

WG: C37.04 – IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers

Vice Chair: Mike Crawford
Secretary: Stephen Cary

Participants: 31 members
36 guests

- 1.) The chair started the meeting with the introduction of all participants
- 2.) An agenda for the meeting was provided
- 3.) The chair asked to approve the MOM (Minutes of Meeting) from the previous meeting in San Diego
 - **John Webb** called for the motion and it was seconded **by Ken Edwards**. All members voted to approve the minutes.
- 4.) The following **auxiliary** switch proposals were discussed.

(See attachment A)

- The chair called for a motion to approve John Webb's proposal. **John Webb** called for the motion and it was seconded by **Ken Edwards**. The switch proposal was approved.
 - Further discussion took place on scope of the standard. Specifically that C37.04 would not specify the number of required switches. Only ratings would be specified in the standard.
- 5.) The following definition of interrupting time was discussed.

"The rated interrupting time of a circuit breaker is the maximum permissible interval between the energizing of the trip circuit at rated control voltage and rated operating pressure for mechanical operation, and the interruption of the current in the main circuit in all poles.
(Give extensions for C-O Operations)"

The following modifications were made to the definition.

"The rated interrupting time is based on a three phase symmetrical short circuit current. It is the maximum interval between the energizing of the open release device at rated control voltage and rated pressure(s) for operation, insulation and/or interruption, and the interruption of the current in the main circuit in all poles. Actual interrupting time of a single phase fault and / or an asymmetrical fault may be longer than the rated interrupting time. See C37.010 for guidance on calculating these values. The interrupting time for a close-open operation shall not exceed the rated interrupting time by more than 1 cycle of rated power frequency for circuit breakers with interrupting times of 5 cycles or more, and 1/2 cycle for circuit breakers with interrupting times of 3 cycles or less. (Cycles are based on corresponding rated power frequency.)"

The chairman called for a motion to approve the proposed modification. A member called for the motion and it was seconded. The interrupting time definition was approved.

6). The Chair called for the members to contribute. Dave Stone, Steven Chen, Tom Mulcahy and Gilbert Carmona came to the table to volunteer

7). It was mentioned that the C37.04 draft without TRV sections would be sent out for membership comments.

8). A motion was made to adjourn and it was approved

Attachment A



Preferred Ratings of Aux. Contacts

Recommendations for
Working Group on C37.04/C37.06/NEMA SG-4
Pat Dilillo, John Webb



Preferred Ratings of Aux. Contacts

- No Recommended Values in other ANSI/IEEE Switchgear Standards
 - Reviewed C37.06, C37.11, C37.010, C37.100.1, C37.20.2, C37.16, C37.20.1
- Survey of Manufacturers Documentation varies:
 - Normally lists ratings at nominal (IEC/ANSI) control voltages only, not max.
 - Often lacks time constants of DC current.
- C37.100.1 lists aux. voltages but no more details.
 - §5.4 No common requirements, refer to equipment standards.
[Intentionally leaves 'Table 6' out to coordinate with IEC 62271-1]
- IEC 62271-1 (Common Clauses) Table 6 lists preferred ratings
 - 3 Classes of Switches
- UL 508 Industrial Control Devices, Part X Auxiliary Devices
 - Provides 'Standard loads for control-circuit devices' (Table 137.1)
 - Provides 'Rating codes for a-c (d-c) control circuit contacts' (Table 139.1, .2)
- NEMA ICS 5 Control Circuit & Pilot Devices
 - Standard Loads, Standard Ratings & Solid State Switching & PLC I/O
 - Same Standard ratings for contacts as UL 508

Sample of Current Mfg. Data

Cont. Curr.	120 Vac (110 Vac)	240 Vac (220 Vac)	48 Vdc (48 Vdc)	125 Vdc (110 Vdc)	250 Vdc (220 Vdc)
20	15	10	16	10	5
20	20	20	20	10	2
10	2A @ 220 Vdc, t=20 ms				
20	20	20	20	10	2
	15	10		10	5
20				10	5
10	25	25	10	8	2
20	15	10	16	10	5
15	75	40	40	11	2

"Legacy Switches"

Mfg.	Type	Cont.	24 Vdc	48 Vdc	125 Vdc	250 Vdc
GE	SB-1	20	6	5	2.7	0.75
(W)	W	20			5	1.65
ITE	L2	40			10	5
A-C	Q-10	15	30	15	10	8
Electro Switch	102	20			10	5



Pat Dilillo Proposal

Basic Ratings

Type	Cont.	24 Vdc	48 Vdc	125 Vdc	250 Vdc	120 Vac	240 Vac
Resistive	20			10	5		
Inductive	20			5	2.5		

Additional Ratings

- 3 sec. withstand of 250 Amps
- 30,000 Electrical Operations
- 50,000 Mechanical Operations

Construction Requirements

- Positive make / break action
- Good Contact Wipe
- Micro Switches Prohibited

Application Requirements

- Manufacturer shall supply 10 'a' and 10 'b' extra aux. contacts
- Indicate Circuit Breaker Position rather than mech. position.
- Wired to terminal blocks in control cabinet
- Multiple contacts per circuit only w/user & mfg. agreement

