Contents

Cooperating organisations 6

Acknowledgements 7

Preface 8

Introduction 9

Chapter 1 The regulations concerning protection against overcurrent 11

1.1 Scope 11
1.2 Nature of overcurrent and protection 12
1.3 Statutory requirements 13
1.4 Omission of protection 13
1.5 Protective devices 13
1.6 Duration of overcurrent 14
1.7 Coordination and discrimination 14

Chapter 2 Protection against overload 19

2.1 Introduction 19
2.2 Load assessment 19
2.3 Selection of protective device 21
2.4 Selection of conductor cross-sectional area with overload protection 23
2.5 Omission of protection against overload current 24
2.6 Grouping of cables 29
2.7 Avoidance of unintentional operation of circuit-breakers 30
2.8 Current ratings of low voltage assemblies (switchboards, panel boards, distribution boards, etc.) 33
2.9 Cables for star-delta starters 33
2.10 Cables in parallel 35
2.11 Ring final circuits 37
2.12 Load assessment 40
2.13 Mineral insulated cables and ring final circuits 40

© The Institution of Engineering and Technology

Chapter 3 Protection against fault current 43
3.1 Types of fault to be considered 43
3.2 Nature of damage and installation precautions 43
3.3 Fault impedance and breaking capacity of protective device 46
3.4 Short-circuit rating of low voltage assemblies (switchboards, panel boards, distribution boards, etc.) 48
3.5 Position of fault current protection and assessment of prospective current 48
3.6 Omission of fault current protection 52
3.7 The use of one device for both overload and fault current protection 54
3.8 Harmonics 54
3.9 Embedded generation 58

Chapter 4 Determination of fault current 59
4.1 Determination of fault current by enquiry 59
4.2 Measurement of fault current 61
4.3 Calculation of fault current 62
4.4 Embedded generation 63

Chapter 5 Equations for the calculation of short-circuit current 65
5.1 General equation for fault current 65
5.2 Single-phase, line to neutral fault 66
5.3 Conductor temperature and resistance 67
5.4 Single-phase circuits 70
5.5 Line-to-line short-circuit 71
5.6 Three-phase short-circuit 72

Chapter 6 Equations for the calculation of earth fault current 75
6.1 General 75
6.2 TN-S and TN-C-S systems 75
6.3 Cable enclosure used as a protective conductor 77
6.4 TT system 83

Chapter 7 Selection of conductor size 85
7.1 General 85
7.2 Overload and short-circuit protection by a single device 85
7.3 Earth fault current 85
7.4 Parallel cables 86
7.5 Energy let-through characteristics 86
7.6 Duration of short-circuit current 88
7.7 Status of adiabatic equations 89
7.8 Alternative values of k 89
7.9 Appendix 4 of BS 7671 90

© The Institution of Engineering and Technology

Appendix A Calculation of reactance **93**
A1 General 93
A2 Line to neutral, single-phase faults 93
A3 Line-to-line, single-phase, short-circuit 94
A4 Three-phase short-circuit 95
A5 Earth faults 96

Appendix B Calculation of k for other temperatures **99**
B1 Adiabatic equation 99

Index **101**

© The Institution of Engineering and Technology