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Amel.
Committee Room B
No. 116—PART 1—1937.

See Amel. No. 1 (inside cover).

British Standards Institution.

Incorporated by Royal Charter.

FORMED IN 1901 AS THE ENGINEERING STANDARDS COMMITTEE.

INCORPORATED IN 1918 AS THE BRITISH ENGINEERING STANDARDS ASSOCIATION.

BRITISH STANDARD SPECIFICATION

FOR

OIL CIRCUIT-BREAKERS,

OIL SWITCHES, AND OIL ISOLATING-SWITCHES,

FOR ALTERNATING-CURRENT CIRCUITS.

PART 1.

THREE-PHASE OIL CIRCUIT-BREAKERS WITH BREAKING-CAPACITY RATINGS
UP TO 500 MVA, SINGLE-PHASE OIL CIRCUIT-BREAKERS, OIL SWITCHES,
AND OIL ISOLATING-SWITCHES.

(REVISED OCTOBER, 1937.)

LONDON:

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October, 1937.

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This British Standard is published in two parts :—

PART 1.—THREE-PHASE OIL CIRCUIT-BREAKERS
WITH BREAKING-CAPACITY RATINGS UP
TO 500 MVA, SINGLE-PHASE OIL CIRCUIT-
BREAKERS, OIL SWITCHES, AND OIL
ISOLATING SWITCHES.

PART 2.—THREE-PHASE OIL CIRCUIT-BREAKERS
WITH BREAKING-CAPACITY RATINGS
ABOVE 500 MVA.

PD 1558

Amendment No. 1, published 27 January, 1953
to B.S. 116 : Part 1 : 1937

Three-phase oil circuit-breakers with breaking-capacity ratings up to 500 MVA, single-phase oil circuit-breakers, oil switches and oil isolating-switches

Revision

B.S. 116 : 1937, Parts 1 and 2, is at present under revision and the provisions relating to *oil circuit-breakers* are cancelled and have been superseded by B.S. 116 : 1952 'Oil circuit-breakers for alternating current systems'.

The portions of Part 1 of B.S. 116 : 1937 relating to *oil switches* and *oil isolating-switches* continue to apply until superseded by other British Standards.

Part 2 of B.S. 116 : 1937 applied only to oil circuit-breakers and is therefore now completely superseded by B.S. 116 : 1952.

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UP TO 500 MVA.. SINGLE-PHASE OIL CIRCUIT-BREAKERS, OIL SWITCHES,
AND OIL ISOLATING-SWITCHES.

(REVISED OCTOBER, 1937.)

This Specification, having been approved by the Electrical Industry Committee, and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council as a British Standard on 18th October, 1937.

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(5)

CO-OPERATING ORGANISATIONS.

The Electrical Industry Committee,† under whose supervision this Specification was prepared, consists of representatives from the following Government Departments and Scientific and Industrial Organisations :—

- | | |
|---|--|
| *Admiralty. | Electric Lamp Manufacturers' Association. |
| *Central Electricity Board. | *Incorporated Association of Electric Power Companies. |
| Electricity Commissioners. | *Incorporated Municipal Electrical Association. |
| *General Post Office. | Institution of Electrical Engineers. |
| *H.M. Office of Works. | *London Electricity Supply Association. |
| *Home Office. | *Provincial Electric Supply Association. |
| *National Physical Laboratory. | *Railway Companies of Great Britain. |
| *War Office. | Tramways, Light Railways, and Transport Association. |
| *Association of Consulting Engineers. | |
| *British Electrical and Allied Manufacturers' Association. | |
| *British Electrical and Allied Industries Research Association. | |
| Cable Makers' Association. | |
| Electrical Contractors' Association (Incorporated). | |

The Government Departments and Scientific and Industrial Organisations marked with an asterisk in the above list, together with the following, were directly represented on the Committee entrusted with the preparation of this Specification :—

Crown Agents for the Colonies.
 High Commissioner for India.
 Mines Department.
 Association of Mining Electrical Engineers.
 Mining Association.

† The Electrical Industry Committee is the British National Committee of the International Electrotechnical Commission.

FOREWORD.

This Specification forms one of a series of British Standards for Switchgear Equipment, and is based upon the First Edition (1937) of the I.E.C. Specification for Alternating-current Circuit-breakers,* as far as this covers the subject.

During the preparation of these Specifications, it has been found that before all the conditions can be laid down with certainty, a large amount of research work is necessary, particularly on the making-capacity and breaking-capacity of oil circuit-breakers of large sizes. This research work is still being carried out by the British Electrical and Allied Industries Research Association, supply companies, Institutions, and switchgear manufacturers.

In due course it is anticipated that further additions to the Specification will be made, based, for example, on further investigations upon the short-circuit performance of circuit-breakers, and on the numerical values of the rate-of-rise of restriking voltage that is likely to exist at typical points on a supply network and their influence upon the selection of a suitably rated circuit-breaker.

