Technique	Ground Support Equipment (GSE) and Facility Equipment Maintenance Program enhancement by adoption of a maintenance practice that provides maintenance and text criteria for electrical circuit breakers.

Maintenance & Test Criteria for Circuit Breakers

Reduces unscheduled maintenance and enhances Reliability

Benefits	Proper maintenance and testing of electrical circuit breakers will enhance system/equipment performance, reliability, and overall availability. Cost savings are realized through testing of circuit breakers prior to or during installation by eliminating damage to other equipment/components caused by defective circuit breakers. Testing will also alert maintenance and logistic to examine existing inventories for other defective circuit breakers. Proper maintenance of circuit breakers will enhance circuit breaker life expectancy as well as the system/equipment it supports. Downtime for unscheduled maintenance is also minimized through proper maintenance and testing of circuit breakers.
Key Words	Circuit breaker test criteria, circuit breaker maintenance.
Application Experience	Kennedy Space Center Shuttle Processing contractor.
Technical Rationale	While this practice may seem to be one that would routinely be found in a maintenance program, in reality that's not so. All too often it is assumed that a new part is not only serviceable, but that it also meets the specification requirements as advertised. However, due to process variables, inspection techniques, and even fraud, this is not always the case. Example: in February 1992 KSC was alerted by NASA HQ/Code QR that the Nuclear Regulatory Commission working with the Inspector General was issuing a GIDEP/Alert on suspect circuit breakers. The situation described that a particular vendor took used circuit breakers from various manufacturers, refurbished the exterior only, falsified circuit breaker data and sold them as new components. These breakers had experienced premature trip, failure to trip (some breakers were not of proper amperage, i.e., mislabeled), and some had exploded. Had KSC not had practice GP-1002, "Maintenance and Test Criteria for Circuit Breakers," in place, suspect circuit breakers could have easily been introduced into KSC's GSE and Facility equipment supporting the Space Shuttle Program. A maintenance program that provides for testing of circuit breakers prior to or upon installation will eliminate these types of failures.
Contact Center	**Kennedy Space Center(KSC)**

Maintenance & Test Criteria for Circuit Breakers
Technique AT-7

In developing a maintenance practice for circuit breakers one should first identify what type of circuit breakers are used (examples; molded-case, draw-out, high-voltage, etc.). Once the circuit breaker types are identified, one can start to identify the criterion for circuit breaker inspection, test, and maintenance. There are many sources of information available to assist one in defining this criterion (example: Federal & Military Specifications/Standards, Air Force Manuals/Regulations, American National Standards Institute (ANSI), National Electrical Manufacturers' Association (NEMA), etc.).

The practice should address safety. Safety should be a prime consideration to all concerned in the planning, scheduling, and accomplishment of the work. Supervisors should brief all personnel, prior to the start of each operation, concerning the hazards that may be encountered and the appropriate safety practices to be observed. Supervisors should ensure that only properly trained and qualified personnel participate and that all personnel are equipped with the tools and equipment necessary to the job safety.

Specific safety hazards that may be encountered while working with circuit breakers should be identified. For example; electric shock and secondary injuries caused by contact with energized circuits or devices that are electrostatically charged after removal of test potential. Also physical damage resulting from short circuits, insulation failures, or faulty equipment.

Identification of safety equipment that is required when working on circuit breakers should be provided. This equipment may consist of nonmetallic hardhats with chin straps, safety goggles, rubber gloves, sleeves, blankets/mats as required, area barricades and signs.
Safety precautions that personnel should be aware of should be identified. For example; turn off power, look out, and disconnect sources of electrical energy before working on equipment. Use of insulated hand tools designed for specific work. Use of protective equipment such as safety-approved rubber-insulated gloves with protectors, insulating blankets/mats, and non-metallic hardhats. Wear safety eye-protection glasses if there is a possibility of arcing or sparking. Ensure that non-current carrying metallic parts of equipment are grounded. Inspect visually or conduct tests to determine the adequacy of grounds.

