ASCO Power Technologies™

Withstand and Closing Ratings for Transfer Switch Equipment

Engineering Application Information

Revision 37

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.

Life Is On Schneider Electric

INTRODUCTION

This publication provides information on withstand and closing ratings (WCRs) for ASCO transfer switches and related products, including compliance with the optional short time ratings and other revisions to UL 1008. Also included are guidelines for special WCR applications and typical methods for specifying WCR requirements.

Guidelines for using the information in this publication to verify suitability of switches for specific applications based on withstand and closing ratings (WCR).

1. Determine the prospective fault current available (from each source) at the location of the switch.
2. Determine the overcurrent protective devices (OPDs) that will be located ahead of the switch.
3. If the OPD is a circuit breaker, refer to the "Time Based" rating column on Table II of page 4. Select the switch rating necessary to handle the full load current. Compare the fault current available at the switch source terminals to the WCR shown in Table II for the applicable switch ampere size and voltage. If the prospective fault current is equal to or less than the Time Based WCR from Table II, the switch selected is suitable for the application.
4. If the prospective fault current is greater than the Time Based WCR obtained from Table II, refer to the "Specific Breaker" list on Table III on pages 5-7. Compare the fault current to the WCR shown in Table II. If the fault current is equal to or less than the WCR shown in Table II, the switch is suitable for the application when protected by any of the circuit breakers shown. If the specific circuit breaker being used is not shown in the table, contact ASCO Power Technologies.
5. If the prospective fault current is greater than the WCR listed in Table III, refer to *Special Application Considerations* on page 8.
6. When the overcurrent protective devices are fuses refer to the "Current Limiting Fuses" column of Table II on page 4. If there are any questions about the suitability of the switch when protected by current limiting fuses contact ASCO Power Technologies.

THE IMPORTANCE OF PROPER RATINGS

The transfer switch is a unique and critical part of the power system. It is the last distribution device feeding the critical loads of a facility. For that reason, the transfer switch should be located as close as possible to the protected loads. In addition, after a fault (short circuit) is cleared, the transfer switch must remain operable so that it can restore power to the critical loads from the alternate power source.

In the design of an electrical power distribution system, a coordination study should be conducted during the design stage to determine the trip settings required for all circuit breakers. Proper trip settings will assure that a fault is cleared as close to its location as practical. The coordination study considers conductor sizes, quantities and lengths as well as any other relevant circuit impedance. The farther from the source a device is located, the lower the fault current will be at that device. Referring to Figure 1, a fault at point A should be cleared by the switchgear feeder breaker F2 and not by M. This would leave the other feeder circuits (F1 & F3 - F7) in operation. A coordination study will determine the magnitude of fault current at the load side of the transfer switch and indicate the settings for F2.

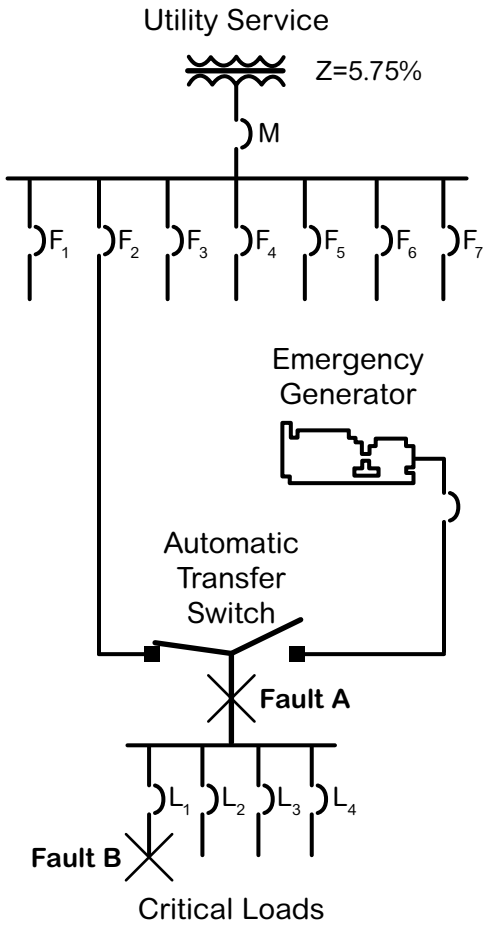


Figure 1. Line diagram of a typical emergency power system.

Consider a fault at point B on the load side of the breaker feeding L1 as shown in Figure 1. If the system breakers have been coordinated properly, the breaker feeding L1 will trip before the upstream breaker or fuse. The transfer switch must withstand this fault current until the circuit breaker or fuse clears the fault. Most automatic transfer switches available today have a standard control circuit time delay of 0.5 seconds or more to override any momentary voltage transients. This is ample time for any over current device to clear the fault, allowing system voltage to return to normal and avoiding any unnecessary operation of the transfer switch.

Now consider a fault at point A of Figure 1. The circuit breakers on the load side of the transfer switch would not see the fault current, but the upstream breaker (F2) would and the instantaneous trip element would be actuated. The transfer switch controller senses there is no voltage from the utility, signals a transfer operation and the transfer switch is now required to close on the fault condition until the generator over current device clears the fault.

If a transfer switch does not have a sufficient withstand and closing rating, severe damage and a potential fire hazard could result from the fault current. Over-rating the transfer switch to achieve a sufficient WCR leads to a less cost-effective design. Good engineering practice requires adequately rated devices in the power distribution system. Therefore, the specified WCR for the transfer switch should be equal to or greater than the available fault current at the location of the transfer switch. Some recommended engineering practices to assist in fault current calculations are referenced at the end of this publication.

HOW CODES IMPACT RATINGS

Codes often require equipment to be approved for its intended use. For example, one of the most common applications for automatic transfer switches is in Emergency Systems per Article 700 of the National Electrical Code (NEC) ANSI/NFPA 70. Section 700-3 and 700-6 require that all transfer equipment be approved for use on Emergency Systems. How does a manufacturer obtain approval? There are several ways, but perhaps the most common is via a third party certification acceptable to the authority having jurisdiction.

