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.

Guidelines for using the information in this publication to verify suitability of switches for specific applications based on withstand current ratings

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 Table II on page 3. Select the switch rating necessary to handle the full load current. Compare the fault current available at the switch to the withstand current rating (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 WCR from Table II, the switch selected is suitable for the application.
4. If the prospective fault current is greater than the WCR obtained from Table II, refer to Table III on pages 3-7. Compare the fault current to the WCR shown in Table III. If the fault current is equal to or less than the WCR shown in Table III, 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 current limiting fuses refer to Table II on page 3. If there are any questions about the suitability of the switch when protected by current limiting fuses contact ASCO Power Technologies.

Introduction

This publication provides information on withstand current ratings (WCRs) for ASCO transfer switches and related products, including compliance with the optional 1½ and 3 cycle "any breaker" WCRs and other revisions to UL 1008. Also included are guidelines for special WCR applications and typical methods for specifying WCR requirements.

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 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. Referring to Figure 1, a fault at point A should be cleared by the switchgear feeder breaker F_2 and not by M. This would leave the other feeder circuits (F_1 & F_3 - F_7) 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 F_2.

Consider a fault at point B on the load side of the breaker feeding L_1 as shown in Figure 1. If the system breakers have been coordinated properly, the breaker feeding L_1 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.

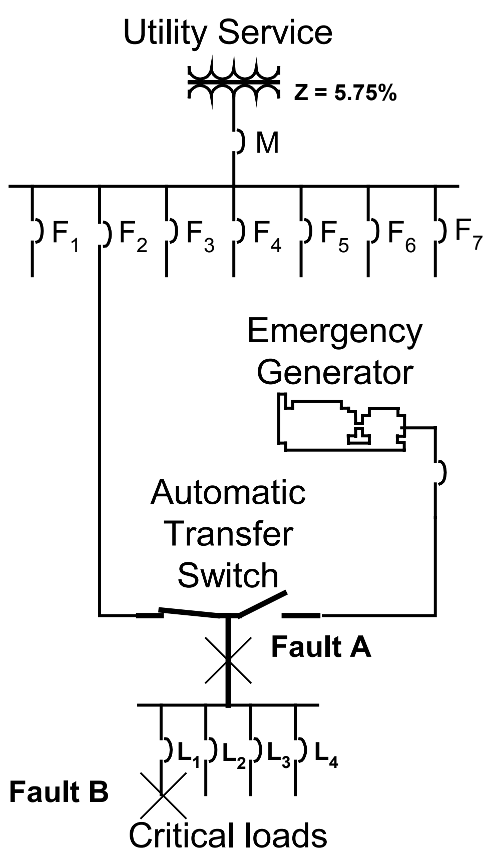


Figure 1. Line diagram of a typical emergency power system.

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 with-stand current rating, severe damage and a potential fire hazard could result from the fault current. Over-rating the transfer switch to achieve a sufficient withstand current rating 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 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 redefine 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 "any breaker" were selected.

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 current ratings of the overlapping neutral transfer pole is identical to the WCR of the phase switching poles.

See page 6, *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	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 Bypass-Isolation 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

Table II. Withstand / Closing Ratings for ASCO Transfer Switches
Used with "Any Circuit Breaker"[1] or Current Limiting Fuses

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (amps)	Withstand / Closing Ratings (RMS Symmetrical Amps)						
			When Protected With Any Circuit Breaker			When Protected With Current Limiting Fuses			
			Volts max.	KA max.	Time Cycles @ 60Hz	kA	Volts max.	Max. Fuse Size (amps)	Fuse Class
165 TS	D	100, 200, 230	240	10	1.5	—			
4000 TS 7000 TS 4ATS, 7ATS 4NTS, 7NTS 7MTS	D	30	600	10	1.5	100	480	60	J
		70, 100, 125, 150				200		200	
		200	480						
		230				100		300	
	J	150 [2], 260, 400, 600 [2]	600	35	3	200	600	600	
			240	65				800	L
	H	800, 1000, 1200	600	50				1600	
				36	18				
7000 TB	E	150	480	35	3	200	480	450	J
			600	22				600	
		260, 400	480	35					
	H	600, 800, 1000, 1200	600	50			600	1600	L
				36	18				
4000 TS 7000 TS 7000 TB	G	1600, 2000 front connected	600	85	3	200	600	3000	L
		1600, 2000		100					
		2600, 3000						4000	
	E	4000		100			480	6000	

[1] Any breaker ratings based on 3 cycle duration for 260-4000 amp continuous ratings and 1-1/2 cycles for 30-230 amp.
[2] J 150 amp is 4ACTS, 4ADTS, 7ACTS, 7ADTS, & 7ASLS only.