The following is extracted from KSC GP-1002 and illustrates how that practice addressed one of the types of circuit breakers found at KSC.

Molded-Case Circuit Breakers

1. *Application*. Molded-case circuit breakers are used to interrupt fault currents, to provide overload protection, and to switch the electrical circuit.

2. *Construction*. Molded-case circuit breakers contain two elements: a switch consisting of a set of contacts with suitable mechanical linkage to operate the contacts; and a trip unit which is an overload and fault sensing device.

3. *Operation*. When the thermal or magnetic trip senses an overload condition in the electrical circuits, a spring-loaded latch is tripped. The released spring mechanism rapidly opens the breaker contacts and de-energizes the faulted circuit.

Most molded-case circuit breakers are equipped with a thermal element composed of a bimetallic strip to provide a time delay and establish the tripping characteristics.

The instantaneous-trip device is magnetic. High current flow through the breaker picks up the armature of the magnetic trip device. Movement of the armature releases the latch and opens the breaker contacts. Some breakers are available with an adjustable instantaneous trip. The pickup of this trip may be changed in the field from approximately 5 to 10 times the continuous rating of the breaker.

Breakers labeled "nonautomatic' have no trip unit and are used as load interrupting switches only.

4. Maintenance.

(1) *Preventive Maintenance.* Circuit breakers shall be exercised at intervals recommended in Table 1. If the circuit breaker is equipped with a trip indicator, exercise it to verify that it also operates properly. During routine maintenance, check molded-case circuit breakers for improper terminal connection at the time of installation, distorted plug-in tabs or sockets, poorly cleaned or corroded conductors, improper conductors for the lugs in use, and loose terminations. All of the above are fault conditions which may cause heating and deterioration of the circuit breaker and its response characteristics.

If overheating of connections is evident through discoloration or arcing, the breaker should be removed from service and all conducting surfaces cleaned. The breaker should then pass operations tests and the installation megger test before reinstallation.

Those breakers with adjustable instantaneous magnetic trip devices should be set at the highest setting unless otherwise directed.

(2) *Corrective Maintenance.* Perform corrective maintenance on molded-case circuit breakers after fault conditions occur. Follow the procedures given in paragraph 4.(1) and perform the tests required in Table 1 (see paragraph 5). If a molded-case circuit breaker interrupts a fault current whose magnitude is equal to its interrupting rating, the breaker may not be operable.

5. *Tests.*

(1) *Insulation Megger Tests.* Perform insulation megger tests at the intervals indicated in Table 1 and the following instructions.

De-energize and, if necessary, remove the breaker from the panel for test. Do not place the megger on large masses of iron nor near strong magnetic fields. Set the megger scale range selector switch in a position that gives a reading in midscale or above. Observe megger readings after a minimum of one minute or when the pointer has reached an apparent stabilized value; record the readings. After completion of the test, apply temporary grounds to all test materials and disconnect all leads.

This procedure tests one phase to ground with all other phases grounded and is equivalent to a phase-to-phase test besides the phase-to-ground test. Each phase must be tested individually. Table 2 provides voltage values for insulation megger tests. If a megger reading of 1 megohm minimum is not obtained for each voltage value replace the circuit breaker.

(2) *Operations Tests.* Perform operations tests at the intervals suggested in Table 1 and with the following instructions. These tests

include overcurrent testing for both time-delay and instantaneous trip.

Molded-case circuit breakers use two basic methods, sometimes combined, to achieve overload protection: thermallic strip and electromagnetic. Check the circuit breaker manufacturer's instruction book to determine the type of overload device, the method of adjustment, and the proper breaker connections. Use a low-voltage high-current source such as Multi-Amp Model MSA for small breakers of ratings up to 100A and Multi-AMP Model CB-225 for larger breakers. Consult the Multi-Amp Tester instruction book to set up tester controls. De-energize and remove the breaker from the panel for test. Record all data obtained by these tests.