THE ROLE OF UNDERWRITERS LABORATORIES

Underwriters Laboratories (UL) is one of several independent testing agencies and is perhaps the most well-known third party certifier. The Standard for Safety under which Underwriters Laboratories tests Transfer Switch Equipment is UL 1008. Equipment which meets UL requirements is listed in UL's *Electrical Construction Materials List*. This list is frequently used by electrical inspectors and other authorities having jurisdiction in conjunction with the device markings and rating label to approve an electrical installation.

UL has issued several revisions to the UL 1008 Standard, which clarify how a transfer switch is to be tested and marked for fault current withstand and closing ratings. A major revision introduced in the 1989 version of UL 1008 allowed an optional rating category for WCR and closing tests. Its purpose was to permit transfer switch manufacturers to conduct tests without overcurrent protective devices. For transfer switches rated 400A and below for use on 10 kA circuit maximum, the on time of the fault current must be at least 25 ms (1½ cycles). For transfer switches rated above 400A or for use on circuits with available fault currents above 10 kA, the on time of the fault current must be at least 50 ms (3 cycles). When this test is successful, the manufacturer may mark the switch for use with any manufacturer's circuit breaker within its rating. Such umbrella ratings give the application engineer more flexibility when specifying and coordinating the transfer switch with overcurrent devices.

Where a transfer switch manufacturer does not opt for this test, the switch can only be marked to show the specific manufacturer's circuit breaker with which the switch was tested, or circuit breakers approved by UL through extension from the original test data. The specific breaker marking can limit the product's application and acceptance by the inspecting authority.

Other issues may develop when the transfer switch WCR is limited to use with specific circuit breakers. Even though a specific breaker is coordinated with the transfer switch upon initial installation, the breaker could possibly be replaced at a later date with another type and/or rating which is not one of the breakers approved by UL. Circuit breakers also change trip characteristics as they age and the tripping time may be become slower, allowing the transfer switch to be subjected to energy above the original short circuit testing values. These issues would not be a concern to the specifying engineer if a transfer switch rated for use with "Time Based" were selected.

Another significant change regarding short circuit testing was made to UL1008 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 would be required to withstand and close on short circuit currents for time durations of 0.1 seconds (6 cycles for 60Hz systems). Consequently, UL added requirements for a new optional short circuit test called "Short Time Current Rating Test". The criteria for a successful test was the same as the short circuit testing in the standard, except the test sample was required to pass a temperature rise test at the conclusion of this new short time test. This meant the transfer switch main contacts had to be virtually "like new" in order to minimize the increase in contact resistance in order to meet the temperature rise limits.

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 based on an I2T function, which is a measurement of the energy handled by the switch. Since the switch has to handle more energy with the longer time duration and also pass a temperature rise test following this event, the short time ratings will be lower for an identical test sample compared to the short circuit ratings obtained for the requirements in UL1008 prior to 2002.

The 7th Edition of UL 1008 became effective November 1, 2014 and resulted in significant changes to the shortcircuit ratings shown on all transfer switch products in the industry. First, the "Any" circuit breaker rating added in 1989 was replaced with a "time based" rating and marking shown in seconds rather than cycles. Generally, these are time durations of 0.025 Sec for short-circuit currents up to 10 kA on switch ratings of 400 amp or less and 0.050 Sec for most other shortcircuit levels.

The most significant change is the way that specific circuit breakers are permitted to be added to the label markings. Specific circuit breakers must be short circuit tested with the transfer switch per UL1008 requirements or can be added based on comparing circuit breaker maximum instantaneous clearing times to the actual time durations of short-circuit tests conducted on the transfer switch. UL has made this change to ensure all manufacturers utilize the criteria described in the 7th edition of UL1008 to qualify circuit breakers for use with transfer switches during short circuit testing of their products.

Unfortunately, this limits the listed population of circuit breakers on the WCR labels of many manufacturers' switches and especially on smaller frame transfer switches, because of the manner in which UL previously evaluated adding circuit breakers to manufacturer's markings. In the past, the listing of specific breakers was based on a comparison of the "published" maximum instantaneous clearing time of the breaker tested to non-tested circuit breakers maximum instantaneous clearing times. 2 The format and appearance of the WCR label was also changed significantly with the addition of more descriptive statements regarding how the ratings should be applied in selecting appropriate over-current protection. An example of these labels is shown on page 8.

ASCO SWITCHES MEET AND EXCEED UL 1008 REQUIREMENTS

ASCO Power Technologies provides withstand current ratings on its products to provide maximum flexibility to the electrical consultant when specifying these products. The ratings apply to the ASCO products shown in Table I and are specified in Tables II and III. The ratings apply to single phase and three phase switches. The withstand & closing ratings of the overlapping neutral transfer pole is identical to the WCR of the phase switching poles.

See page 8, *Special Application Considerations*, if ratings beyond those listed are required. Contact ASCO Power Technologies to determine if ratings have been increased or for ratings beyond three cycles which may not be UL Listed, but which are based on other tests.

Table I. Applicable Products (Refer to Specific Rating Tables for Each Products Rating)

ASCO Product	Typical Applications	Product Description	
		Automatic Transfer Switch	Non-Automatic Transfer Switch
Series 165, 185	Residential	Automatic	Manual
Series 300 / 386	Industrial / Light Commercial	Automatic Transfer Switch (Light Commercial Applications)	Non-Automatic – Electrically Operated Transfer Switch
4000 TS 4000 Series Power Transfer Switches	Industrial, Commercial, Institutional	4ATS – Automatic Transfer Switch 4ACTS – Automatic Closed Transition Switch 4ADTS – Automatic Delayed Transition Switch	4NTS – Non-Automatic Transfer Switch 4NCTS – Non-Automatic Closed Transition Switch 4NDTS – Non-Automatic Delayed Transition Switch
7000 TS 7000 Series Power Transfer Switches	Health Care, Critical Power Facilities	7ATS – Automatic Transfer Switch 7ACTS – Automatic Closed Transition Switch 7ADTS – Automatic Delayed Transition Switch 7ASLS – Automatic Soft Load Transfer Switch	7NTS – Non-Automatic Transfer Switch 7NCTS – Non-Automatic Closed Transition Switch 7NDTS – Non-Automatic Delayed Transition Switch 7MTS – Manually Operated Transfer Switch
7000 TB 7000 Series Transfer Switches with BypassIsolation Feature	Health Care, Critical Power Facilities, Mission Critical	7ATB – Automatic Transfer Switch with Bypass-Isolation 7ACTB – Automatic Closed Transition Transfer Switch with Bypass-Isolation 7ADTB – Automatic Delayed Transition Transfer Switch with Bypass-Isolation 7ASLB – Automatic Soft Load Transfer Switch with Bypass-Isolation	7NTB – Non-Automatic Transfer Switch with Bypass-Isolation 7NCTB – Non-Automatic Closed Transition Transfer Switch with Bypass-Isolation 7NDTB – Non-Automatic Delayed Transition Transfer Switch with Bypass-Isolation