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)	Withstand / Closing Rating kA RMS Symmetrical amps	Volts max.	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (amps max.) Per NEC
300	D	30	10	600	Any	Any Breaker	
300 386 4000 TS 7000 TS	D	70	22	480	GE	TB1	100
						TEL, THED, THLC1, THLC2	150
						TFL	225
					I-T-E	CED6, ED6, HED4, HED6	125
						CFD6	150
						FD6, FXD6, HFD6	250
					Square-D	FH	80
						FC, FI	100
						KA, KC, KH, KI, LA, LH	250
					Cutler-Hammer	FCL, TRI-PAC FB	100
						FD, FDC, HFD	150
						HJD, JD, JDB, JDC	250
						HKD, KD, KDB,KDC,LCL,TRI-PAC LA	400
					ABB	S1	125
						S3	150
					Merlin Gerin	CE104, CE106	100

Table III. continued

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (amps)	Withstand / Closing Rating kA RMS Symmetrical amps	Volts max.	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (amps max.) Per NEC
300 386 4000 TS 7000 TS	D	100	22	480	GE	TB1	100
						TEL, THED, THLC1, THLC2	150
						TFL	225
					I-T-E	CED6, ED6, HED4, HED6	125
						CFD6	150
						FD6, XD6, HLD6	250
					Square-D	FC, FI	100
						KA, KC, KH, KI, LA, LH	250
					Cutler-Hammer	FCL, TRI-PAC FB	100
						FD, FDC, HFD	150
						HJD, JD, JDB, JDC	250
						HKD,KD,KDB,KDC, LCL, TRI-PAC LA	400
					ABB	S1	125
						S3	150
					Merlin Gerin	CE104, CE106	100
						CF250	250
4000 TS 7000 TS	D	125	22	480	GE	TEL, THED, THLC1	150
						TFL, THFK, THLC2	225
						SFL, SFP, TFJ, TFK	250
						SGL4, SGP4, TLB4	400
					I-T-E	CFD6	200
						FD6, FXD6, HFD6	250
					Square-D	KA, KC, KH, KI	250
					Cutler-Hammer	FD, FDC, HFD	150
						HJD, JD, JDB, JDC	250
						HKD, KD, KDB,KDC,LCL,TRI-PAC LA	400
					ABB	S3	150
					Merlin Gerin	CF250	250
300 386 4000 TS 7000 TS	D	150 200 230	22	480	GE	TEL, THED, THLC1	150
						TFL, THFK, THLC2	225
						SFL, SFP, TFJ, TFK	250
						SGL4, SGP4, TLB4	400
					I-T-E	CFD6, FD6, FXD6, HFD6	250
						CJD6, HHJD6, HHJXD6, HJD6, JD6, JXD6, SCJD6	400
						SHJD6, SJD6	400
					Square-D	KA, KC, KH, KI	250
						LC, LI	300
						LA, LH	400
					Cutler-Hammer	FD, FDC, HFD	150
						JD, JDB, JDC, HJD	250
						HKD, KD, KDB,KDC,LCL,TRI-PAC LA	400
					ABB	S3	150
					Merlin Gerin	CF250	250
						CJ400	400
300, 386 4000 TS 7000 TS	D	150 200 230	42	240	Square-D	JG	250
7000 TB	E	150	42	480	GE	TEL, THED, THLC1	150
						TFL, THLC2	225
						SFL, SFLA, SFP	250
						SGL4, SGP4, TB4, THLC4, TLB4	400
						SGLA, SGL6, SGP6, TB6	600
					I-T-E	CFD6, HFD6	250
						CJD6, HHJD6, HHJXD6, HJD6, SCJD6, SHJD6	400
						CLD6, HHLD6, HHLXD6, HLD6, SHLD6	600
					Square-D	KC, KI	250
						LC, LI	400
					Cutler-Hammer	HJD, JDC	250
						HKD, KDC, LCL, TRI-PAC LA	400
						HLD	600
						TRI-PAC NB	800
					ABB	S3	150
					Merlin Gerin	CF250	250
						CJ400	400

