NHP Technical NEWS

ISSUE 39 - July 2003

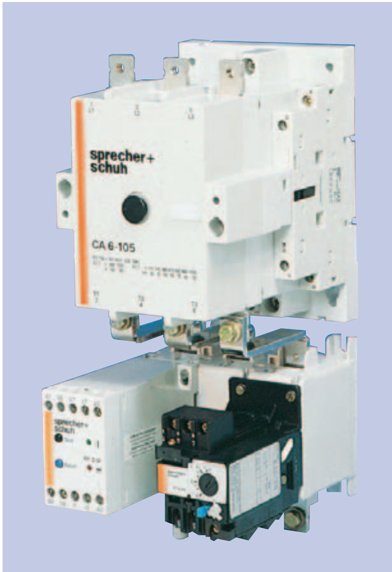
Quarterly Technical Newsletter of Australia's leading supplier of low-voltage motor control and switchgear

Please circulate to

____
____
____
____
____
____
____

MOTOR PROTECTION & THE WIRING RULES

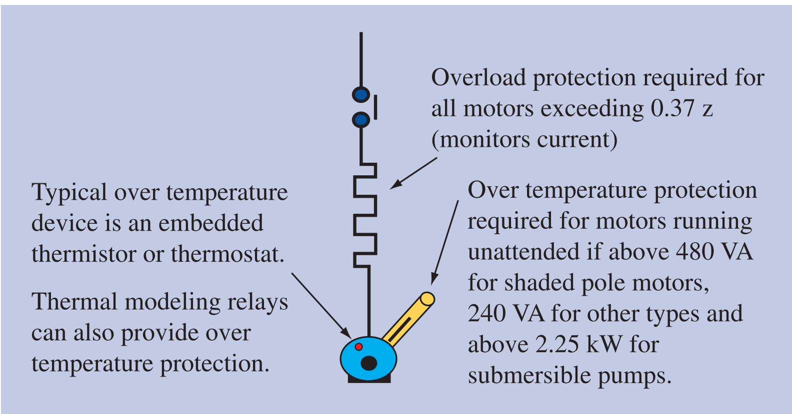
The introduction of the year 2000 edition of the Wiring Rules changed the requirements for the protection of motors and the cables supplying them. These changes are still causing confusion and the result is that some installations do not comply and installations that do comply have been rejected. This article is intended to help clarify the situation.



Motor Protection assembly with overcurrent and thermistor overtemperature relays

Protection of the motor

An electric motor can be damaged by many things including overloading, incorrect supply voltage and phase imbalance. The Wiring Rules require most motors to be protected against overload currents. This is achieved with the typical thermal overload relay used for monitoring the current drawn by the motor. In addition to this, there is a requirement for motors running unattended to have over temperature protection. While the intention of the basic thermal overload relay is to prevent over heating of the motor, it may not always correctly sense the temperature of the windings. A device embedded in the windings such as a thermistor or thermostat is typically used to directly monitor temperature. These are connected in the control circuit in a way that causes the motor control contactor to open when high temperatures are detected.



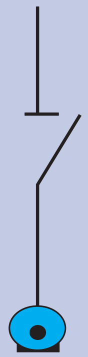
In this Issue...

2

Protection of the operator

Isolation devices are required to allow the motor to be turned off by the operator should an unsafe condition arise. For maintenance an isolation device is required and if remote from the motor, it must be provided with the means to lock it in the OFF position. The circuit breaker providing short circuit protection is often used for this purpose.

If remote from the motor an isolation device must be provided with the means to secure it in the open position.



Isolation means to be provided so it can easily be operated by the person in charge of the motor and at all points where danger is likely to occur.

Cable selection

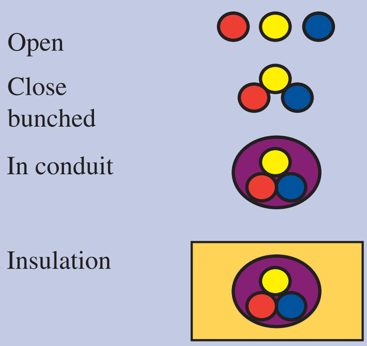
The cables supplying a motor are now treated in the same manner as any other cable in the fixed wiring system. They must be provided with protection against overload and fault currents.