Table 1. Recommended Maintenance/Test Intervals for Molded-Case Circuit Breakers

Schedule				
	New	Institutional	Noncritical (Supporting Launch Operations)	Critical
Exercise Circuit Breaker	On Installation	Annually	Annually	Annually
Maintenance	During Installation in Existing Substation	Three Years or After Fault	Annually or After Fault	Annually or After Fault
Insulation Megger Tests	Prior to Installation	After Fault	After Fault	After Fault
Operations Tests	Prior to Installation	After Fault	After Fault	After Fault

Note: The above are minimum recommended maintenance/test intervals. Additional tests may be made when the operating agency has experience to indicate need for concern.

Table 2. Voltage Values for Insulation Megger Tests--Molded-Case Circuit Breakers

Voltage Values	Test Points	Megger Value
480V	phases to ground	1000
120/108V	phases to ground	500

Individually test each pole that is equipped with an overload device. Operate (open and close) the breaker two or three times before applying the overcurrent. Connect the Multi-Amp tester across one pole of the breaker with the breaker closed.

If the overload protective device of the breaker under test is the thermal bimetallic strip type, allow sufficient time for the heater element to cool to near ambient temperature before starting a second test. No waiting period between tests is necessary for the electromagnetic type of overload protective device.

(3) *Time Current Trip Test.* If the breaker is electrically operated, connect temporary power to the breaker control circuits. Check for proper voltage and if alternating or direct current. The tests currents provided in Table 3 should be used. If the breaker being tested is not listed in Table 3, the test currents should be approximately 3 times the normal trip rating of the breaker. Perform the time current trip test in accordance with Multi-Amp instructions. Observe and record the time shown on the timer as the operating time of the breaker at that percent of rated overload. Compare this test time with times given in Table 3. If the operating time of the breaker does not agree with the curve or Table 3, replace the breaker. If the breaker is not listed in Table 3, check the manufacturer's time current curves for the appropriate trip time.

(4) *Instantaneous Trip Test.* Connect the breakers to the Multi-Amp tester and select the proper ammeter range (about 10 times the normal trip current rating of the test breaker). Do not rotate the main control while large currents are flowing. Alternately increase the output current and jog the tester until the breaker trips or until the maximum test current is reached. If the breaker does not trip at the desired current value, replace the breaker.

The above is only an example of one type of circuit breaker. The criteria should address all circuit breakers that an organization supports.

References

Kennedy Space Center (KSC) General Practice (GP) 1002, "Maintenance and Test Criteria for Circuit Breakers."

Table 3 (Page 1 of 9). TRIP CHARACTERISTICS FOR MOLDED-CASE CIRCUIT BREAKER					
CIRCUIT BREAKER		**LONGTIME-DELAY TRIP**		**INSTANTANEOUS TRIP**	
TYPE	**RATING (AMPERES)**	**TEST CURRENT (AMPERES)**	**TRIP TIME (SECONDS) ± 20%**	**TEST CURRENT (AMPERES)**	**TRIP TIME (SECONDS) ± 20%**
FEDERAL PACIFIC					
NB	15	45	3.3 to 23	300	0 to 0.013
NB	20	60	3.3 to 23	400	0 to 0.013
NB	30	90	3.3 to 23	600	0 to 0.013
NB	50	150	3.3 to 23	1000	0 to 2.0
NFL	200	600	54 to 140	2000	0 to 0.2
NJL	300	900	55 to 190	3000	0 to 0.01
NFJ	200	600	42 to 140	2000	0 to 0.004
NEF	15	45	12 to 28	300	0 to 0.017
NEF	20	60	12 to 28	400	0 to 0.017
NEF	30	90	5 to 15	600	0 to 0.017
NEF	50	150	5 to 15	1000	0 to 0.017