The I.E.C. also is studying this problem with the object of issuing international recommendations in future editions of its Specification.

It should be appreciated that some time must necessarily elapse after the issue of this Specification (No. 116—1937) before every circuit-breaker can be supplied and certified to comply with it in all respects; its application should therefore be subject to mutual agreement between contracting parties.

Pending the issue of a British Standard Specification for industrial circuit-breakers, B.S. Specification No. 116—1929 may be applied to such circuit-breakers for voltages below 3.3 kV and for breaking-capacities below 25 MVA.

In order to keep abreast of progress in the Industries concerned, the British Standard Specifications are subjected to periodical review.

Suggestions for improvements, addressed to the British Standards Institution, 28, Victoria Street, London, S.W.1, will be welcomed at all times. They will be recorded, and in due course brought to the notice of the Committees charged with the revision of the Specifications to which they refer.

* Publication 56 of the International Electrotechnical Commission.

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NOTE.—The Institution desires to call attention to the fact that this Specification is intended to include the technical provisions necessary for the supply of the material herein referred to, but does not purport to include all the necessary provisions of a contract.

BRITISH STANDARD

5

SPECIFICATION

FOR

**OIL CIRCUIT-BREAKERS,
OIL SWITCHES, AND OIL ISOLATING-SWITCHES,**

FOR ALTERNATING-CURRENT CIRCUITS.

10

PART 1.

THREE-PHASE OIL CIRCUIT-BREAKERS WITH BREAKING-CAPACITY RATINGS UP TO 500 MVA.,
SINGLE-PHASE OIL CIRCUIT-BREAKERS, OIL SWITCHES, AND OIL ISOLATING-SWITCHES.

(REVISED OCTOBER, 1937.)

*The figures in British measures are to be regarded as the Standard. 15
Approximate metric equivalents are given for the convenience of users in
countries in which the metric system has been generally adopted.*

1. SCOPE.

This Specification applies to single-phase and 3-phase oil circuit-breakers with 3-phase rated breaking-capacities between 20 25 and 500 MVA, to single-phase oil switches, and to oil-isolating-switches, as defined in Clauses 1, 2, and 3.

It does not cover industrial switches, contactors or circuit-breakers which are required to make and break circuits frequently at short intervals (e.g., starting-switches), nor the additional 25 requirements necessary in connection with flameproof switchgear, as given in B.S. Specification No. 229.

The service conditions for which oil circuit-breakers and oil switches conforming to this Specification are suitable are given in Appendix C. 30

2. BASIS OF SPECIFICATION.

The Specification sets out standards suitable for circuit-breakers of the smaller sizes (*see* 1. Scope), which are usually associated in service with a recovery-voltage approximating to the rated

service-voltage, and which are type-tested on this basis at short-circuit testing-stations. The Specification conforms with the rules for the short-circuit conditions of the First Edition of the I.E.C. Specification for Alternating-current Circuit-breakers (Publication No. 56*).

5

Fundamental Terms.

The Specification is based on the use of values of short-circuit current (such as making-current at a specified service-voltage, breaking-current at a specified recovery-voltage, and short-time current during a specified time) to express the rating of a circuit-breaker and the results obtained during type-tests. A typical oscillogram showing the varying values of currents and voltages as functions of time obtained with a three-phase circuit-breaker is given in Fig. 1 for guidance when reading the Specification.

MVA Rating.

15

For the practical convenience of specifying standard MVA breaking-capacity ratings for circuit-breakers and for comparing a given rating with the MVA value of a short circuit at any given point in a supply network, the fundamental symmetrical breaking-capacity rating in amperes assigned to a circuit-breaker is converted into an MVA rating by multiplying it by the rated service-voltage, the phase-factor, and 10^{-6} .

Criteria of Severity.

The Specification standardises generally accepted criteria of severity under which type-tests are made and ratings are assigned, but it does not specify the rate-of-rise of the restriking-voltage, which also affects the severity of the service demanded of a circuit-breaker. The rate-of-rise of restriking-voltage depends upon :—

- | | | |
|--------------------------|---|---|
| (i) Recovery-voltage | { | These factors control the amplitude of the restriking-voltage transient. |
| (ii) Power-factor | | |
| (iii) D.C. component | | |
| (iv) Natural frequencies | { | These frequencies control the time taken by the restriking-voltage transient to attain its maximum amplitude. |

35

Since present knowledge is insufficient to specify standard rates-of-rise of restriking-voltage, the Specification conforms with the 1937 I.E.C. Specification, which, whilst acknowledging in its Preface the importance of the natural frequencies of the circuit in controlling the rate-of-rise of restriking-voltage, at the same time only specifies the factors (i), (ii), and (iii) stated above, which control its amplitude.

* Issued by the International Electrotechnical Commission.