Zone 1

The first step is to select a cable suitable for the motor rated current (Zone 1). The cable rating is determined by the temperature reached in the installed position. Any restriction on the cable s ability to transfer the heat produced by the passage of current to the surrounding environment will reduce its rating. The standard AS/ANZ3008.1 provides rating tables for cables mounted in typical configurations. The cable rating selected must be equal to or greater than the rated motor current and equal to or greater than the setting of the over current protection device. The over current device will not normally trip at its setting and will require some degree of overload before it does. The Wiring Rules allow a factor of 1.45 x, the setting for tripping to occur. Motor protection thermal overload devices comply with this requirement and are therefore suitable for the overload protection of the cables as well as the motor.

Zone 2

The second step is to check that the cable selected is protected against fault currents. High currents cause rapid heating of cables and for durations under 5 seconds, it is considered that all the heat produced in the cable is absorbed by the cable and no heat is lost to the surroundings. The protective device must operate quickly enough to prevent the peak temperature reached from causing significant damage to the cable insulation. The factors to be considered are the cable cross section, the accepted peak temperature of the insulation and the starting temperature. The combination of these factors is considered in AS/ANZ3008.1 and tables are provide so that an overall factor k can be determined. A typical factor used is k = 111 and the adjacent cable selection table provides the current that will produce the permitted rise with a 5 and 0.1 second duration. These points can be compared with the protective devices



Wire current rating is determined by the method of installation. The temperature must not exceed the insulation rating.

Select the cable size to have a rating equal to or greater than the setting of the overcurrent device.

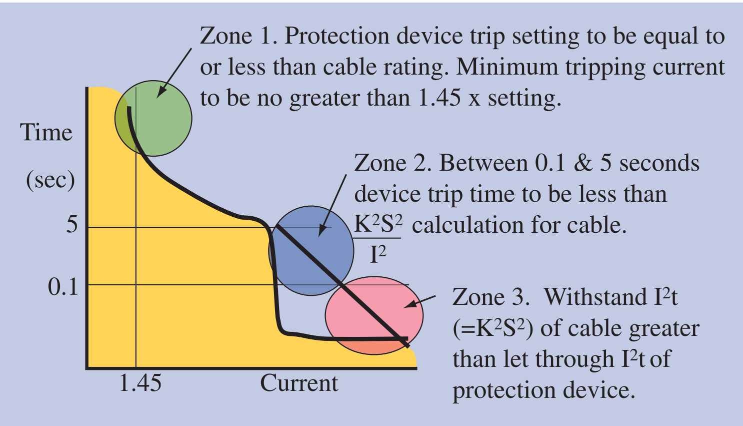
3

time current curve to check the devices clears the fault before these times are reached (Zone 2). If the time current curve is plotted with a log scale for both the X and Y axis, the cable 5 and 0.1 second points can be joined with a straight line for consideration of intermediate times.

Zone 3

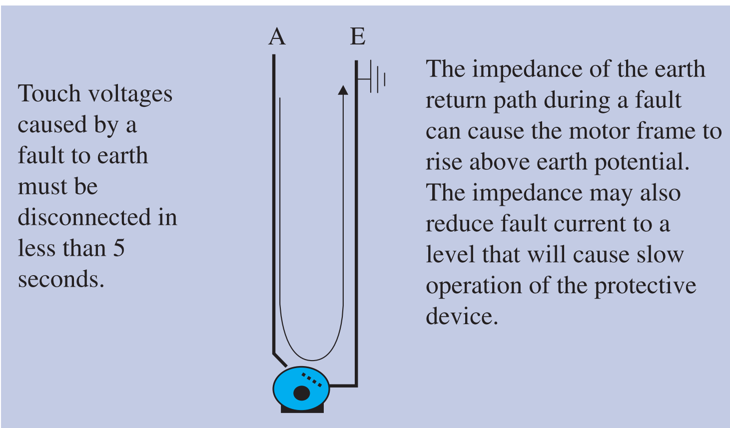
For fault levels producing a shorter clearing time than 0.1 second (Zone 3), the let through I^2t of the protective device needs to be compared with the cable withstand I^2t. This is a comparison of energies. For circuit breakers, the energy let through varies greatly with fault current level so the value to be considered is the let through energy at the maximum fault prospective at the point of installation of the circuit breaker. For fuses, it is normal just to consider the energy let through at the maximum short circuit rating. Manufactures provide energy let through characteristic for circuit breakers and fuses.

