 50kA “Any Breaker” would be applicable or a larger transfer switch with a higher WCR would need to be selected. Therefore, it is crucial to still maintain as many breakers as possible on the WCR label while still meeting the qualification requirements imposed by the 7th Edition if the higher short circuit rating is required for the application.

It is important to note the time based short-circuit and short time ratings are both optional for product qualification under UL 1008 and not all transfer switch manufacturers offer these two optional ratings in addition to the specific breaker rating. Once again, these optional ratings offer more convenience and flexibility in selecting an acceptable circuit breaker to coordinate with the desired transfer switch rating.

Conclusion

There have been significant changes in short-circuit testing requirements and resultant WCR ratings shown on the transfer switch labels since the UL 1008 standard was originally issued. These changes have affected both the short-circuit testing methods and the resultant transfer switch product designs. The 7th Edition of UL 1008 has had a major impact in the industry because of changes in the short-circuit testing requirements, specific breaker qualification criteria and the appearance of these ratings shown on all transfer switch equipment labels.

The result of this most recent change should put all transfer switch manufacturers with products listed to UL 1008 on an “even playing field” when evaluating short-circuit performance. The more robust transfer switch products which are tested and qualified to the optional time based short-circuit and short time requirements specified in UL 1008 certainly offer more flexibility in coordinating the transfer switch and over-current devices in the electrical distribution system.

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