Table III. continued

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (amps)	Withstand / Closing Rating kA RMS Symmetrical amps	Volts max.	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (amps max.) Per NEC
4000 CTS 4000 DTS 7000 CTS 7000 DTS	J	150	50	480	Cutler-Hammer	HJD, JDC, JGH, JGC	250
						HKD, CHKD, KDC	400
						HLD, CHLD, LDC, CLDC	600
					GE	SFL, SFP	250
						TJL4V, TJL1S-6S	600
						SGL1, SGL4, SGP1, SGP4	600
					Siemens	HFD, HFXD	250
						HJD, HJXD, SHJD	400
					Square-D	KC	250
						CK400N, CK400NN, CM1250HH	400
			42	600	Cutler-Hammer	JGC	250
						KDC	400
						LDC, CLDC	600
					GE	SGL1, SGL4, SGP1, SGP4	600
300 386 7000 TB	E	260	42	480	GE	TFL, THLC2	225
						SFL, SFLA, SFP	250
						SGL4, SGP4, TB4, THLC4, TLB4	400
						SGLA, SGL6, SGP6, TB6	600
						SKHA, SKLB, SKP8, TKL	800
					I-T-E	CFD6, FD6, FXD6,	250
						CJD6, HHJD6, HHJXD6, HJD6, JD6, JXD6, SCJD6	400
						SHJD6, SJD6	400
						CLD6, HHLD6, HHLXD6, HLD6, SCLD6, SHLD6	600
						CMD6, HMD6, HND6, MD6, MXD6, SCMD6, SHMD6	800
						SMD6, SND6	800
					Square-D	KC, KI	250
						LC,LI	600
						MH	800
					Cutler-Hammer	HJD, JDC	250
						HKD, KDC, LCL, TRI-PAC LA	400
						HLD	600
						TRI-PAC NB	800
					ABB	S5	400
						56	800
					Merlin Gerin	CF250	250
						CJ400	400
4000 TS 7000 TS	J	260	50	480	Cutler-Hammer	HJD, JDC, JGH, JGC	250
						HKD, CHKD, KDC	400
						HLD, CHLD, LDC, CLDC	600
						MDL, CMDL, HMDL, CHMDL, NGS, NGH, NGC	800
					GE	SFL, SFP	250
						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
					Siemens	HFD, HFXD	250
						HJD, HJXD, SHJD	400
						HLD, HLXD, SHLD	600
						LMD, LMXD, HLMD, HLMXD, HMG	800
						MD, MXD, HMD, HMXD, SMD, SHMD	800
					Square-D	KC	250
						CK400N, CK400NN, CM1250HH	400
						LC	600
						CK800N, CK800NN, CM1600HH	800
			42	600	Cutler-Hammer	HJD, JGC	250
						KDC	400
						LDC, CLDC	600
					GE	TBC4	400
						TBC6, SGL1, SGL4, SGL6, SGP1, SGP4, SGP6	600
						TBC8, TKL4V, TKL8S-12S, SKL8, SKP8	800
					Siemens	HLMD, HLMXD, HMD, HMXD, SHMD	800