For normal protection of cables, the consideration of fault current levels will not normally result in the need to over size the cable. In the case of motor protection, it is common to have the fault current protective device selected for a larger rating than the motor. This is to prevent tripping on motor starting currents. In these cases, a larger cable may be required especially if the over sizing has resulted in the next circuit breaker frame size being selected.



Fault loop

Selection of the cable sizes and protection device can also be altered by the requirement to ensure that during a fault, exposed conductive parts are not raised to a potential of greater than 50 volts for a period of time greater than 4 seconds for fixed equipment. The passage of current through the earth system produces this rise in voltage and it can be a problem with long cable runs. As the cable length increases so does the impedance, increasing the possible touch voltage as well as reducing the maximum fault current. With the reduction in fault current, it is possible to have operating times of the protective device greater than 4 seconds. Options to overcome this include the fitting of earth fault sensing relays and increasing the cable cross section. Selecting faster acting protection is not always an option when considering motor protection arrangements. Some motor protection relays operate faster when the currents are out of balance and this should be considered if tripping time is found to be a problem.



SHORT CIRCUIT PROTECTION

Let through energy I^2t

Fuse		
Type	Rating	Total I^2t
	Amps	x 10^3
N range	10	0.4
BS88 style	16	0.7
	20	1.2
	25	2
	32	4
	40	7
	50	9
	63	17
	80	21
	100	59
	125	92
	160	144
	200	370
	250	490
	315	709
	355	1,100
	400	2,270
	500	2,010
	630	4,500
	710	4,300
	800	8,640

Circuit breaker						
Type	Rating	I^2t (x 10^3) at fault prospective				
	Amps	10 kA	20 kA	30 kA	40 kA	50 kA
DinT 10	10	24				
	16	29				
	20	35				
	25	41				
	32	47				
	40	50				
	50	63				
	63	70				
XS125NJ	50-125	550	1,200			
XH125NJ	50-125	530	850	1,100	1,250	1,300
XS250NJ	160-250	900	2,000			
XH250NJ	160-250	780	1,400	1,800	2,300	2,400
XS400NJ	250-400	1,300	2,800	4,400	5,800	6,800
XH400NJ	250-400	1,300	2,800	4,400	5,800	6,800
XS630NJ	400-630		6,000	8,000	12,000	14,000
XH630NJ	400-630		6,000	8,000	12,000	14,000

Note: Fuses and circuit breaker from NHP.

CABLE SELECTION

Withstand currents and I^2t (k = 111)

Cable area	Current (amps) for		I^2t
(sq mm)	0.1 sec	5 sec	x 10^3
2.5	878	124	77
4	1,404	199	197
6	2,106	298	444
10	3,510	496	1,232
16	5,616	794	3,154
25	8,775	1,241	7,701
35	12,285	1,737	15,093
50	17,551	2,482	30,803
70	24,571	3,475	60,373
95	33,346	4,716	111,197
120	42,122	5,957	177,422
150	52,652	7,446	277,223
185	64,937	9,184	421,686
240	84,243	11,914	709,690
300	105,304	14,892	1,108,890
400	140,405	19,856	1,971,360
500	175,506	24,820	3,080,250

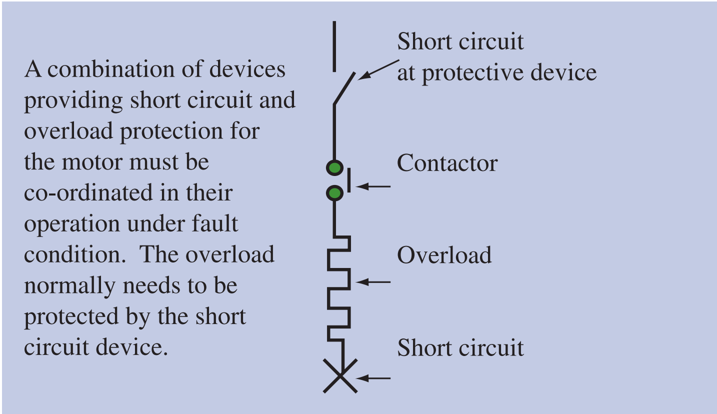
Cable withstand current for 0.1 seconds and 5 seconds to be higher than the trip current of protective device for the same times. Refer to catalogue information for protective devices times versus current curve.