(9)

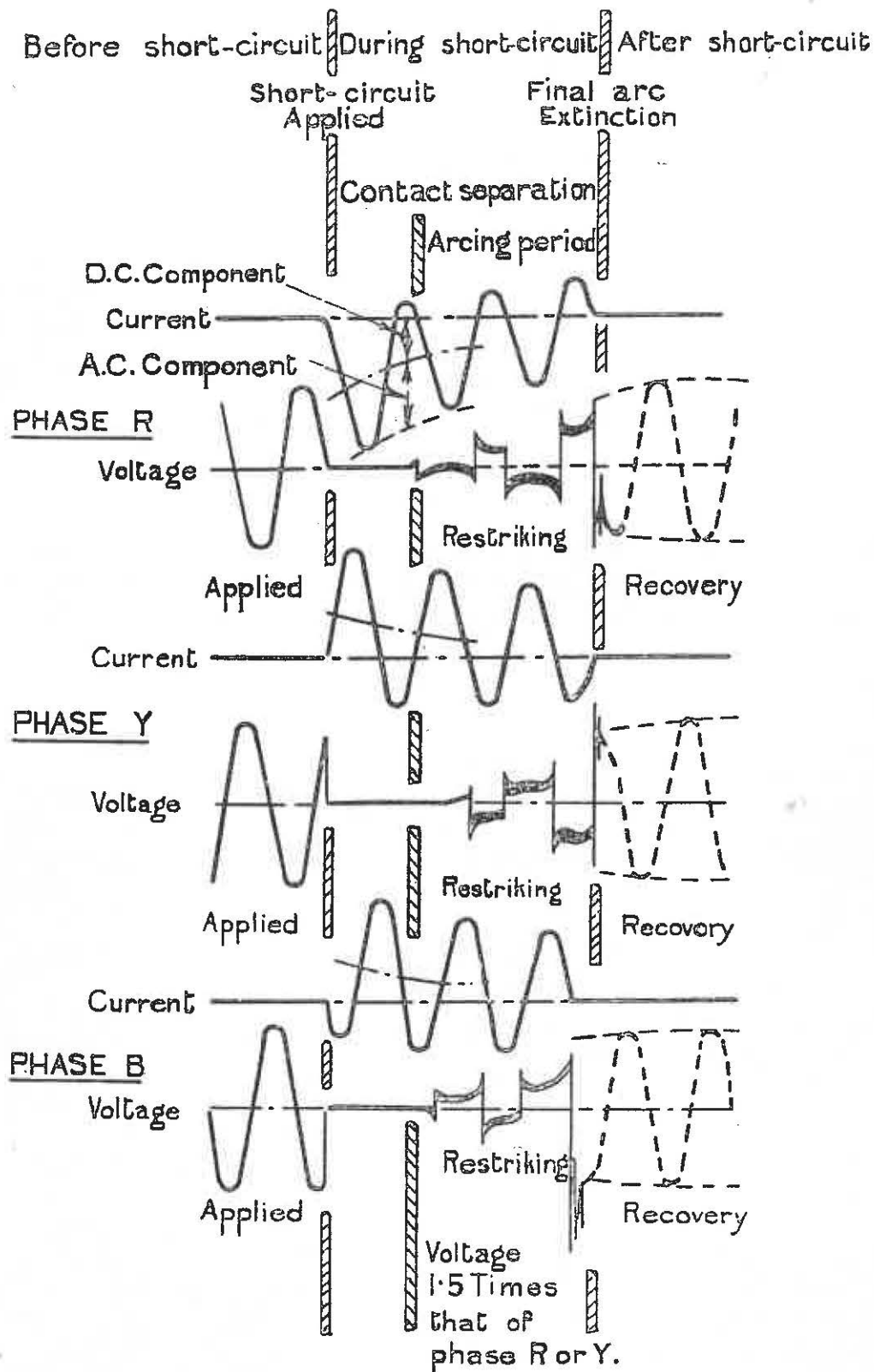


Fig. 1.—Typical Oscillogram of Three-phase Short-circuit.

The natural frequencies of the circuits in a short-circuit testing-station are frequently in excess of those of a supply-network, and hence it usually follows that for given values of the factors (i), (ii), and (iii), the severity of the test-circuit as judged by the rate-of-rise of the restriking-voltage is usually greater 5 than that of the corresponding circuit in service.

Note.—It will be observed that gaps occur in the sequence of the numbering of the Clauses in this Specification (i.e., between Clauses 37 and 40 and between Clauses 99 and 101. These gaps arise from the fact that corresponding Clauses in Part 1 and Part 2 of the Speci- 10 fication have been given identical reference numbers.

3. DEFINITIONS AND SYMBOLS.

Definitions.

The following definitions have been adopted for the purposes of this Specification :—

1. An *Oil Circuit-breaker* is a mechanical device capable of making and breaking the circuit in oil under normal and abnormal conditions such as that of short-circuit. 15

2. An *Oil Switch* is a mechanical device suitable for making and breaking in oil current not greatly in excess of the rated 20 normal current.