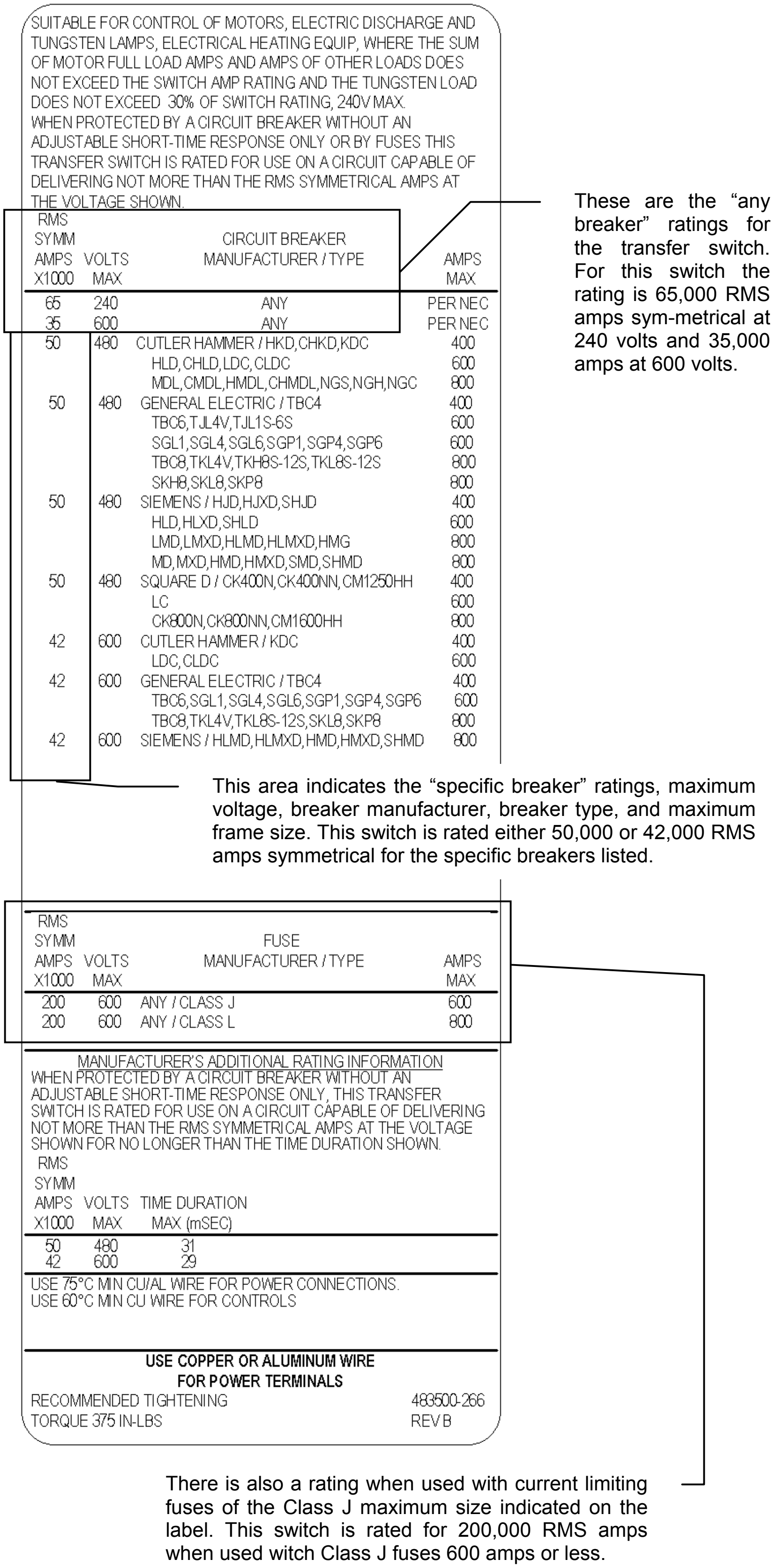
Table III. continued

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (amps)	Withstand / Closing Rating kA RMS Symmetrical amps	Volts max.	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (amps max.) Per NEC
4000 TS 7000 TS	J	400	50	480	Cutler-Hammer	HKD, CHKD, KDC	400
						HLD, CHLD, LDC, CLDC	600
						MDL, CMDL, HMDL, CHMDL, NGS, NGH, NGC	800
					GE	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
					Siemens	HJD, HJXD, SHJD	400
						HLD, HLXD, SHLD	600
						LMD, LMXD, HLMD, HLMXD, HMG	800
						MD, MXD, HMD, HMXD, SMD, SHMD	800
					Square-D	CK400N, CK400NN, CM1250HH	400
						LC	600
						CK800N, CK800NN, CM1600HH	800
			42	600	Cutler-Hammer	KDC	400
						LDC, CLDC	600
					GE	TBC4	400
						TBC6, SGL1, SGL4, SGL6, SGP1, SGP4, SGP6	600
						TBC8, TKL4V, TKL8S-12S, SK8L, SK8P	800
					Siemens	HLMD, HLMXD, HMD, HMXD, SHMD	800
300 386 7000 TB	E	400	42	480	GE	SGL4, SGP4, TB4, THLC4, TLB4	400
						SGLA, SGL6, SGP6, TB6	600
						SKHA, SKL8, SKP8, TKL	800
					I-T-E	CJD6, HHJD6, HHJXD6, HJD6, SCJD6, SHJD6	400
						CLD6, HHLD6, HHLXD6, HLD6, SCLD6, SHLD6	600
						CMD6, HMD6, HND6, MD6, MXD6, SCMD6, SHMD6	800
						SMD6, SND6	800
					Square-D	LC, LI	600
						MH	800
					Cutler-Hammer	HKD, KDC, LCL, TRI-PAC LA	400
						HLD	600
						TRI-PAC NB	800
					ABB	S5	400
						S6	800
					Merlin Gerin	CJ600	600