Cable I^2t to be higher than protection devices let through I^2t.

5

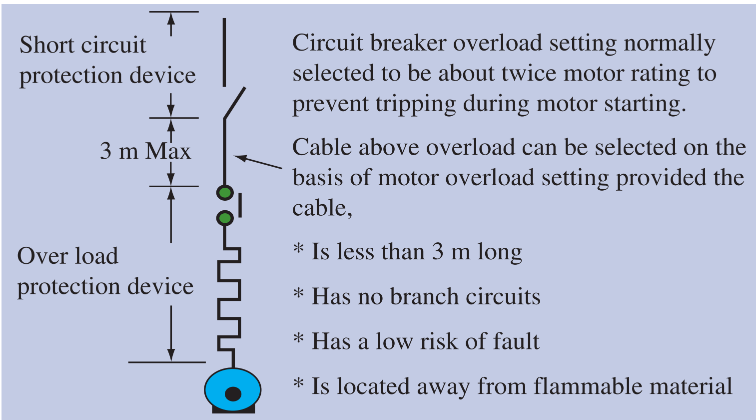
Protection co-ordination

If separate devices are used for overload and fault current protection, the Wiring Rules require their operation to be co-ordinated so that the overload device is protected under short circuit conditions. In motor starting application, motor starter combinations are tested in accordance to AS3947.4 to prove the combination is satisfactory under fault conditions. Co-ordination can be to Type 1 or Type 2, with the major difference being that Type 1 permits permanent welding of the contactor contacts.



Location of devices

In a motor starting arrangement, it is common for the overload and the short circuit device to be at different locations in the circuit. With the circuit breaker selected having a thermal current setting greater than the motor rating, there is often an issue regarding the protection of the cable between the overload and the circuit breaker. If the method of installation meets the requirements of the Wiring Rules, this cable can be considered as being protected by the downstream overload. The basic requirements are, less than 3 m long, no branch circuits, low risk of fault and located away from flammable materials.



Disclaimer. This article does not detail all requirements of the Wiring Rules and installers should only consider this as a basic guide.

6

If you would like previous copies of Technical News, please complete the following form and **fax to NHP on (03) 9429 1075** marked to the attention of the **Marketing Services Department.**

Name: ....

Title: ....

Company: ....

Address: ....

....

Telephone: ( ).. Fax: ( )......................................

Other issues currently available. Please tick those you would like to receive.