3. An *Oil Isolating-switch* is an oil switch suitable for disconnecting the circuit only when carrying no load-current.

4. A *Selector Switch* is one whereby connection can be made to any one (or more) of two (or more) alternative circuits. 25

5. A *Quick-break Switch* is one in which a quick break is ensured through the medium of a spring or other means, independently of the speed of action of the operator.

6. A *Slow-break Switch* is one in which the speed of breaking is dependent upon the operator. 30

7. A *Remote-controlled Switch* or *Circuit-breaker* is one that can be opened and closed from a distance by electrical or mechanical or other means.

8. An *Auxiliary Switch* is one working in conjunction with, and actuated by, another switch, circuit-breaker, contactor, 35 or the like, to control a circuit for operating auxiliary devices such as trip coils or alarm bells.

9. The *Main Contacts* are the fixed and moving contacts in the main current-carrying circuit.

10. An *Arcing Contact* (Auxiliary-break Contact) is a contact 40 that opens after, and closes before, the main contacts, and is intended to protect the main contacts from injury.

11. The *Number of Poles* is said to be one, two, three or more, according to whether one, two, three or more conductors or lines are to be broken. 45

(II)

12. The *Break* is the sum of the gaps introduced in one pole between contacts, or arcing contacts (if any), when the switch or circuit-breaker is in the fully-opened position.

13. The *Minimum Clearance between Terminals on one Pole* is the shortest total distance, in air or oil, between the contacts or any metal parts connected thereto, measured on one pole, with the switch or circuit-breaker in the fully-opened position. 5

14. The *Minimum Clearance between Poles* is the shortest total distance in air or oil measured between any live parts on adjacent poles. 10

15. The *Minimum Clearance to Earth* is the shortest total distance in air or oil measured between any live part and earthed parts.

16. The *Travel* is the distance through which the moving contacts pass between the closed and open positions. 15

17. A *Fixed-trip Circuit-breaker* is one in which the automatic release mechanism cannot function independently of the means used to close the breaker.

18. A *Trip-free Circuit-breaker* is one in which the automatic release mechanism can function independently of the means used to close the breaker. 20

19. *Opening-time* (until separation of the arcing-contacts). The opening-time of a circuit-breaker is measured from the instant of application of the tripping power to the circuit-breaker when in the closed position, to the instant of separation of the arcing-contacts, any time-delay device being adjusted to its minimum setting, or, if possible, cut out entirely. 25

20. A *Loop* is the part of an alternating wave that extends from any zero to the next.

21. The *Arc-duration* or *Arcing-time* of a circuit-breaker is the time interval between the instant of separation of the arcing-contacts and the instant of arc-extinction. 30

For the purpose of indicating the number of current zeros after the instant of separation of the arcing-contacts up to the instant of arc-extinction, arc-duration or arcing-time may be referred to as including a stated number of loops. 35

22. *Total-break-time* (until final arc-extinction). The total-break-time of a circuit breaker, from the closed position, is the sum of the opening-time and the arc-duration as defined in Clauses 19 and 21. 40

NOTE.—The total break-time must not be taken as the total duration of mechanical opening, which is measured up to the instant when the moving contact reaches the end of its stroke.

23. The *Make-time* of a circuit-breaker is the interval of time between the initiation of the closing operation and the instant when the arcing contacts touch, and includes the operating time of any auxiliary equipment used to close it.

24. The *Make-break-time* of a circuit-breaker is the interval of time between the instant when the arcing contacts touch and the instant of final arc-extinction in all poles. 5

25. An *Over-current Release* is one that causes a circuit breaker to open the circuit automatically when the current exceeds that predetermined value at which the release has been adjusted 10 to operate.

26. A *Definite-time-limit Over-current Release* is one that retards the tripping of a circuit-breaker by a definite time, which may be adjustable, but is independent of the magnitude of the over-current. 15

27. An *Inverse-time-limit Over-current Release* is one which retards the tripping of a circuit-breaker by a time inversely dependent upon the over-current.

28. An *Inverse-time-limit Over-current Release with a Definite Minimum Time Delay* is one that retards the tripping 20 of a circuit-breaker by a time inversely dependent upon the over-current, except that the time-delay approaches a definite minimum value for large over-current values.

29. An *Under-voltage Release* is one that causes a circuit-breaker to open the circuit if the voltage falls below a pre- 25 determined value.

NOTE.—The terms “no-volt release” and “low-voltage release” applied to the above are deprecated.

30. A *Shunt Trip* is one that enables a circuit-breaker to be opened by a circuit-closing relay, push-button or other 30 apparatus, which may be independent of the circuit-breaker and arranged for distant operation.