ASCO UL1008 Withstand and Closing Ratings [1,2,7]
(RMS Symmetrical Amps)

Frame	Switch Rating (Amps)		300, 4000 & 7000 Series																	
			Current Limiting Fuses				Specific Breaker			Time Based				Short Time Ratings[3] (sec)							
														480V Max.				600V Max.			
	Transfer Switches	Bypass Switches	480V Max.	600V Max.	Max Size, A	Class	240V Max.	480V Max.	600V Max.	Time (sec)	240V Max.	480V Max.	600V Max.	.13	.2	.3	.5	.1	.13	.3	.5
D	30	-	100kA	-	300	J	22kA	25kA	10kA	0.025	10kA	10kA	10kA	-				-			
			200kA	35kA	200	J															
			35kA	35kA	200	RK1															
D	70, 100	-	35kA	35kA	200	RK1	150kA	85kA	25kA	0.025	10kA	10kA	10kA	-				-			
			200kA	35kA	200	J															
D	150	-	35kA	35kA	200	RK1	150kA	85kA	25kA	0.025	10kA	10kA	10kA	-				-			
			200kA	35kA	200	J															
D	200	-	200kA	35kA	200	J	200kA	85kA	14kA	0.025	10kA	10kA	10kA	-				-			
			35kA	35kA	200	RK1															
D	230	-	100kA	-	300	J	200kA	85kA	14kA	0.025	10kA	10kA	-	-				-			
E	260, 400	-	200kA	-	600	J	65kA	42kA	22kA	0.05	35kA	35kA	22kA	-				-			
J	150, 200, 230, 260	150, 200, 230, 260	200kA	200kA	600	J	200kA	200kA	100kA	0.05	65kA	42kA[5]	35kA	7.5kA		-		-			
					800	L															
J	400	400	200kA	200kA	600	J	200kA	200kA	100kA	0.05	65kA	42kA[5]	35kA	7.5kA		-		-			
					800	L															
J	600	600	200kA	200kA	800	L	200kA	200kA	100kA	0.05	65kA	42kA[5]	35kA	7.5kA[9]		-		-			
			200kA	200kA	600	J															
H[8]	600	600	200kA	200kA	1600	L	200kA	200kA	100kA	0.05	50kA	50kA	50kA	36kA			-	36kA			-
P[8]	600	600	200kA	200kA	1600	L	200kA	200kA	100kA	0.05	50kA	50kA	50kA	36kA			30kA	36kA			-
P[8]	800	800 - 1200	200kA	200kA	1600	L	150kA[6]	150kA[6]	65kA	0.05	50kA	50kA	50kA	36kA			30kA	36kA			-
H	800 - 1000	800 - 1000	200kA	200kA	1600[4]	L	150kA[6]	150kA[6]	65kA	0.05	50kA	50kA	50kA	36kA			-	36kA			-
H	1200	1200	200kA	200kA	1600[4]	L	150kA[6]	150kA[6]	65kA	0.05	50kA	50kA	50kA	36kA			-	36kA			-
Q[8]	600-1600	600-1600	200kA	200kA	2000	L	65kA	65kA	65kA	0.05	65kA	65kA	65kA	50kA				50kA			
S[8]	800 - 1200	800 - 1200	200kA	200kA	2500	L	100kA	100kA	65kA	0.05	100kA	100kA	65kA	65kA				65kA			
G[8]	1000 - 1200	1000 - 1200	200kA	200kA	2000	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	-				-			
G	1600 - 2000 (Front Connected TS Only)		200kA	200kA	2500	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	42kA			36kA	-			
G[8]	1600 - 2000	1600 - 2000	200kA	200kA	3000	L	200kA	200kA	100kA	0.05	100kA	100kA	100kA	42kA			36kA	42kA			-
S[8]	1600 - 2000	1600 - 2000	200kA	200kA	2500	L	100kA	100kA	85kA	0.05	100kA	100kA	85kA	85kA			65kA	85kA			65kA
G	2600 - 3000	2600 - 3000	200kA	200kA	4000	L	125kA[6]	125kA[6]	100kA	0.05	100kA	100kA	100kA	42kA			36kA	42kA			-
G[8]	3200	-	200kA	-	4000	L	100kA	100kA	-	0.05	100kA	100kA	-	-				-			
G	4000	4000	200kA	200kA	5000	L	100kA	100kA	100kA	0.067	100kA	100kA	100kA	85KA	65kA			65kA			
U[8]	2600 - 4000	2600 - 4000	200kA	200kA	5000	L	125kA	125kA	125kA	0.05	125kA	125kA	125kA	100kA				100kA			

Notes:
1) All WCR values indicated are tested in accordance with the requirements of UL 1008, 7th Edition. See ASCO Pub. 1128 for more WCR information
2) Application requirements may permit higher WCR for certain switch sizes.
3) Short Time ratings are provided for applications involving circuit breakers that utilize trip delay settings for system selective coordination
4) Max fuse rating is 1200A on front connected H frame switches
5) Switches utilizing overlapping neutral (code "C") have 35kA, 0.050 Sec time based rating at 480V Max
6) Rating shown is for Bypass switches only. Transfer Switch rating is up to 100kA. See ASCO Pub. 1128 for details.
7) See ASCO for Service Entrance Switch ratings
8) These frames are only available on the 7000 Series product
9) Short Time Rating applies to 600A Bypass switch only, the 600A Transfer Switch does not have a Short Time Rating

12-Feb-25

Table III. Withstand / Closing Ratings for Transfer Switches Used with Specific Manufacturer's Molded Case Circuit Breakers

