Selective Coordination Consideration in Power Transfer

25th May 2022
### Learning Objectives

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<th>Learning Objective</th>
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<tbody>
<tr>
<td>1</td>
<td>Define the difference between Circuit Breaker A.I.C and Transfer Switch W.C.R.</td>
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<td>2</td>
<td>ASCO Publication 1128 - Withstand and Closing Ratings for Transfer Switch Equipment</td>
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<td>3</td>
<td>Understand the different overcurrent protection devices &amp; W.C.R vs. Time</td>
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<td>4</td>
<td>UL 1008 Hi-Lights</td>
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<td>5</td>
<td>Selective Coordination</td>
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<td>6</td>
<td>ASCO Transfer Switch Products</td>
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<td>Resources available</td>
</tr>
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</table>
Please use the “Q&A” feature to ask technical questions.
Speaker’s Biography

Daniel Barrios
Customer Project Technical Engineer

- Holds a Bachelor of Electrical Engineering in University of New Orleans
- With E.I.T in Texas and Louisiana
- Has been in the Power Generation and Standby Power industry for 34 years working for ASCO Power Technologies, Zenith Controls, Cummins Power and Caterpillar
- Instructor for The Electrical Generating Systems Association (EGSA) presenting Automatic Transfer Switches and Generator Paralleling Switchgear
Circuit Breakers (AIC) vs. Transfer Switches (WCR)?

**Ampere Interrupting Capacity (AIC)** - Capability to safely interrupt or break short circuit currents and disconnect the power source from the load under overcurrent conditions.

**Withstand Close-On Rating (WCR)** - Capability to safely endure and close-on short circuit currents until overcurrent conditions are interrupted.

WCR of an ATS has an inverse relationship to the length of fault time - the longer the fault time, the lower the current it can withstand and close-on.

### Typical Clearing Times

- **Fuses**: 1/4 to 1/2 cycle
- **Thermal Mag Type MCBs**: 1.5 to 2 cycles
- **MCCBs w/Electronic Trip**: 2 to 3 Cycles
- **Power Breakers**: 3 to 30 Cycles
ASCO Power Technologies

Engineering Application Information

WITHSTAND AND CLOSING RATINGS FOR TRANSFER SWITCH EQUIPMENT

ASCO products comply with all mandatory UL 1008 withstand and closing ratings.

By using the information in this publication and calculating available short circuit currents, the system designer can be assured the transfer switches will be properly rated for the electrical system.
### Table III. Withstand / Closing Ratings for Transfer Switches

Used with Specific Manufacturer's Molded Case Circuit Breaker

<table>
<thead>
<tr>
<th>ASCO Transfer Switch Product</th>
<th>Transfer Switch Frame Prefix</th>
<th>Transfer Switch Rating (Arms)</th>
<th>WCR/Closing Rating kA RMS Symmetrical Amps</th>
<th>Volts Max</th>
<th>Circuit Breaker Manufacturer</th>
<th>Circuit Breaker Type or Class</th>
<th>Circuit Breaker Rating (Amp) Per NEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 TS</td>
<td>D</td>
<td>30</td>
<td>22</td>
<td>480</td>
<td>GE</td>
<td>THED</td>
<td>40</td>
</tr>
</tbody>
</table>

Sample page listing Circuit breakers by manufacture
## ASCO UL1000 Withstand and Closing Ratings

### (RMS Symmetrical Amps)

<table>
<thead>
<tr>
<th>Frame</th>
<th>Switch Rating (Amps)</th>
<th>Current Limiting Class</th>
<th>Specific Breaker</th>
<th>Time Based</th>
<th>Short Time Ratings¹ (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>240V Max.</td>
<td>480V Max.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Max.</td>
<td>Max.</td>
<td>Size, A</td>
<td>10KA</td>
</tr>
<tr>
<td>D</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>D</td>
<td>70, 100</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>D</td>
<td>150</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>D</td>
<td>200</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>D</td>
<td>300</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>J</td>
<td>150, 200, 260</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>J</td>
<td>400</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>H</td>
<td>400</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>S</td>
<td>600</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>G</td>
<td>1000 - 2000 (Front Connected TS Only)</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>G</td>
<td>1600 - 2000</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>S</td>
<td>1600 - 2000</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>G</td>
<td>2600 - 3000</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>G</td>
<td>3000</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>G</td>
<td>4000</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
<tr>
<td>U</td>
<td>2000 - 4000</td>
<td>-</td>
<td>-</td>
<td>J</td>
<td>0.025</td>
</tr>
</tbody>
</table>

¹ Short Time Ratings include 1.3, 1.5, and 2.0 sec.
Fuse rating:

UL 1008, 9.13.3.14 – Fuse testing at levels above 10KA (Class J, L, T, or RK-5)

- Easiest WCR test to meet due to only a ¼ cycle fault exposure; many non-US based mfr.’s test only with this rating to obtain UL 1008 qualification
- Must utilize the specific fuse type listed by the mfr. (since NOT all mfr.’s test or list with all qualifying fuses)
- Can afford very high WCR fault protection, 100KA / 200KA (since fault time is limited)
Specific device (series) rating:

UL 1008, 5.2.5.2 – “When protected by a circuit breaker of the specific manufacturer, type, and ampere rating”

- Requires Engineer design coordination
- Based on a particular C.B. (by mfg., model # & frame size)
- Molded case only
- Difficult to utilize on an “open” specification project
- Typically offers a higher WCR than Time Base Rating
Time Based w/o Short Time (historical “Any Breaker” rating):

UL 1008, 9.13.3.11 – “Test current shall pass through the switch at least 0.05 seconds”

9.13.3.12 – “Rated 400A circuit the test current shall pass through the switch for at least 0.025 seconds”

- The Time Based (“Any Breaker Rating”) allows for a wide range of C.B.
- Time Based Rating requires a coordination with upstream devices.
- Time Based Rating allows for the use of most molded case C.B. or Power Breakers with an instantaneous trip.
- Time Based Rating ensures a probability of future coordination should the initial C.B. be replaced.
Time Based with Sort Time:

UL 1008, 9.13.3.9 and 9.13.2.2 – Short-Time Current Rating Test. 5.2.3.2
This transfer switch is suitable for use in a circuit capable of delivering the short-circuit current for the maximum voltage marked below.

“When protected by a circuit breaker, the circuit breaker must include an instantaneous trip response that cannot be disabled.”

- Allows for selective coordination
- Not all manufactures offer products to meet this requirement
- Pay to play! Short time rated switches (i.e. 18 – 30 cycle)
UL 1008 Hi-Lights

- “Any Breaker” has been revised to “Time Based”
UL 1008 has resulted in significant changes to short-circuit testing ratings shown on the transfer switch:

- The “Any” circuit breaker ratings were replaced by “time-based” ratings shown in seconds rather than cycles.
- Short-time ratings (where applicable) are also shown in “seconds” instead of “cycles”.
- Specific guidelines were added for qualifying additional circuit breakers to be shown on the short circuit label markings.
- More descriptive statements have been added regarding how the short circuit ratings should be applied in selecting appropriate over-current protection.
The term “ANY” circuit breaker has been replaced with Time Duration markings on the WCR label shown in seconds.

Time based ratings are more conducive for comparison to the time current curves published by breaker manufacturers.
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- “Any Breaker” has been revised to “Time Based”
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Short-Time Current Rating Test UL 1008

**UL 1008 Standard - Passing Criteria:**
- Alternate Source Main Contacts Must Exhibit Continuity After Test
- Enclosure Door Must Remain Closed
- Phase-to-Enclosure Fuse Must Be Intact
- ATS Must be Operable by Intended Means
- No Breakage of Switch Base…
- Power Cables Can’t Pull Free of Terminal Lugs
- For Short Time Test: ALL Contacts Must Exhibit Continuity AND Pass Temperature Rise! Must be ‘Like New’!
Unsuccessful Test
Acceptable Performance per UL 1008

- Ability to close on untested contacts of the opposite power source circuit
- Ability to operate using whatever automatic or manual controls are provided
- No continuity between the terminals of the normal and alternate power source circuits
- No opening of doors on transfer enclosures
- Cables cannot pull away from lugs and connectors

Source ASCO UL1008 Transfer Switch Withstand and Closing Ratings White paper
UL 1008 Hi-Lights

- “Any Breaker” has been revised to “Time Based”
- Short-Time Rating in seconds in lieu of cycles
- Selective Coordination
Selective Coordination Requirements

- Selective Coordination: localization of an overcurrent condition to isolate outages to the circuit affected by selecting appropriate overcurrent protective devices and settings.

- 1993 - First added to the NEC for elevator circuits and (3) subsequent articles were added in 2005 and 2008:
  - 2005 - Article 700.27 - Emergency Systems Coordination
  - 2005 - Article 701.18 - Legally Required Standby Systems

- UL recognized applications where transfer switches would be required to withstand and close-on short-circuit currents for time durations greater than 0.1 secs (6 cycles for 60Hz).

By selectively coordinating breaker trip times, faults can be isolated to the loads furthest downstream, minimizing impact to the remainder of a facility.
Both approaches are common, but what about the impact on Arc Flash & Cost?
UL 1008 Hi-Lights

• “Any Breaker” has been revised to “Time Based”
• Short-Time Rating in seconds in lieu of cycles
• Selective Coordination
• Specific Breaker Guidelines
UL 1008 has resulted in significant changes to short-circuit testing ratings shown on the transfer switch:

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- More descriptive statements have been added regarding how the short circuit ratings should be applied in selecting appropriate over-current protection.
Qualifying Specific Breakers UL1008

• **Problem:** Prior to 7th edition there was no guarantee that all listed breakers would adequately clear a fault & protect the Transfer Switch.

• Method for listing specific breakers was not defined in the standard and was based on a comparison of the “published” instantaneous clearing time between the tested breaker and non-tested circuit breakers.

• If the non-tested circuit breaker’s *published* clearing time was equal to or less than the tested circuit breaker’s *published* clearing time, the non tested breaker could be listed.