31. A *Series Trip* is one that is energised by the main current passing through a circuit-breaker.

32. The *Rating* of a switch or circuit-breaker is the set 35 of values assigned by the maker to define the working conditions for which it is built.

33. The *Performance* of a switch or circuit-breaker is the general term used to denote the actual values obtained from tests carried out upon it under prescribed conditions. 40

34. The *Reference Ambient-temperature*, to which the ratings of apparatus are referred, is a conventional reference temperature of the available cooling air. It is stated fundamentally as a maximum peak limit, and is considered in conjunction with a maximum value of the average temperature over 24-hour periods. 5

35. An *Operating Duty* is a defined sequence of making and/or breaking operations carried out without any deliberate alteration of the main circuit in which the switch or circuit-breaker is placed.

36. The *Service Voltage* is the R.M.S. working-voltage 10 of the system at the point where a switch or circuit-breaker may be installed.

37. The *Recovery Voltage* is the normal-frequency R.M.S. voltage that re-appears between the poles of a circuit-breaker after final arc-extinction. 15

40. The *Restriking Voltage* is the high-frequency transient voltage that exists at, or in close proximity to, each zero current pause during the arcing-time; the important attributes being the amplitude and rate-of-rise (expressed in volts per micro-second) at the time of final arc-extinction. 20

41. The *Normal Current* of a switch or circuit-breaker is the R.M.S. current that it is capable of carrying continuously under prescribed conditions.

42. The *Short-time (1 second or 5 seconds) Current* of a switch or circuit-breaker is the R.M.S. current that it is capable of 25 carrying in the fully closed position for the stated time under prescribed conditions.

43. The *Breaking-current* is the current broken by a pole of a circuit-breaker at the instant of contact separation.

(i) The *Symmetrical Breaking-current* is the R.M.S. value 30 of the A.C. component of the breaking-current.

(ii) The *Asymmetrical Breaking-current* is the R.M.S. value of the total breaking-current, which includes both the A.C. and the D.C. components of the breaking-current.

44. The *Breaking-capacity* of a circuit-breaker is expressed 35 by two quantities :—

(i) The *Symmetrical Breaking-capacity* is the R.M.S. value of the A.C. component of current that can be broken at a stated voltage simultaneously in all poles of a circuit-breaker, or, when stated in rated MVA for practical convenience, is a 40 product of that current and the rated service voltage.

(ii) The *Asymmetrical Breaking-capacity* is the R.M.S. value of the combined A.C. and D.C. components of current that can be broken at a stated voltage by any one pole of a circuit-breaker.

45. The *Making-current* of a circuit-breaker is the peak value of the maximum current-wave (including the D.C. component) in the first cycle of the short-circuit current after the circuit is closed by the circuit-breaker. 5

46. The *Making-capacity* of a switch or circuit-breaker is the making-current that it is capable of making and carrying 10 instantaneously at rated service-voltage, under prescribed conditions.

47. *Circuit Closing*. The circuit is closed at the instant when the arcing contacts touch and allow current to pass.

48. *Circuit-breaker Closing*. A switch or circuit-breaker 15 is closed only when it has completed its closing operation properly.

49. *Trip-free Operation*. The trip-free operation of a circuit-breaker is the operation of tripping out at the instant of circuit closing or at any following instant when the circuit-breaker is partially or fully closed. 20

Symbols.

50. The following symbols are used in this Specification to define the steps of any operating or test duty :—

B denoting a breaking operation.

M denoting a making operation. 25

MB denoting a making operation followed by a breaking operation, without the introduction of any intentional time delay.

t (or a numeral) denoting a time interval between the successive operations of an operating duty. 30

4. RATING AND MARKING.

Rating of an Oil Switch or Oil Isolating-switch.

51. An oil switch or oil isolating-switch shall be rated in terms of its normal current, service voltage, frequency and short-time current. The ratings shall apply at the standard reference 35 ambient temperature.

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Rating of an Oil Circuit-breaker.

52. An oil circuit-breaker shall be rated in terms of the following quantities :—

- (a) Number of poles.
- (b) Service voltage. 5
- (c) Normal current.
- (d) Frequency.
- (e) Breaking-capacity.
- (f) Making-capacity.
- (g) Short-time current : 1 second and 5 seconds. 10
- (h) Operating duty.

The ratings shall apply at the standard reference ambient temperature.

Rated Service Voltage.

53. (i) The rated service voltage of an oil switch or oil circuit-breaker shall be the R.M.S. voltage of the circuit or system in which the apparatus is intended to be used.

(ii) The rated service voltage for three-phase apparatus shall have one of the following standard values :—

TABLE 1.

20

Standard Service-Voltage Ratings			
3.3 kilovolts		66 kilovolts	
6.6	"	88	"
11	"	110	"
22	"	132	"
33	"	165	"
44	"	220	"

25

Rated Normal-current.