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (Amps)	WCR / Closing Rating kA RMS Symmetrical Amps	Volts Max	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (Amp Max) Per NEC
300 TS 7000 TS	D	30	22	480	GE	THED	40
			25		Siemens	ITE CED6	125
			30			3VA41	
300 TS 4000 TS 7000 TS	D	70	150	240	Square-D	HR	250
			125			HL	150
			100			BJ, HJ	125
			65			BG, HG	125
			42			QG, QJ	90
			25			HD	150
						BD	125
			85	480		HL, HR	150
			50			BJ	125
			35			HG, HJ	150
						BG	125
			18			BD, HD	125
			30		Siemens	3VA41	125
			22		GE	THED	90
			25	600	Square-D	HJ, HL, HR	150
						BJ	125
			18			HG	150
						BG	125
			14			HD	150
						BD	125
		100	150	240		HR	250
			125			HL	150
			100			BJ, HJ	125
			65			BG, HG	125
			42			QG, QJ	125
			25			HD	150
						BD	125
			85	480		HL, HR	150
			50			BJ	125
			35			HG, HJ	150
						BG	125
			18			BD, HD	125
			30		Siemens	3VA41	125
			22		GE	THED	150

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (Amps)	WCR / Closing Rating kA RMS Symmetrical Amps	Volts Max	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (Amp Max) Per NEC
300 TS 4000 TS 7000 TS	D	100	25	600	Square-D	HJ, HL, HR	150
						BJ	125
			18			HG	150
						BG	125
			14			HD	150
						BD	125
		150	150	240		HR	150
			125			HL	
			100			BJ, HJ	125
			200			JR	250
			125			JL	
			100			JJ	
			65			JG	
						BG, HG	125
			42			QG, QJ	200
			25			HD	150
						BD	125
			85	480		HL, HR	150
			50			BJ	125
			35			HG, HJ	150
						BG	125
			85			JL, JR	250
			30			JG, JJ	
			18			BD, HD	125
			22		GE	THED	150
			25	600	Square-D	HJ, HL, HR	
						BJ	125
			18			HG	150
						BG	125
			14			HD	150
						BD	125
		200 230	200	240		JR	250
			125			JL	
			100			JJ	
			65			JG	
			42			QG, QJ	225
			25			JD	250
			85	480		JL, JR	
			30			JG, JJ	
			18			JD	
			14	600		JD, JG, JJ, JL, JR	
300 TS	E	260 400	65	240	GE	THLC4	350
			42	480	Cutler Hammer	HMC	800

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (Amps)	WCR / Closing Rating kA RMS Symmetrical Amps	Volts Max	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (Amp Max) Per NEC
300 TS 4000 TS 7000 TS 7000 TB	J	150 200 230 260 400 600	65	240	GE	THQMV	225
						SGL1, SGL4, SGL6, SGP1, SGP4, SGP6	600
					Cutler Hammer	LDC, CLDC, HLD, CHLD	
					Siemens / ITE	HLD6, HLXD6	
					Square-D	QG, QJ	250
			100			HJ (Current Limiting)	150
						JJ (Current Limiting)	250
						LJ (Current Limiting)	600
			125			HL (Current Limiting)	150
						JL (Current Limiting)	250
						LL (Current Limiting)	600
			150		Siemens / ITE	3VA41, 3VA51	125
			200			3VA52	150
						3VA53	400
						3VA54	600
					Square-D	HR (Current Limiting)	150
						JR (Current Limiting)	250
						LR (Current Limiting)	600
					Eaton	PD2 (Current Limiting)	225
						PD3 (Current Limiting)	600
		150 200 230	50	480	Cutler Hammer	HFDE, FDC, FDCE	225
						NHH	250
						JDC, JGU, JGX	350
						HKD, CHKD, KDC, HKDB, CHKDB, LHH	400
						HLD, CHLD, LDC, CLDC, LGH*, LGC*, LGU*, LGX*	600
						HMDLB, CHMDLB	800
					GE	SEL, SEP	150
						SFL, SFP, FEN, FEH	250
						TBC4	400
						TJL4V, TJL1S-6S, TBC6, SGL1, SGL4, SGL6, SGP1, SGP4, SGP6, FGN, FGH, FGL, FGP	600
						TB8	800
					Siemens / ITE	HDG, LDG	150
						HFD, HFD6, HFXD, HFXD6, HHFD6, HHFXD6, CFD6, HFG, LFG	250
						HJD, HJD6, HJXD, HJXD6, SHJD, SHJD6, HHJD6, HHJXD6, CJD6, SCJD6, HJG, LJG, LLG	400

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (Amps)	WCR / Closing Rating kA RMS Symmetrical Amps	Volts Max	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (Amp Max) Per NEC
300 TS 4000 TS 7000 TS 7000 TB	J	150 200 230	50	480	Siemens / ITE	HLD6, HLXD6, HHLD6, HHLXD6, CLD6, SHLD6, SCLD6, HLG	600
					Square-D	KC, KI, CF250L, NSF250	250
						CK400N, CK400NN, CK400H, CK400HH, CJ400L, NSJ400	400
						LC, DJ, DL, LI, NSJ600	600
						MasterPact STR 28D, PK, PJ, PL	800
			65			HJ (Current Limiting)	150
						JJ (Current Limiting)	250
						LJ (Current Limiting)	600
			100			HL (Current Limiting)	150
						JL (Current Limiting)	250
						LL (Current Limiting)	600
			200			HR (Current Limiting)	150
						JR (Current Limiting)	250
						LR (Current Limiting)	600
			100		Eaton	PD2 (Current Limiting)	225
						PD3 (Current Limiting)	600
					ABB	XT2L	125
			65			XT2H	
			150			XT2V	
			65		Siemens	3VA41	
						3VA51	
			100			3VA52	150
			200			3VA61	
			42	600	Cutler Hammer	JGU, JGX, JGH	250
						KDC	400
						LDC,CLDC	600
					GE	TBC4	400
						SGL1, SGL4, SGL6, SGP1, SGP4, SGP6, FGP	600
					Square-D	KI, CF250L	250
						CK400H, CK400HH, CJ400L	400
						LI, MasterPact STR 28D, PK	600
					Siemens / ITE	HJD, CFD6	250
						HHJD6, HHJXD6, CJD6, SCJD6	400
						HHLD6, HHLXD6, CLD6, SCLD6, LNG, LPG, LGC*, LGU*, LGX*	600