Table 3 (Page 2 of 9). TRIP CHARACTERISTICS FOR MOLDED-CASE CIRCUIT BREAKER					
CIRCUIT BREAKER		LONGTIME-DELAY TRIP		INSTANTANEOUS TRIP	
TYPE	RATING (AMPERES)	TEST CURRENT (AMPERES)	TRIP TIME (SECONDS)	TEST CURRENT (AMPERES)	TRIP TIME (SECONDS)
GENERAL ELECTRIC					
TE	15	45	9 to 25	300	0.1 to 0.5
TE	20	60	9 to 25	400	0.1 to 0.5
TE	30	90	9 to 25	600	0.1 to 0.5
TE	40	120	9 to 25	800	0.1 to 0.5
TE	50	150	9 to 25	1000	0.1 to 0.5
TE	70	210	9 to 30	2800	0 to 0.25
TE	90	270	9 to 30	3600	0 to 0.25
TE	100	300	9 to 30	4000	0 to 025
136M1100	100	0	0	2000	0 to 0.2
TEF, THEF(480V)	15	45	18 to 50	300	0 to 0.02
TEF, THEF(480V)	20	60	18 to 50	400	0 to 0.02
TEF, THEF(480V)	30	90	18 to 50	600	0 to 0.02
TEF, THEF(480V)	40	120	18 to 50	800	0 to 0.02
TEF, THEF(480V)	50	150	32 to 80	1000	0 to 0.02
TEF, THEF(480V)	60	180	32 to 80	1200	0 to 0.02
TEF, THEF(480V)	70	210	32 to 80	1400	0 to 0.02
TEF, THEF(480V)	90	270	32 to 80	1800	0 to 0.02
TEF, THEF(480V)	100	300	32 to 80	2000	0 to 0.02
TEF, THEF(600V)	15	45	8 to 35		0 to 0.02
TEF, THEF(600V)	20	60	8 to 35		0 to 0.02
TEF, THEF(600V)	30	90	8 to 35		0 to 0.02
TEF, THEF(600V)	40	120	8 to 35		0 to 0.02
TEF, THEF(600V)	50	150	33 to 80		0 to 0.02
TEF, THEF(600V)	60	180	33 to 80		0 to 0.02
TEF, THEF(600V)	70	210	33 to 80		0 to 0.02
TEF, THEF(600V)	90	270	33 to 80		0 to 0.02
TEF, THEF(600V)	100	300	33 to 80		0 to 0.02
TF	15	45	18 to 50	150	0 to 1.3
THQB	20	60	5 to 35	400	0 to 0.45
THQB	30	90	5 to 35	600	0 to 0.45
THQB	60	180	9 to 42	1200	0 to 1.0
TQB, TQC, TQL	15	45	5 to 35	525	0 to 0.45
TQB, TQC, TQL	30	90	5 to 35	1050	0 to 0.45
TQB, TQC, TQL	40	120	5 to 35	1400	0 to 0.45
TQB, TQC, TQL	50	150	5 to 35	1750	0 to 0.45