30

54. (i) The rated normal-current of an oil switch or oil circuit-breaker shall be such as the apparatus can carry continuously with a temperature-rise in accordance with the conditions in Section 5, and for an oil switch, also after the performance of the type-test operating duties specified in Section 9.

35

(16)

(ii) The rated normal-current shall have one of the following standard values :—

TABLE 2.

Standard Normal-current Ratings.	
200 amperes	5
400 "	
600 "	
800 "	
1200 "	10
1600 "	
2000 "	

(iii) When special conditions necessitate higher current ratings than those given in the Table, it is recommended that the higher ratings shall be graded in steps of 1,000 amperes, commencing at 3,000, e.g., 4,000, 5,000, etc.

Normal-Current Ratings for Non-standard Frequencies.

55. When an oil switch or oil circuit-breaker is used for frequencies other than 50 c/sec., its standard normal-current rating may be increased or decreased, if necessary, in order that the oil switch or oil circuit-breaker shall comply in all other respects with the requirements of this Specification. Such modified current shall then be the rated normal-current at the frequency marked on the nameplate.

Rated Making-capacity of an Oil Circuit-breaker.

56. (i) The rated making-capacity current shall be marked on the nameplate. It shall be not less than the rated symmetrical breaking-capacity, in amperes, multiplied by the factors 1.8 and 1.414, i.e., by 2.55.

(ii) An oil circuit-breaker shall be capable of closing the circuit at its rated making-current in accordance with the test requirements of Clause 86.

Rated Breaking-capacity of an Oil Circuit-breaker.

57. (i) The rated symmetrical and asymmetrical breaking-capacities shall be marked on the nameplate, and an oil circuit-breaker shall be capable of breaking circuit at these values in accordance with the type-test requirements of Clause 86.

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(ii) For practical convenience, the rated symmetrical breaking-capacity shall also be marked on the nameplate in terms of MVA as the product of the rated symmetrical breaking current (in kA), the rated service voltage (in kV), and the factor 1.73 or 1, for three-phase or single-phase circuit-breakers respectively. 5

(iii) The rated symmetrical breaking-capacity of a three-phase oil circuit-breaker in MVA as derived in sub-Clause (ii) shall have one of the standard values given in Table 3; the corresponding symmetrical breaking-currents at the various standard service voltages are listed in Table 4. 10

TABLE 3.

Standard 3-Phase MVA Breaking-capacity Ratings	
25	150
50	250
75	350
100	500

15

Rated Short-time Currents.

58. No permanent damage shall be sustained by an oil switch or an oil circuit-breaker owing to electro-magnetic forces, thermal effects or any other physical cause, as a result of carrying the rated short-time currents. For an oil circuit-breaker, the rated 1-second short-time current shall not be less than the rated symmetrical breaking-capacity current. 20

Operation in Service: Oil Switches.

59. An oil switch shall be capable of making and/or breaking 25 its rated normal-current at the rated service-voltage and frequency, without the temperature-rise, when carrying normal current, exceeding the limits specified in Clauses 68 and 69, provided that successive operations are separated by time intervals of not less than three minutes, the short-time ratings have not been exceeded, 30 and the load has not otherwise exceeded the normal-current.

Operation in Service: Oil Circuit-breakers.

60. (i) The maintenance and the opening and closing operations shall be carried out in conformity with the instructions for the manipulation and use of the oil circuit-breaker and its 35 auxiliary apparatus.

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TABLE 4.

STANDARD THREE-PHASE OIL CIRCUIT-BREAKERS.

Correlation of Standard Symmetrical Breaking-currents and Normal-current Ratings with Standard MVA Breaking-capacity and Service-voltage Ratings.

Standard Service-voltage.	Standard Breaking-capacity Ratings.	Standard Symmetrical Breaking-currents corresponding to MVA in Col. 2.	Standard Normal-current Ratings.			
kV.	MVA.	Kilo-Amperes.	Amperes.			
3·3	25	4·38	200	400	600	
	50	8·76	200	400	600	
	75	13·1	200	400	600	800
	100	17·5	400	600	800	
	150	26·3	400	600	800	
	250	43·8	400	800	1200	
6·6	75	6·57	200	400	600	
	100	8·76	200	400	600	800
	150	13·1	200	400	600	800
	250	21·9	400	800	1200	
	350	30·6	400	800	1200	1600
	500	43·8	800	1200	1600	2000
11	75	3·94	200	400		
	100	5·25	200	400	600	800
	150	7·88	200	400	600	800
	250	13·1	400	800	1200	
	350	18·4	400	800	1200	1600
	500	26·3	400	800	1200	1600 2000
22	250	6·57	200	400		
	350	9·2	400	800		
	500	13·1	400	800	1200	
33	250	4·38	200			
	350	6·13	400			
	500	8·76	400	800		
44	500	6·57	400	800		
66	500	4·38	400			
For Pole-mounting Types only.						
6·6	50	4·38	200			
11	50	2·63	200			

NOTE.—The lower current values in the various ranges are the minimum permissible currents for the appropriate breaking-capacities; the higher current values represent the usual maxima employed in practice.