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (Amps)	WCR / Closing Rating kA RMS Symmetrical Amps	Volts Max	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (Amp Max) Per NEC
300 TS 4000 TS 7000 TS 7000 TB	J	150 200 230	50	600	Square-D	HL (Current Limiting)	150
						JL (Current Limiting)	250
						LL (Current Limiting)	600
			100			HR Current Limiting)	150
						JR (Current Limiting)	250
						LR (Current Limiting)	600
			65		Eaton	PD3 (Current Limiting)	600
			42		ABB	XT2V	125
			100		Siemens	3VA61	150
		260	50	480	Cutler Hammer	HFDE, FDCE, HFD, FDC, LHH	225
						JDC, JGH, JGC, JGU, JGX	250
						HKD, HKDB, CHKD, CHKDB, KDC	400
						HLD, CHLD, LDC, CLDC, LGH*, LGC*, LGU*, LGX*, NHH	600
						MDL, CMDL, HMDL, CHMDL, NGS, NGH, NGC, MDLB, CMDLB, HMDLB, CHMDLB	800
					GE	SFL, SFP, FEN, FEH	250
						TBC4	400
						TBC6, TJL4V, TJL1S-6S, SGL1, SGL4, SGL6, SGP1, SGP4, SGP6, FGN, FGH, FGL, FGP	600
						TBC8, TKL4V, TKH8S-12S, TKL8S-12S, SKH8, SKL8, SKP8, TB8	800
					Siemens / ITE	HFD6, HFXD6, HHFD6, HH-FXD6, CFD6, HFG, LFG	250
						HJD6, HJXD6, SHJD6, HHJD6, HHJXD6, CJD6, SCJD6, HJG, LJG, LLG	400
						HLD6, HLXD6, SHLD6, HHLD6, HHLXD6, CLD6, SCLD6, HLG	600
						LMD, LMD6, LMXD, LMXD6, HLMD, HLMD6, HLMXD, HLMXD6, MD, MD6, MXD6, HMG, HMD6, HMXD6, SMD6, SHMD6, CMD6, SCMD6, LMG, MG	800
					Square-D	KI, KC, CF250L, NSF250	250
						CK400N, CK400NN, CK400H, CK400HH, CJ400L, NSJ400	400
						LC, DJ, DL, LI, NSJ600	600
						CK800N, CK800NN, CK800H, CK800HH, MasterPact STR 28D, MJ, PK, PJ, PL	800

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (Amps)	WCR / Closing Rating kA RMS Symmetrical Amps	Volts Max	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (Amp Max) Per NEC
300 TS 4000 TS 7000 TS 7000 TB	J	260	50	480	Square-D	CK1000HL	1000
						CK1200NN, CK1200HH	1200
			65			HJ (Current Limiting)	150
						JJ (Current Limiting)	250
						LJ (Current Limiting)	600
			100			HL (Current Limiting)	150
						JL (Current Limiting)	250
						LL (Current Limiting)	600
			200			HR (Current Limiting)	150
						JR (Current Limiting)	250
						LR (Current Limiting)	600
			100		Eaton	PD2 (Current Limiting)	225
						PD3 (Current Limiting)	600
			65		ABB	XT4H	250
			100			XT4L	
			150			XT4V	
			200		Siemens	3VA62	
			42	600	Cutler Hammer	JGU, JGX	250
						KDC	400
						LDC, CLDC	600
					GE	TBC4	400
						TBC6, SGL1, SGL4, SGL6, SGP1, SGP4, SGP6, FGP	600
						TBC8, TKL4V, TKL8S-12S, SKL8, SKP8	800
					Siemens / ITE	HJD, CFD6	250
						HHJD6, HHJXD6, CJD6, SCJD6	400
						HHLD6, HHLXD6, CLD6, SCLD6	600
						HLMD6, HLMXD6, HMXD6, SHMD6, HMD6, CMD6, SCMD6, LMG, LNG, LPG, LGC*, LGU*, LGX*	800
					Square-D	KI, CF250L	250
						CK400H, CK400HH, CJ400L	400
						LI	600
						CK800H, CK800HH, Master-Pact STR 28D, PK	800
			50			HL (Current Limiting)	150
						JL (Current Limiting)	250
						LL (Current Limiting)	600
			100			HR (Current Limiting)	150
						JR (Current Limiting)	250
						LR (Current Limiting)	600

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (Amps)	WCR / Closing Rating kA RMS Symmetrical Amps	Volts Max	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (Amp Max) Per NEC
300 TS 4000 TS 7000 TS 7000 TB	J	260	65	600	Eaton	PD3 (Current Limiting)	600
			50		ABB	XT4L	250
			65			XT4V	
			100		Siemens	3VA62	250
		400	50	480	Cutler Hammer	JGH, JGC, NHH	250
						HKD, CHKD, KDC, HKDB, CHKDB, LHH	400
						CHLD, LDC, CLDC, LGH*, LGC*, LGU*, LGX*	600
						MDL, CMDL, HMDL, CHMDL, NGS, NGH, NGC, MDLB, CMDLB, HMDLB, CHMDLB	800
						NGU	1600
					GE	TBC4	400
						TBC6, TJL4V, TJL1S-6S, SGL1, SGL4, SGL6, SGP1, SGP4, SGP6, FGN, FGH, FGL, FGP	600
						TBC8, TKL4V, TKH8S-12S, TKL8S-12S, SKH8, SKL8, SKP8, TB8	800
					Siemens/ ITE	HFD6, HFXD6, HFG, LFG	250
						HJD6, HJXD6, SHJD6, HHJD6, HHJXD6, CJD6, SCJD6, HJG, LLG, LJG	400
						HLD6, HLXD6, SHLD6, HHLD6, HHLXD6, CLD6, SCLD6, HLG	600
						LMD6, LMXD6, HLMD6, HLMXD6, MD6, MXD6, HMD6, HMXD6, SMD6, SHMD6, CMD6, SCMD6, HMG, LMG	800
					Square-D	CK400N, CK400NN, CK400H, CK400HH, CJ400L, NSJ400	400
						LC, DJ, DL, LI, NSJ600	600
						CK800N, CK800NN, CK800H, CK800HH, MJ	800
						CK1000HH	1000
						PK, PJ, PL, MH, MasterPact STR 28D, CK1200HH	1200
			65			JJ (Current Limiting)	250
						LJ (Current Limiting)	600
			100			JL (Current Limiting)	250
						LL (Current Limiting)	600
			200			JR (Current Limiting)	250
						LR (Current Limiting)	600
			100		Eaton	PD3 (Current Limiting)	600