Table 3 (Page 3 of 9). TRIP CHARACTERISTICS FOR MOLDED-CASE CIRCUIT BREAKER					
CIRCUIT BREAKER		LONGTIME-DELAY TRIP		INSTANTANEOUS TRIP	
TYPE	RATING (AMPERES)	TEST CURRENT (AMPERES)	TRIP TIME (SECONDS) ± 20%	TEST CURRENT (AMPERES)	TRIP TIME (SECONDS) ± 20%
GENERAL ELECTRIC					
TQB, TQC, TQL	50	150	5 to 35	1750	0 to 0.45
TQB, TQC, TQL	60	180	9 to 42	1500	0 to 1.0
TQB, TQC, TQL	70	210	9 to 42	1750	0 to 1.0
TQB, TQC, TQL	90	270	9 to 42	2250	0 to 1.0
TQB, TQC, TQL	100	300	9 to 42	2500	0 to 1.0
TFJ, TFK, THFK	70	210	30 to 75	1400	0 to 0.025
TFJ, TFK, THFK	90	270	30 to 75	1800	0 to 0.025
TFJ, TFK, THFK	100	300	30 to 75	2000	0 to 0.025
TFJ, TFK, THFK	125	375	20 to 75	2500	0 to 0.025
TFJ, TFK, THFK	150	450	20 to 75	3000	0 to 0.025
TED, THEF(600V)	15	45	9 to 40	450	0 to 0.2
TED, TEHD(600V)	20	60	9 to 40	600	0 to 0.2
TED, THED(600V)	30	90	9 to 40	900	0 to 0.2
TED, THED(600V)	40	120	9 to 40	1200	0 to 0.2
TED, THED(600V)	45	135	9 to 40	1350	0 to 0.2
TED, THED(600V)	50	150	25 to 120	1500	0 to 1.7
TED, THED(600V)	60	180	25 to 120	1800	0 to 1.7
TED, THED(600V)	70	210	25 to 120	2100	0 to 1.7
TED, THED(600V)	80	240	25 to 120	2400	0 to 1.7
TED, THED(600V)	90	270	32 to 115	2700	0 to 0.02
TED, THED(600V)	100	300	32 to 115	3000	0 to 0.02
TFJ,TFK,THFK	175	525	30 to 75	3500	0 to 0.025
TFJ,TFK,THFK	200	600	30 to 75	4000	0 to 0.025
TFJ,TFK,THFK	225	675	30 to 75	4500	0 to 0.025
TJJ,TJK,THJK	125	375	35 to 100	2500	0 to 0.025
TJJ,TJK,THJK	150	450	35 to 100	3000	0 to 0.025
TJJ,TJK,THJK	175	525	35 to 100	3500	0 to 0.025
TJJ,TJK,THJK	200	600	35 to 100	4000	0 to 0.025
TJJ,TJK,THJK	225	675	35 to 100	4500	0 to 0.025
TJJ,TJK,THJK	250	750	35 to 100	5000	0 to 0.025
TJJ,TJK,THJK	300	900	35 to 100	6000	0 to 0.025
TJJ,TJK,THJK	350	1050	35 to 100	7000	0 to 0.025
TJJ,TJK,THJK	400	1200	35 to 100	7500	0 to 0.035
TJJ,TJK,THJK	500	1500	35 to 150	7500	0 to 0.035
TJJ,TJK,THJK	600	1800	35 to 150	9000	0 to 0.035

Table 3 (Page 4 of 9). TRIP CHARACTERISTICS FOR MOLDED-CASE CIRCUIT BREAKER					
CIRCUIT BREAKER		**LONGTIME-DELAY TRIP**		**INSTANTANEOUS TRIP**	
TYPE	**RATING (AMPERES)**	**TEST CURRENT (AMPERES)**	**TRIP TIME (SECONDS) ± 20%**	**TEST CURRENT (AMPERES)**	**TRIP TIME (SECONDS) ± 20%**
HEINEMANN X0412					
	20	60	12 to 38	0	0
	25	75	12 to 38	0	0
	30	90	12 to 38	0	0
	35	105	12 to 38	0	0
	40	120	12 to 38	0	0
	50	150	12 to 38	0	0

Table 3 (Page 5 of 9). TRIP CHARACTERISTICS FOR MOLDED-CASE CIRCUIT BREAKER					
CIRCUIT BREAKER		**LONGTIME-DELAY TRIP**		**INSTANTANEOUS TRIP**	
TYPE	**RATING (AMPERES)**	**TEST CURRENT (AMPERES)**	**TRIP TIME (SECONDS) ± 20%**	**TEST CURRENT (AMPERES)**	**TRIP TIME (SECONDS) ± 20%**
ITE					
ALB-1	5	15	8 to 20	100	0 to 0.55
	10	30	8 to 20	200	0 to 0.55
	15	45	8 to 20	300	0 to 0.55
	20	60	8 to 20	400	0 to 0.55
	25	75	8 to 20	500	0 to 0.016
	30	90	8 to 20	600	0 to 0.016
	35	105	8 to 20	700	0 to 0.016
	40	120	8 to 20	800	0 to 0.016
	50	150	8 to 20	1000	0 to 0.016
AQB-A100	15B	90	20 to 32	210	0 to 0.02
	15BF	90	20 to 32	105	0 to 0.05
	25B	150	20 to 32	350	0 to 0.025
	25BF	150	20 to 32	175	0 to 0.05
	50B	300	20 to 32	700	0 to 0.025
	50BF	300	20 to 32	350	0 to 0.05
	75B	450	20 to 32	1050	0 to 0.025
	75BF	450	20 to 32	525	0 to 0.05
	100B	600	20 to 32	1400	0 to 0.025
	100BF	600	20 to 32	700	0 to 0.05
AQB-LF 100	15D	90	20 to 32	210	0 to 9.025
	15DF	90	20 to 32	105	0 to 0.05
	25D	150	20 to 32	350	0 to 0.025
	25DF	150	20 to 32	210	0 to 0.05
	50D	300	20 to 32	700	0 to 0.025
	50DF	300	20 to 32	350	0 to 0.05
	75D	450	20 to 32	1050	0 to 0.025
	75DF	450	20 to 32	525	0 to 0.05
	100D	600	20 to 32	1400	0 to 0.025
	100DF	600	20 to 32	700	0 to 0.05
QP-1	20	40	17 to 55	480	2.0
QP-2	20	40	12 to 110	920	0.62
QP-3	20	40	12 to 110	920	0.62
HE	15	45	32 to 120	650	0 to 0.013
HE	20	60	32 to 120	650	0 to 0.013
HE	30	90	32 to 120	650	0 to 0.013