(19)

(ii) An oil circuit-breaker shall be capable of operating at any currents up to its rated making-capacity and rated breaking-capacity in accordance with the following duty :—

$$B - 3' - MB - 3' - MB.$$

(iii) When operating conditions are more severe than those covered by the formula above (for instance, with auto-reclosing oil circuit-breakers), an oil circuit-breaker shall be capable of performing in accordance with the number of operations and intervals for which it is rated, and these shall be marked on the nameplate. 5

(iv) The behaviour of an oil circuit-breaker shall be satisfactory irrespective of the proportions of the D.C. and A.C. components of the breaking-current, provided that the A.C. component does not exceed the rated symmetrical breaking-capacity and the asymmetrical breaking-current does not exceed the rated asymmetrical breaking-capacity. 15

(v) When performing these operations, an oil circuit-breaker shall not show undue distress. For example, there shall be no outward emission of flame, and the gases produced, together with the oil displaced thereby, shall be conducted harmlessly from the circuit-breaker, and diverted from all bare conductors that are normally alive. The amount of oil lost during an individual opening and/or closing operation shall be such as not to affect the satisfactory behaviour of the oil circuit-breaker during the later operations prescribed in (ii) above. 20

(vi) After the operations described in (ii) above, the mechanical parts and insulators of the circuit-breaker shall be essentially in the same condition as before, and the oil circuit-breaker shall be capable of making, carrying, and breaking its rated normal-current at the rated service-voltage, although its making-capacity and breaking-capacity may be materially reduced. 30

(vii) After the operations described in (ii) above, and to restore the making-capacity and breaking-capacity to the original rated values, maintenance shall be undertaken, and the following are typical adjustments :—

(a) Renewal of the arcing contacts and other parts that assist in extinguishing the arc. 35

(b) Filtration or renewal of the oil, or the addition of quantities necessary to restore its normal level.

(c) Removal from the insulation of carbon or other deposit caused by decomposition of the oil. 40

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Electrical Power Closing-devices.

61. (i) The standard rated voltage for auxiliary circuits supplying closing-devices operated by electrical power shall be 110 volts or 230 volts.

(ii) An oil switch or oil circuit-breaker shall be capable of 5 performing the standard type-test duties of Clauses 87 or 98 respectively when the voltage of the supply at the terminals of the closing-device at standard ambient temperature is 20 per cent below the maximum operating voltage.

(iii) Unless it is specified that unusual conditions of voltage-10 drop exist in the leads connecting the source of electrical power to the closing-device, the 20 per cent reduction in operating value shall be deemed to correspond with 100 per cent to 80 per cent of the standard rated voltage of the auxiliary supply circuit.

The maximum and minimum operating voltages at the 15 terminals of the closing-device that correspond to the percentage operating range shall be marked on the nameplate.

NOTE.—Where more than one size of oil switch or oil circuit-breaker is operated from a common source of auxiliary power, means shall be provided to avoid the possibility of the closing-device having 20 to operate at a pressure in excess of the maximum operating voltage.

Shunt Trip-coils.

62. (i) Shunt trip-coils shall be capable of operating satisfactorily at any value of the auxiliary supply between 50 per cent below and 20 per cent above the rated operating voltage unless 25 otherwise stated on the nameplate and at the time of tendering, the operation starting at standard ambient temperature.

(ii) The rated operating voltage shall be marked on the nameplate.

**Series Trip-coils, Current-transformer Windings, and
Over-current Releases.**

30

63. (i) The series trip-coils incorporated in an oil circuit-breaker for any purpose (such as over-current protection) shall withstand without thermal or electro-magnetic damage the rated making and short-time-current values of the oil circuit-breaker 35 itself for periods corresponding to their own time lags and to the oil circuit-breaker operating duty.

(ii) Where a current-transformer in accordance with B.S Specification No. 81 forms part of an oil circuit-breaker panel, and its short-circuit current ratings differ from the making-current 40 and short-time current ratings of the oil circuit-breaker as defined in this Specification, the ratings of the current-transformer (corresponding to the making-current and short-time current as defined for oil circuit-breakers) shall be marked on the circuit-breaker nameplate.

45

(iii) The normal-current of transformer-operated trip-coils shall be marked on the nameplate.

(21)

(iv) The value of the lowest setting of an over-current release shall not exceed the rated normal-current, except that oil circuit-breakers with direct-acting over-current trip-coils with time-limits may have a lowest setting not exceeding 33 per cent in excess of the rated normal-current. 5

(v) The value of the maximum calibration mark on the scale shall be not less than three times the rated normal-current for instantaneous release, and shall be not less than twice the rated normal-current for time-limit release.

(vi) The over-current release shall operate with currents differing 10 by not more than 10 per cent from the settings marked.