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (Amps)	WCR / Closing Rating kA RMS Symmetrical Amps	Volts Max	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (Amp Max) Per NEC
300 TS 4000 TS 7000 TS 7000 TB	J	400	65	480	ABB	XT5H	400
			100			XT5L	
			150			XT5V	
			100		Siemens	3VA53	
			200			3VA63	
			42	600	Cutler Hammer	KDC	400
						LDC, CLDC, LGC*, LGU*, LGX*	600
					GE	TBC4	400
						TBC6, SGL1, SGL4, SGL6, SGP1, SGP4, SGP6, FGP	600
						TBC8, TKL4V, TKL8S-12S, SKL8, SKP8	800
					Siemens/ ITE	HHJD6, HHJXD6, CJD6, SCJD6	400
						HHLD6, HHLXD6, CLD6, SCLD6	600
						HLMD6, HLMXD6, HMXD6, SHMD6, HMD6, CMD6, SCMD6, LMG	800
						LNG, LPG	1200
					Square-D	CK400H, CK400HH, CJ400L	400
						LI	600
						CK800H, CK800HH	800
						MasterPact STR 28D, PK	1200
			50			JL (Current Limiting)	250
						LL (Current Limiting)	600
			100			JR (Current Limiting)	250
						LR (Current Limiting)	600
			65		Eaton	PD3 (Current Limiting)	600
			65		ABB	XT5L	400
			100			XT5V	
					Siemens	3VA63	
		600	50	480	Cutler Hammer	JGH, JGC, HFG, LFG	250
						HLD, CHLD, LDC, CLDC, LGH*, LGC*, LGU*, LGX*	600
						MDL, CMDL, HMDL, CHMDL, NGS, NGH, NGC, NGU, MDLB, CMDLB, NF	800
					GE	TBC6, TJL4V, TJL1S-6S, SGL1, SGL4, SGL6, SGP1, SGP4, SGP6, FGN, FGH, FGL, FGP	600
						TBC8, TKL4V, TKH8S-12S, TKL8S-12S, SKH8, SKL8, SKP8, TB8	800
						SKL12, SK12P	1200

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (Amps)	WCR / Closing Rating kA RMS Symmetrical Amps	Volts Max	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (Amp Max) Per NEC
300 TS 4000 TS 7000 TS 7000 TB	J	600	50	480	Siemens/ ITE	HLD6, HLXD6, SHLD6, HHLD6, HHLXD6, CLD6, SCLD6, HLG LLG	600
						LMD6, LMXD6, HLMD6, HLMXD6, MD6, MXD6, HMD6, HMXD6, SMD6, SHMD6, CMD6, SCMD6, HMG, LMG	800
						HND6, HNXD6, SND6, SHND6, ND6, NXD6, HNG, LNG, CND6	1200
					Square-D	LC, DJ, DL, LI, NSJ600	600
						CK800N, CK800NN, MJ	800
						MH, CK1200N, CK1200NN, CK1200H, CK1200HH, NT-H, NT-L1, NT-L, NT-LF, PK, PJ, PL	1200
						CM2000HH	2000
						CM2500HH	2500
			85			PL1200	1200
			65			LJ (Current Limiting)	600
			100			LL (Current Limiting)	
			200			LR (Current Limiting)	
			100		Eaton	PD3 (Current Limiting)	
			65		ABB	XT5H	
			100			XT5L	
			150			XT5V	
			100		Siemens	3VA54	600
			200			3VA64	
			42	600	Cutler Hammer	JGC	250
						TBC4	400
						LDC, CLDC	600
					GE	TBC6, SGL1, SGL4, SGL6, SGP1, SGP4, SGP6, FGP	600
						TBC8, TKL4V, TKL8S-12S, SKL8, SKP8	800
						SKL12, SKP12	1200
					Siemens/ ITE	HHLD6, HHLXD6, CLD6, SCLD6	600
						HLMD6, HLMXD6, HMXD6, SHMD6, HMD6, CMD6, SCMD6, LMG	800
						HND6, HNXD6, HNG, LNG, SHND6	1200
					Square-D	LI	600
						CK800H, CK800HH	800
						CK1000HL	1000