John Webb Proposal

DC Current				
Class	Rated Continuous Current	Rated short-time withstand current	Breaking Capacity	
			=48 V	110 V = U_a = 280 V
0	20 A	250 A / 3 sec		1250 W
1	10 A	100 A / 30 ms		440 W
2	2 A	100 A / 30 ms		22 W
3	200 mA	1 A / 30 ms	50 mA	
Note 1	This table refers to auxiliary contacts [IEV 441-15-10] which are included in an auxiliary circuit and mechanically operated by the switching device. Control contacts [IEV 441-15-09] which are included in a control circuit of a mechanical switching device may be covered by this table.			
Note 2	If insufficient current is flowing through the contact, oxidation may increase the resistance. Therefore, a minimum value of current may be required for class 1 contact.			
Note 3	In the case of the application of static contacts, the rated short-time withstand current may be reduced if current-limiting equipment, other than fuses, is employed.			
Note 4	For all classes, breaking capacity is based on a circuit time constant of not less than 20ms with a relative tolerance of +20 / -0 %.			
Note 5	An auxiliary contact which complies with class 0, 1, 2 or 3 for d.c. is normally able to handle corresponding a.c. current and voltage.			
Note 6	Class 3 contacts are not intended to be subjected to full substation auxiliary-supply short-circuit current. Class 0, 1 and 2 contacts are intended to be subjected to full substation auxiliary-supply short-circuit current.			
Note 7	Breaking current at a defined voltage value between 110 V and 280 V may be deduced from the indicated power value for class 1 and class 2 contacts (for example, 2 A at 220 V d.c. for a class 1 contact).			



Reference Information

- IEC 62271-1 Table 6
- IEC 62271-1 Aux. Contact Usual Arrangements
 - Included to show typical application of Class 0, 1, 2, 3
- UL 508 DC Contacts
- UL 508 Standard Loads

IEC 62271-1 Table 6

DC Current				
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			=48 V	110 V = U _a = 250 V
1	10 A	100 A / 30 ms		440 W
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Note 5	An auxiliary contact which complies with class 1, 2 or 3 for d.c. is normally able to handle corresponding a.c. current and voltage.			
Note 6	Class 3 contacts are not intended to be subjected to full substation auxiliary-supply short-circuit current. Class 1 and 2 contacts are intended to be subjected to full substation auxiliary-supply short-circuit current.			
Note 7	Breaking current at a defined voltage value between 110 V and 250 V may be deduced from the indicated power value for class 1 and class 2 contacts (for example, 2 A at 220 V d.c. for a class 1 contact).			

IEC 62271 -1 Aux. Contacts

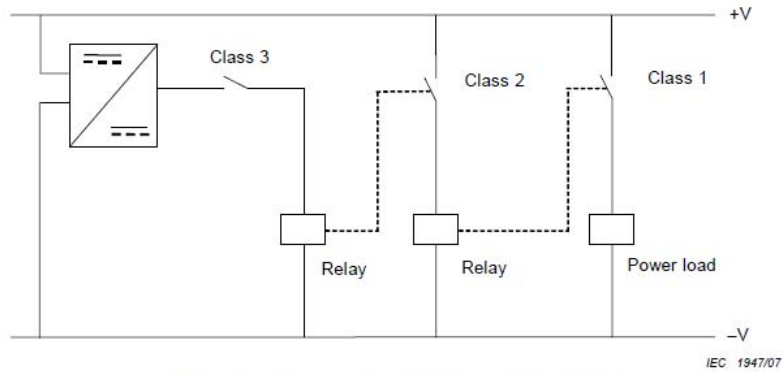


Figure 2 – Examples of classes of contacts



UL 508 DC Contacts

Rating codes for d-c control-circuit contacts					
Contact rating code designation	Thermal continuous test current (A)	Maximum make or break current (A)			Maximum make or break VA at 300 volts or less
		125 Volt	250 Volt	301 to 600 Volt	
N150	10	2.2	-	-	275
N300	10	2.2	1.1	-	275
N600	10	2.2	1.1	0.4	275
P150	5.0	1.1	-	-	138
P300	5.0	1.1	0.55	-	138
P600	5.0	1.1	0.55	0.2	138
Q150	2.5	0.55	-	-	69
Q300	2.5	0.55	0.27	-	69
Q600	2.5	0.55	0.27	0.1	69
R150	1.0	0.22	-	-	28
R300	1.0	0.22	0.11	-	28

^a The numerical suffix designates the maximum voltage design values, which are to be 600, 300, and 150 volts for suffixes 600, 300, and 150 respectively. Test voltage shall be 600, 250, or 125 volts.

^b For maximum ratings at 300 volts or less, the maximum make and break ratings are to be obtained by dividing the volt-ampere rating by the application voltage, but the current values are not to exceed the thermal continuous test current.

^c Inductive loads as specified in Section 8.2.7 of Industrial Control and Systems; Control Circuit and Pilot Devices, ANSI/NEMA ICS5-1993.

10A Continuous Current Rating

AC Contact Table also exists (139.1) Not as limiting as DC Table



UL 508 Standard Loads

Standard loads for control-circuit devices				
Normal Potential	Standard Duty Codes B & P		Heavy Duty Codes A & N	
	Normal Current	Current inrush	Normal Current	Current inrush
110 - 120 a-c	3	30	6	60
220 -240 a-c	1.5	15	3	30
440 - 480 a-c	0.75	7.5	1.5	15
550 -600 a-c	0.6	6	1.2	12
115 - 125 d-c	1.1	-	2.2	-
230 - 250 d-c	0.55	-	1.1	-
550 -600 d-c	0.2	-	0.4	-

Summary

- Existing Manufacturer & User info too diverse and poorly documented to easily reconcile.
- Existing ratings and User Specifications do not appear to have a basis for the ratings assigned; merely what was historically available and continues in use.
- IEC 62271-1 also appears 'arbitrary' but is within limits of most manufacturers surveyed.
- UL 508 / NEMA ICS 5 provide most well defined ratings, include testing & performance criteria.
- UL 508 also provides a basis for the ratings.
- BUT UL 508 / ICS 5 also the smallest ratings of all.