Inverse Time-limit Attachments to Over-current Releases.

64. (i) When a mechanical or electro-magnetic inverse time-limit attachment is provided with an oil circuit-breaker, the time rating at any over-current setting shall be based on the delay 15 that will occur when a current is applied 25 per cent in excess of the setting.

(ii) When the inverse-time-limit attachment is in the form of a fuse connected in parallel with the trip-coil, the rating of the fuse shall be the current that will melt it in two minutes. 20

Under-voltage releases.

65. (i) An under-voltage release, with or without time-limit attachment, shall operate on a falling voltage, at normal frequency, between the limits of 65 per cent and 25 per cent of the normal system-voltage. With half normal frequency the lower 25 limit of operation shall be not less than 15 per cent of the normal system voltage.

(ii) When the release is self-resetting it shall require not more than 90 per cent of the normal system-voltage to reset it.

Marking of Nameplate.

66. (i) All oil switches shall be indelibly marked with the following rating data :—

(a) To British Standard Specification 116-1937.

(b) Service Voltage.

(c) Normal Current. 35

(d) Design Frequency.

(e) Short-time Current.

(ii) All oil circuit-breakers shall be indelibly marked with the following rating data :—

(a) To British Standard Specification 116-1937. 40

(b) Service Voltage.

(c) Normal Current.

(d) Design Frequency.

- (e) Breaking-capacity : symmetrical.. .. (amperes),
equivalent to .. MVA;
asymmetrical .. (amperes).
- (f) Making-capacity.
- (g) Short-time current : 1 second. 5
5 seconds.

Also, where applicable, the information required by Clauses 60, 61, 62, and 63.

5. LIMITS OF TEMPERATURE-RISE.

Standard Reference Ambient-temperature.

10

67. The Standard Reference Ambient-temperature for the purpose of this Specification has a peak value of 40° C., and an average value of 35° C. over 24-hour periods.

Temperature-rise of Parts other than Coils.

68. The following maximum temperature-rises of parts other than coils are permitted when the oil switch or oil circuit-breaker is carrying its rated normal-current continuously.

(i) For oil switches and oil circuit-breakers having a rated normal-current of 200 amperes or less, the temperature-rise of any current carrying part in oil shall not exceed 30° C. 20
(54° F.).

(ii) For oil switches and oil circuit-breakers having a rated normal current greater than 200 amperes up to and including 800 amperes, the temperature-rise of any current-carrying part in oil shall not exceed 40° C. (72° F.). 25

(iii) For oil switches and oil circuit-breakers having a rated normal-current greater than 800 amperes, the temperature-rise of any current carrying part in oil shall not exceed 50° C. (90° F.).

(iv) The type test record of millivolt drop across contacts and/or terminals or equivalent resistance measurement shall be taken as a datum for all subsequent tests to prove compliance with this Clause.

NOTE.—For service conditions (including ambient temperature) reference should be made to Appendix C, and for temperature measurement reference should be made to Appendix G.

Temperature-rise of Coils.

69. (i) The temperature-rise, measured on the surface by thermometer or thermo-couple (in accordance with methods (a) or (b) specified in Appendix G), of any continuously-rated coil working in air shall not exceed the value given in Table 5, column 2, and in the case of intermittently-rated coils working

(23)

in air it shall not exceed the value given in column 3, corresponding to the class of material with which the coil is insulated.

(ii) The temperature-rise of any coil which is oil-immersed shall not exceed 40°C . (72°F .) if it is continuously rated, or 50°C . (90°F .) if it is intermittently rated. 5

(iii) The limitations in sub-Clauses (i) and (ii) above shall apply to tripping coils and closing coils after operation at the rated normal voltage or current under one of the following conditions :—

(a) When the time of operation is dependent upon the operator, the current shall be maintained for 30 seconds. 10

(b) When the time of operation is independent of the operator, the operation shall be repeated ten times in rapid succession.

(iv) The temperature limits stated in sub-Clauses (i) and (ii) shall apply after continuous operation at the rated voltage and 15 frequency for under-voltage releases, and at the rated current and frequency for over-current releases when set to trip at 133 per cent of the rated current.

TABLE 5.
TEMPERATURE-RISES FOR COILS IN AIR.

20

1 Insulating Material.	2 Maximum Temperature-rise $^{\circ}\text{C}$.		3
	Continuously-rated Coils.	Intermittently-rated Coils.	
<i>Class "O"</i> Cotton, silk, paper and similar materials non-impregnated	40	45	25
<i>Class "A"</i> Cotton, silk, paper and similar materials when impregnated, also enamel when associated with such fibrous material	50	55	30
Enamelled wire not in association with such fibrous material	65	75	
<i>Class "B"</i> Built-up asbestos, mica, and similar materials, and bare coils	85	95	35
<i>Class "D"</i> Coils with synthetic resin impregnation	65	75	