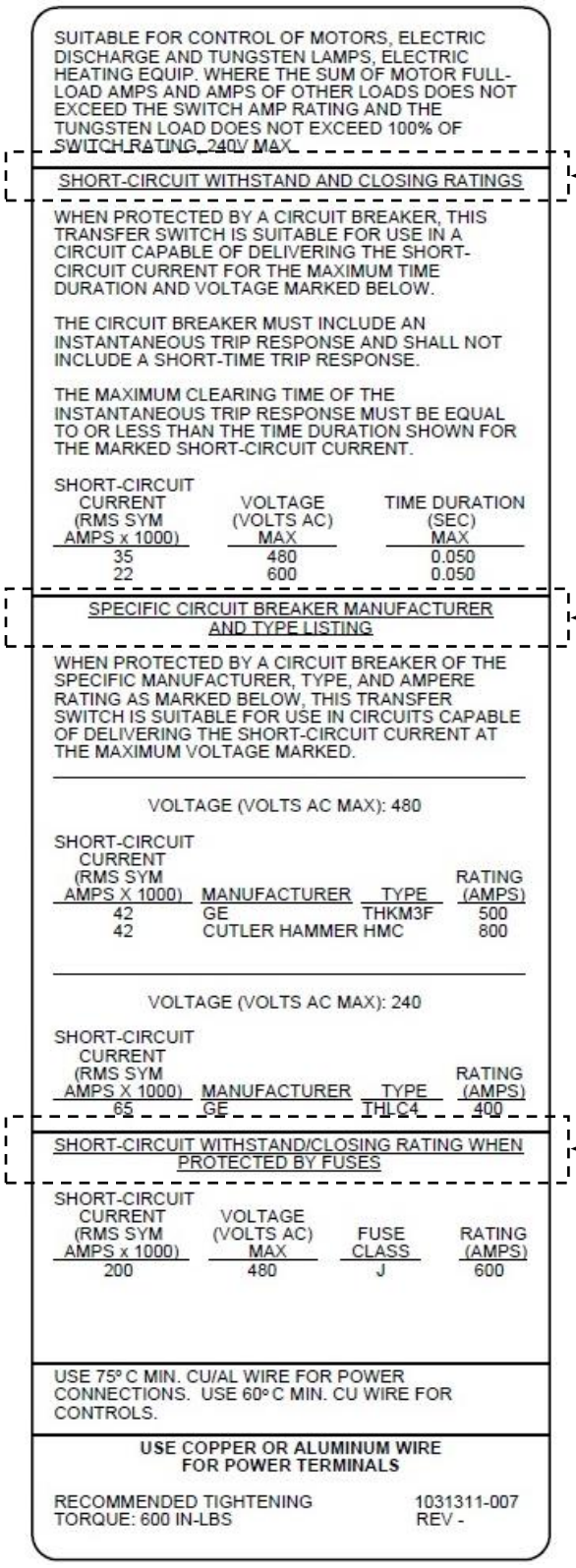
ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (Amps)	WCR / Closing Rating kA RMS Symmetrical Amps	Volts Max	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (Amp Max) Per NEC
300 TS 4000 TS 7000 TS 7000 TB	J	600	42	600	Square-D	CK1200H,CK1200HH, NT-H, NT-L, NT-LF, NT-L1, Master-Pact STR 28D, PK	1200
			50			LL (Current Limiting)	600
			100			LR (Current Limiting)	
			65		Eaton	PD3 (Current Limiting)	
			65		ABB	XT5L	
			100			XT5V	
			200		Siemens	3VA64	
						3VA54	
						3VA55	800
						3VA56	
						3VA66	1000
	H P**	600 800 960 1000 1200	65	480	Cutler Hammer	HLD, CHLD, LGH, LGC, LGU, LGX, LDC, CLDC	600
						HMDL, CHMDL, HMDLB, CHMDLB	800
						HND, CHND, NDC, CNDC, NF	1200
						NGH, NGC, NGU	1600
						RGH, RGC	2500
					GE	TBC6, TJL4V, SGL, SGP6	600
						TBC8, SKL8, SKP8	800
						SKL12, SKP12, TKL4V	1200
					Siemens/ ITE	HLXD6, HHLXD6, HHLD6, CLD6, SHLD6, SCLD6, HLG, LLG	600
						HMXD6, HMD6, SHMD6, HMG, LMG, CMD6, SCMD6	800
						SHND6, CND6, HNXD6, HNG, LNG	1200
						HPG, LPG, HPD, HPD6, CPD6, HPXD, HPXD6, SHPD, SHPD6	1600
						HRD6, HRXD6	2000
					Eaton	PDG4xM, PDF4xM	1000
						PDG5xM, PDF5xM	1200
					Square- D	LI, LE LSI, LE LI, LX, LXI, LJ, LL, LR	600
						MJ, ME, MX, CK800H, CK-800HH	800
						CK1000HL	1000
						NT-L1, NT-L, NT-LF, NE, NX, CK1200H, CK1200HH, PJ, PL	1200
						NW, RJ, RL, MTZ	1600
						PE, PX	2500

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (Amps)	WCR / Closing Rating kA RMS Symmetrical Amps	Volts Max	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (Amp Max) Per NEC
300 TS 4000 TS 7000 TS 7000 TB	H P**	600 800 960 1000 1200	65	480	Square- D	SES, SE, SEH (LS or LSI TRIP)	3000
						SE (LI, LSI-E, and LI-E TRIP)	4000
						MasterPact STR 28D	6300
7000 TB			150			MTZ2-16LF1	1600
			65		ABB	Formula A	250
300 TS 4000 TS 7000 TS 7000 TB						XT5H	600
						XT6H	800
			65			XT7H	1200
			100			XT5L	600
			150			XT5V	
			100		Siemens	3VA54	600
						3VA55	800
						3VA65	
						3VA66	1000
			200			3VA64	600
			65			3VA57, 3VA67	1200
			65	600	Cutler Hammer	TRI-PAC NB	800
						RDC	2500
					Siemens/ ITE	CND	1200
					ABB	XT5L	600
			100			XT5V	
					Siemens	3VA64	
300 TS 7000 TS 7000 TB	G	1600 2000 2600 3000	125	480	Square-D	MTZ2/3-L	3000
7000 TB						Master Pact NW-L	
7000 TS[1] 7000 TB		1600 2000	150			MTZ2-LF	2000
			200			MTZ2-L1/L1F	

*: With Digitrip 310+ LS or LSG Inst. Override set to 12X

**: P Frames only available as 7000TS and 7000TB

Note 1: Rear Connected Only



SUITABLE FOR CONTROL OF MOTORS, ELECTRIC DISCHARGE AND TUNGSTEN LAMPS, ELECTRIC 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 100% OF SWITCH RATING. 240V MAX.

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.

SHORT-CIRCUIT CURRENT (RMS SYM AMPS x 1000)	VOLTAGE (VOLTS AC) MAX	TIME DURATION (SEC) MAX
35	480	0.050
22	600	0.050

SPECIFIC CIRCUIT BREAKER MANUFACTURER AND TYPE LISTING

WHEN PROTECTED BY A CIRCUIT BREAKER OF THE SPECIFIC MANUFACTURER, 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.

VOLTAGE (VOLTS AC MAX): 480

SHORT-CIRCUIT CURRENT (RMS SYM AMPS X 1000)	MANUFACTURER	TYPE	RATING (AMPS)
42	GE	THKM3F	500
42	CUTLER HAMMER	HMC	800

VOLTAGE (VOLTS AC MAX): 240

SHORT-CIRCUIT CURRENT (RMS SYM AMPS X 1000)	MANUFACTURER	TYPE	RATING (AMPS)
65	GE	THLC4	400

SHORT-CIRCUIT WITHSTAND/CLOSING RATING WHEN PROTECTED BY FUSES

SHORT-CIRCUIT CURRENT (RMS SYM AMPS x 1000)	VOLTAGE (VOLTS AC) MAX	FUSE CLASS	RATING (AMPS)
200	480	J	600

USE 75° C MIN. CU/AL WIRE FOR POWER CONNECTIONS. USE 60° C MIN. CU WIRE FOR CONTROLS.