HF	40	120	32 to 120	650	0 to 0.013
Table 3 (Page 6 of 9). TRIP CHARACTERISTICS FOR MOLDED-CASE CIRCUIT BREAKER					
CIRCUIT BREAKER		**LONGTIME-DELAY TRIP**		**INSTANTANEOUS TRIP**	
TYPE	**RATING (AMPERES)**	**TEST CURRENT (AMPERES)**	**TRIP TIME (SECONDS) ± 20%**	**TEST CURRENT (AMPERES)**	**TRIP TIME (SECONDS) ± 20%**
ITE					
HF	50	150	32 to 120	650	0 to 0.013
HF	70	210	32 to 120	1100	0 to 0.013
HF	90	270	32 to 120	1100	0 to 0.013
HF	100	300	32 to 120	1100	0 to 0.013
AQB-A250	125N	750	18 to 32	1300	0 to 0.2
	150N	900	18 to 32	1300	0 to 0.2
	175N	1050	18 to 32	1300	0 to 0.2
	225N	900	40 to 90	1300	0 to 0.2
	250N	1000	40 to 90	1300	0 to 0.2
AQB-LF250	125L	750	20 to 32	1300★★	0 to 0.2
	125LM	750	20 to 32	3000★★	0 to 0.2
	150L	900	20 to 32	1300★★	0 to 0.2
	150LM	900	20 to 32	3000★★	0 to 0.2
	175L	1050	20 to 32	1300★★	0 to 0.2
	175LM	1050	20 to 32	3000★★	0 to 0.2
	225L	900	50 to 100	1300★★	0 to 0.2
	225LM	900	50 to 100	3000★★	0 to 0.2
	250L	1000	50 to 100	1300★★	0 to 0.2
	250LM	1000	50 to 100	3000★★	0 to 0.1
				★★Hi Setting	

Table 3 (Page 7 of 9). TRIP CHARACTERISTICS FOR MOLDED-CASE CIRCUIT BREAKER					
CIRCUIT BREAKER		**LONGTIME-DELAY TRIP**		**INSTANTANEOUS TRIP**	
TYPE	**RATING (AMPERES)**	**TEST CURRENT (AMPERES)**	**TRIP TIME (SECONDS) ± 20%**	**TEST CURRENT (AMPERES)**	**TRIP TIME (SECONDS) ± 20%**
SQUARE D					
FA	15	45	14 to 45	525	0 to 0.02
FA	20	60	13 to 47	525	0 to 0.02
FA	30	90	9 to 30	600	0 to 0.02
FA	40	120	9 to 30	800	0 to 0.02
FA	50	150	9 to 30	1000	0 to 0.02
FA	60	180	9 to 30	1200	0 to 0.02
FA	70	210	9 to 30	1400	0 to 0.02
FA	90	270	20 to 60	1800	0 to 0.02
FA	100	300	20 to 60	2000	0 to 0.02
ML-1	20	60	15 to 30	600	0.01 to 0.035
ML-1	40	120	7 to 18	800	0 to 0.023
ML-3	125	375	80 to 180	2500	0 to 0.018
ML-3	225	0	0	4500	0 to 0.018