- ☐ 1. First edition (Latched and delayed contactors)
- ☐ 2. Non-standard contactor applications (Parallel and series connections of contacts varying frequencies)
- ☐ 3. Contactor failure (Reasons for the failure)
- ☐ 4. Soft start for generator loads (Advantages of electronic soft starters)
- ☐ 5. Set the protection (MCCB breakers and application)
- ☐ 6. Contactor operating speed (Difference between AC and DC systems)
- ☐ 7. Quick guide to fault levels (Calculating the approximate fault levels)
- ☐ 8. IP ratings what do they mean? (IP Ratings, use and meaning)
- ☐ 9. Utilisation categories (Electrical life of switches)
- ☐ 10. AC variable frequency drives and breaking (Regenerative energy)
- ☐ 11.Don t forget the motor protection (Motor protection devices and application)
- ☐ 12. Electrical life of contactors (How and why contactors are tested)
- ☐ 13. Liquid resistance starter developments (For large slipring motors)
- ☐ 14. Taking the hiss out of DC switching (DC switching principles)
- ☐ 15. Start in the correct gear (Application of different motor starters)
- ☐ 16. Application guide to lamp selection (Industrial pushbutton controls)
- ☐ 17. Electrical surges can be expensive (Electrical surges)
- ☐ 18. Putting the PLC in control (advantages of the PLC)
- ☐ 19. The thinking contactor (The development of the contactor)
- ☐ 20. Some don t like it hot (Temperature rise in electrical switchgear)
- ☐ 21. Pollution of the airwaves (Unwanted signals and their effects on motor protection devices)
- ☐ 22. What s different about safety (Safety devices and their application)
- ☐ 23. Talk about torque (Motors and torque)
- ☐ 24. Power factor what is it? (Power factor and correction equipment)
- ☐ 25. Terminations, good or bad? (Terminals)
- ☐ 26. RCDs are saving lives (Earth leakage protection; RCDs)
- ☐ 27. The quality switchboard (Switchgear and protection devices for Switchboards)
- ☐ 28. How does electrical equipment rate (Understanding ratings of electrical equipment)
- ☐ 29. EMC - what s all the noise about (Understanding EMC)
- ☐ 30. Controlling high short circuit currents with current limiting circuit breakers (Short circuit co-ordination KT 7)
- ☐ 31. Another step in electrical safety (Changes to electrical safety)
- ☐ 32. Keep your cables cool (New requirements on cable protection)
- ☐ 33. A leak to earth can be electric (RCDs)
- ☐ 34. Keep Cool (Derating)
- ☐ 35. Improving star-delta protection. (Overload and short circuit protection)
- ☐ 36. Does your CT measure up? (Selecting the correct current transformer)
- ☐ 37. Is your copper flexible? (Flexible busbars)
- ☐ 38. Where did the 10 volts go? (world uniform voltages)

Editorial content: - Please address all enquiries to:
The Editor - NHP Technical News PO Box 199, Richmond, Victoria, 3121.

NHP Electrical Engineering Products Pty Ltd A.B.N. 84 004 304 812
www.nhp.com.au
AUSTRALIA
VICTORIA
MELBOURNE
43-67 River Street
Richmond VIC 3121
Phone (03) 9429 2999
Fax (03) 9429 1075
NEW SOUTH WALES
SYDNEY
30-34 Day Street North,
Silverwater NSW 2128
Phone (02) 9748 3444
Fax (02) 9648 4353
NEWCASTLE
575 Maitland Road
Mayfield West NSW 2304
Phone (02) 4960 2220
Fax (02) 4960 2203
QUEENSLAND
BRISBANE
25 Turbo Drive
Coorparoo QLD 4151
Phone (07) 3891 6008
Fax (07) 3891 6139
TOWNSVILLE
62 Leyland Street
Garbutt QLD 4814
Phone (07) 4779 0700
Fax (07) 4775 1457
ROCKHAMPTON
14 Robison Street
Rockhampton QLD 4701
Phone (07) 4927 2277
Fax (07) 4922 2947
TOOWOOMBA
Cnr Carroll St & Struan Crt
Toowoomba QLD 4350
Phone (07) 4634 4799
Fax (07) 4633 1796
CAIRNS
14/128 Lyons Street
Bungalow QLD 4870
Phone (07) 4035 6888
Fax (07) 4035 6999
SOUTH AUSTRALIA
ADELAIDE
36-38 Croydon Road
Keswick SA 5035
Phone (08) 8297 9055
Fax (08) 8371 0962
WESTERN AUSTRALIA
PERTH
38 Belmont Ave
Rivervale WA 6103
Phone (08) 9277 1777
Fax (08) 9277 1700
NORTHERN TERRITORY
DARWIN
3 Steele Street
Winnellie NT 0820
Phone (08) 8947 2666
Fax (08) 8947 2049
TASMANIA
HOBART
2/65 Albert Road
Moonah Tasmania 7009
Phone (03) 6228 9575
Fax (03) 6228 9757
NEW ZEALAND
NHP Electrical Engineering Products (NZ) Limited
7 Lockhart Place
Mt Wellington Auckland NZ
Phone 64 9 276 1967
Fax 64 9 276 1992
476 St Asaph Street
Linwood Christchurch NZ
Phone 64 9 389 7604
Fax 64 9 389 7605
Version 6

TNL-39 07/03 14M