• Most switch manufacturers included a formidable list of specific breaker manufacturers and types on their WCR label at that time. Unfortunately, this method could not guarantee that all listed breakers would adequately protect the ATS.

• The most significant change in the 7th Edition requires comparing the publish trip time of the new breaker with actual breaker trip time from a previous short circuit test.
• Breaker from previous test cleared short circuit in 10ms
• Only non tested breakers with maximum published clearing times of 10ms could be listed on WCR label
UL1008

UL 1008 has resulted in significant changes to short-circuit testing ratings shown on the transfer switch:

• The "Any" circuit breaker ratings were replaced by “time based” ratings shown in seconds rather than cycles.

• Short-time ratings (where applicable) are also shown in “seconds” instead of “cycles”.

• Specific guidelines were added for qualifying additional circuit breakers to be shown on the short circuit label markings.

• More descriptive statements have been added regarding how the short circuit ratings should be applied in selecting appropriate over-current protection.
What do you specify?

Both I and/or S can be disabled

L - Long
S - Short
I – Instant.
More descriptive statements have been added regarding how the ratings should be applied in selecting appropriate over-current protection. Notice if the circuit breaker is used with a transfer switch w/o a short time rating, the short-time delay adjustment must be set to zero.

**SHORT-CIRCUIT WITHSTAND AND CLOSING 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 AND SHALL NOT INCLUDE A SHORT-TIME TRIP RESPONSE.**

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

<table>
<thead>
<tr>
<th>SHORT-CIRCUIT CURRENT (RMS SYM AMPS x 1000)</th>
<th>VOLTAGE (VOLTS AC) MAX</th>
<th>TIME DURATION (SEC) MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>240</td>
<td>0.050</td>
</tr>
<tr>
<td>42</td>
<td>460</td>
<td>0.050</td>
</tr>
<tr>
<td>35</td>
<td>600</td>
<td>0.050</td>
</tr>
</tbody>
</table>
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 breaker must clear the short-time fault in a time duration shorter than shown on the Transfer Switch label.
UL 1008 Hi-Lights

- “Any Breaker” has been revised to “Time Based”
- Short-Time Rating in seconds in lieu of cycles
- Selective Coordination
- Specific Breaker Guidelines
- Specifiers Recommendations and Considerations
Specifier Recommendations

Provide 3 cycle (0.05 sec) short circuit rating to guarantee contact opening and no damage when transfer switch is served by molded case circuit breakers as indicated on the drawings.

and

Provide 18 cycle (0.3 sec) short circuit rating to guarantee contact opening and no damage when transfer switch is served by power circuit breakers as indicated on the drawings.

65kA WITHSTAND CLOSE-ON RATING/36kA 18 CYCLE WITHSTAND RATING.
Let’s Consider This Example:

- 3 switches were upsize to 800A
- Significant cost increase
- 2 units wouldn’t fit in the specified location

Calculated potential:
- XFMR: 52KA
- Main switchboard: 16.7KA
- Secondary switchboard: 10.2KA
- ATS’s: all <14.5KA
Something Else to Consider:

- Selective coordination does NOT equal 30 cycle
- It’s not just an ATS issue
- Consideration must be given to the entire system (e.g. conductors, XFMR’s)
- Special equipment might be required

Table 2: Maximum Short-Circuit Current Rating In Ampere (Per IEEE 755® Insulation Damage)

- 32,451 (Onderdonk Melting, 1083° C)

I. M. Onderdonk developed an equation that relates current and the time it takes for a wire to melt.
UL 1008 Hi-Lights

- “Any Breaker” has been revised to “Time Based”
- Short-Time Rating in seconds in lieu of cycles
- Selective Coordination
- Specific Breaker Guidelines
- Specifiers Recommendations and Considerations
- ASCO Transfer Switch Products
ASCO’s Offerings

![Diagram of ASCO’s Offerings](image-url)
Summary

The purpose of transfer switches is to connect electrical loads to alternate power sources when a normal source is unacceptable. To do so, they must be able to both withstand and close on foreseeable fault currents. If switches cannot withstand and close on fault currents, the circuit could open, de-energizing all downstream circuits and cause unnecessarily large outages to loads.

UL1008 specifies testing requirements for verifying manufacturer Withstand and Closing Ratings. Current Withstand and Closing Tests provide both “Time Based” and “Specific” breaker ratings that offer application flexibility. Optional short-time ratings require both short-time current and temperature rise tests. The resulting Short-Time Ratings support Overcurrent Protective Device selective coordination schemes.

Source ASCO UL1008 Transfer Switch Withstand and Closing Ratings White paper
Resources Available

1. www.ASCOPower.com

2. ASCO Publication 1128 – Engineering Application Information Withstand and Closing Rating for Transfer Switch Equipment

3. ASCO Published White Papers at whitepapers.ascopower.com

4. Contact your local ASCO Sales Office

5. ASCO at (800) 800-ASCO (2726)
For further information

• **CEU and PDH Certificates**
  All attendees will receive an email 24 hours after this webinar with instructions regarding the link to download your PDH certificate and the CEU exam.

• **Speaker’s contact**
  Feel free to reach out to the speaker by email should you have any questions

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Thank You!

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