Table 3 (Page 8 of 9). TRIP CHARACTERISTICS FOR MOLDED-CASE CIRCUIT BREAKER					
CIRCUIT BREAKER		**LONGTIME-DELAY TRIP**		**INSTANTANEOUS TRIP**	
TYPE	**RATING (AMPERES)**	**TEST CURRENT (AMPERES)**	**TRIP TIME (SECONDS) ± 20%**	**TEST CURRENT (AMPERES)**	**TRIP TIME (SECONDS) ± 20%**
WESTINGHOUSE					
E	15	35	15 to 60	900	0 to 0.2
E	20	50	15 to 60	1200	0 to 0.2
E	30	75	15 to 60	1800	0 to 0.2
E	40	100	15 to 60	2400	0 to 0.2
E	50	125	15 to 60	3000	0 to 0.2
EHB(1 Pole)	15	45	7 to 20	450	0.023 to 0.25
EHB(1 Pole)	30	90	7 to 20	900	0.023 to 0.25
HFB(1 Pole)	30	90	7 to 20	900	0.023 to 0.25
HFB(3 Pole)	100	300	25 to 45	3000	0.50 to 1.7
MA	125	375	15 to 30	1250	0 to 0.01
MA	150	450	15 to 30	1500	0 to 0.01
MA	200	800	15 to 30	2000	0 to 0.01
MA	250	1000	15 to 55	2500	0 to 0.01
MA	300	1200	15 to 55	3000	0 to 0.01
MA	350	1400	15 to 55	3500	0 to 0.01
MA	400	1600	15 to 55	4000	0 to 0.01
MA	500	2000	15 to 55	5000	0 to 0.01
MA	600	2400	15 to 55	6000	0 to 0.01
MA	700	2100	100 to 300	6000	0 to 0.004
MA	800	2400	100 to 300	6000	0 to 0.004
F, HF	15	45	6 to 14	450	0 to 0.02
F, HF	20	60	6 to 14	600	0 to 0.02
F, HF	30	90	6 to 14	900	0 to 0.02
F, HF	40	120	6 to 14	1200	0 to 0.02
F, HF	50	150	20 to 50	500	0 to 0.02
F, HF	60	180	20 to 50	600	0 to 0.02
F, HF	70	210	20 to 50	700	0 to 0.02
F, HF	90	270	20 to 50	900	0 to 0.02
F, HF	100	300	20 to 50	3000	0 to 0.02
FA, HFA	15	45	10 to 25	450	0 to 0.02
FA, HFA	20	60	10 to 25	600	0 to 0.02
FA, HFA	30	90	10 to 25	900	0 to 0.02
FA, HFA	40	120	10 to 25	1200	0 to 0.02
FA, HFA	50	150	20 to 45	1500	0 to 0.02
FA, HFA	60	180	20 to 45	1800	0 to 0.02
FA, HFA	70	210	20 to 45	2100	0 to 0.02

Table 3 (Page 9 of 9). TRIP CHARACTERISTICS FOR MOLDED-CASE CIRCUIT BREAKER					
CIRCUIT BREAKER		LONGTIME-DELAY TRIP		INSTANTANEOUS TRIP	
TYPE	RATING (AMPERES)	TEST CURRENT (AMPERES)	TRIP TIME (SECONDS) ± 20%	TEST CURRENT (AMPERES)	TRIP TIME (SECONDS) ± 20%
WESTINGHOUSE					
FA, HFA	90	270	20 to 45	2700	0 to 0.02
FA, HFA	100	300	20 to 45	3000	0 to 0.02
FA	125	375	25 to 40	3750	0 to 0.02
FA	150	450	25 to 40	4500	0 to 0.02