USE COPPER OR ALUMINUM WIRE FOR POWER TERMINALS

RECOMMENDED TIGHTENING TORQUE: 600 IN-LBS

1031311-007 REV -

These are the “Time Based” ratings for the transfer switch. For this switch the rating is 35,000 RMS amps symmetrical at 480 volts and 22,000 RMS amps at 600 volts.

This area indicates the “Specific Breaker” ratings, maximum voltage, breaker manufacturer, breaker type, and maximum frame size. This switch is rated either 65,000 RMS amps at 240 volts or 42,000 RMS amps at 480 volts for the specific breakers listed.

Shown here is the rating when used with current limiting fuses of the Class J maximum size indicated on the label. This switch is rated for 200,000 RMS amps when used with Class J fuses 600 amps or less.

Figure 2. Typical rating label for ASCO 400 amp Transfer Switch.

MARKING REQUIREMENTS

UL requires markings on each switch listing the approved short circuit ratings for each product and its ampacity. ASCO switches display rating labels similar to the one shown in Figure 2. would leave the other feeder circuits (F1 & F3 - F7) in operation. A coordination study will determine the magnitude of fault current at the load side of the transfer switch and indicate the settings for F2.

SPECIAL APPLICATION CONSIDERATIONS

ASCO Power Technologies provides a line of switches which are highly reliable, utilize latest technology, include features most frequently used by the consulting engineer, and which are rated to meet a wide variety of requirements. For special applications, such as when higher ratings or longer withstand times are needed, the system designer can consider several rating alternatives:

1. Consider relocating the switch closer to the load where the added impedance of the feeder conductors will reduce the available fault current to an acceptable level. This is consistent with good engineering practice of locating transfer switches as close to the load as possible in order to minimize the risk of conductor failures between the load side of the switch and the utilization equipment.

2. Use current limiting fuses or current limiting circuit breakers to reduce fault currents.

3. Use a larger ampacity switch with a higher withstand/closing rating.

4. When the overcurrent protective device ahead of the transfer switch has a clearing time exceeding three cycles, a zone selective interlocking scheme may be considered. Such a scheme permits intentional delays to be over-ridden and the breaker to trip instantaneously whenever the fault is within the breaker’s zone of primary protection.

5. Contact ASCO Power Technologies to determine if additional ratings are available.

HOW TO SPECIFY WITHSTAND AND CLOSING RATINGS

Calculated values of available fault current should be specified for each transfer switch based on its location in the electrical system. This will assure that a properly rated switch will be applied and avoid specified ratings which are too low for the actual location (resulting in an unsafe practice or ratings which are too high (resulting in unnecessarily higher costs).

A growing number of specifying professionals are adding fault current withstand and closing current tables to the electrical plans showing the calculated values for each switch. A typical arrangement is shown in Table IV.

Table IV. Typical Listings of Transfer Switch Fault Current Ratings on an Electrical Plan

Transfer Switch Ident. No.	No. of Poles	Switched Neutral Y/N	Transfer Switch Ampacity	System Voltage	Calculated Fault Currents		Type of OCD
					RMS Sym. Amperes	X/R Ratio	
ATS-E8	4	Y	260	480/277	29,000	2.3	MCCB
ATS-E9	3	N	400	480	33,000	2.3	MCCB
ATS-LS1	4	Y	100	480/277	7,300	2.1	MCCB
ATS-LS2	4	Y	150	480/277	8,900	2.4	MCCB
ATS-EQ1	3	N	1000	480	48,000	3.2	MCCB

IMPORTANCE OF X/R RATIO

The circuit reactance to resistance ratio (X/R) is a determinant in preparing fault current studies. Consideration should be given to the X/R ratio at each transfer switch location. The actual X/R ratio should not exceed the X/R ratio at which the transfer switch was tested. Table V shows the power factor test requirements of UL 1008 with equivalent X/R ratios. If an application requires higher X/R ratios, consider the Special Application Considerations previously discussed or consult ASCO Power Technologies for a recommendation. By using the information in this publication and calculating short circuit currents, the system designer can be assured that the transfer switches will be properly rated for the electrical system.

Table V. UL Maximum Test Factor with Equivalent X/R Ratio

Available Fault Current (amperes)	Maximum Test Power Factor	Equivalent X/R Ratio
10,000 or less	0.50	1.73
10,001 – 20,000	0.30	3.18
greater than 20,000	0.20	4.90

SUGGESTED FAULT CURRENT STUDY REFERENCE GUIDES

1. The Institute of Electrical and Electronics Engineers, Inc., IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems, IEEE Buff Book, ANSI/IEEE Std. 242-1986, New York, N.Y., pp. 45-113.

2. The Institute of Electrical and Electronics Engineers, Inc., IEEE Recommended Practice for Electric Power Distribution for Industrial Plants, IEEE Red Book, ANSI/IEEE Std. 141-1993, New York, N.Y., pp. 109-184.

3. The Institute of Electrical and Electronics Engineers, Inc., IEEE Recommended Practice for

4. Power System Analysis, IEEE Brown Book, ANSI/IEEE Std. 399-1990, New York, N.Y., pp. 171-194. The Institute of Electrical and Electronics Engineers, Inc., IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications, IEEE Orange Book, ANSI/IEEE Std. 446-1995, New York, N.Y., pp. 175196.

5. The Institute of Electrical and Electronics Engineers, Inc., IEEE Recommended Practice for Electric Systems in Health Care Facilities, IEEE White Book, ANSI/IEEE Std. 602-1996, New York, N.Y., pp. 50-51; 72-74.

6. Frank W. Kussy and Jack L. Warren, Design Fundamentals for Low-Voltage Distribution and Control, Marcel Dekker Inc., pp. 104-117, 1987.

7. Hermann W. Reichenstein, Applying Low-Voltage Fuses-Classes and Characteristics, McGraw-Hill Inc., 1979.

In addition to the above, most manufacturers of overcurrent protective devices can provide application data on calculating short circuit currents. Various software packages are also available to assist the application engineer in performing calculations by computer.

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