Table III. continued

ASCO Transfer Switch Product	Transfer Switch Frame Prefix	Transfer Switch Rating (amps)	Withstand / Closing Rating kA RMS Symmetrical amps	Volts max.	Circuit Breaker Manufacturer	Circuit Breaker Type or Class	Circuit Breaker Rating (amps max.) Per NEC
300 386 4000 TS 7000 TS	J	600	50	480	Cutler-Hammer	HLD, CHLD, LDC, CLDC	600
						MDL, CMDL, HMDL, CHMDL, NGS, NGH, NGC	800
					GE	TBC6, TJL4V, TJL1S-6S	600
						SGL1, SGL4, SGL6, SGP1, SGP4, SGP6	600
						TBC8, TKL4V, TKH8S-12S, TKL8S-12S	800
						SKH8, SKL8, SKP8	800
					Siemens	HLD, HLXD, SHLD	600
						LMD, LMXD, HLMD, HLMXD, HMG	800
						MD, MXD, HMD, HMXD, SMD, SHMD	800
						ND, NXD, HND, HNXD, HNG, SND, SHND	1200
					Square-D	CK400N, CK400NN, CM1250HH	400
						LC	600
						CK800N, CK800NN, CM1600HH	800
						CM2000HH	1000
						MH, CK1200N, CK1200NN, CM2500HH	1200
			42	600	Cutler-Hammer	LDC, CLDC	600
					GE	TBC6, SGL1, SGL4, SGL6, SGP1, SGP4, SGP6	600
						TBC8, TKL4V, TKL8S-12S, SKL8, SKP8	800
					Siemens	HLMD, HLMXD, HMD, HMXD, SHMD	800
						HND, HNXD, HNG, SHND	1200
300 386 4000 TS 7000 TS 7000 TB	H	600 [4] 800 1000 1200	65	480	GE	TB8	800
						MICROVERSATRIP TKL	1200
					I-T-E	CLD6, HHLD6, HHLXD6, HLD6, SCLD6, SHLD6	600
						CMD6, HMD6, SCMD6, SHMD6	800
						CND6, HND6, SCND6, SHND6	1200
						CPD6	1600
					Square-D	MH SERIES 2	1000
						SE (LS TRIP), SHE (LS TRIP)	2500
				600	Cutler-Hammer	TRI-PAC NB	800
						TRI-PAC PB	1600
						RDC	2500
			42	480	ABB	S6	800
						S7	1200
					Merlin Gerin	CJ600	600
						CK1200	1200

[4] H 600 amp is 4000 TS, 7000 TS & 7000 TB only. Use J 600 amp for Series 300 & 386.



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 X1000	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

RMS SYMM AMPS X1000	VOLTS MAX	FUSE MANUFACTURER / TYPE	AMPS MAX
200	600	ANY / CLASS J	600
200	600	ANY / CLASS L	800

MANUFACTURER'S ADDITIONAL RATING INFORMATION
WHEN PROTECTED BY A CIRCUIT BREAKER WITHOUT AN ADJUSTABLE SHORT-TIME RESPONSE ONLY, THIS TRANSFER SWITCH IS RATED FOR USE ON A CIRCUIT CAPABLE OF DELIVERING NOT MORE THAN THE RMS SYMMETRICAL AMPS AT THE VOLTAGE SHOWN FOR NO LONGER THAN THE TIME DURATION SHOWN.

RMS SYMM AMPS X1000	VOLTS MAX	TIME DURATION MAX (mSEC)
50	480	31
42	600	29

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 375 IN-LBS
483500-266 REV B

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 ea ch product and its ampacity. ASCO switches display rating labels similar to the one shown in Figure 2.

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 specifiers 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 Power System Analysis*, IEEE Brown Book, ANSI/IEEE Std. 399-1990, New York, N.Y., pp. 171-194.
4. 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. 175-196.
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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