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BULLETIN #165

ALL SINGLE PHASE EQUIPMENT

PRIMARY SUPPLY REQUIREMENTS FOR SINGLE PHASE EQUIPMENT

Some service agents may recall a document which discussed some issues concerning the primary current requirements of single phase welders.

The part of that document dealing with primary wiring and circuit breakers is now out of date.

This is because a new edition of the Australian Wiring Rules AS3000 has been released. The old edition included a clause 2.4.3.4 which allowed an oversized circuit breaker to be fitted to a circuit supplying a welder. In the new Australian Wiring Rules this clause does not exist.

So, please find attached two new documents, which attempt to clarify what is now a fairly complicated situation.

The choice of most suitable circuit breaker now revolves around matching the tripping current v's time characteristics of available circuit breakers to the maximum primary draw and duty cycle time of the welder.

The single sided sheet is a short form which shows the important items of data in an 'easy to read' format.

The double sided sheet provides a full technical explanation of the topic.

regards,

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QUALITY WELDING PRODUCTS, SYSTEMS AND SERVICES

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PRIMARY SUPPLY REQUIREMENTS FOR WELDING EQUIPMENT

This is an interpretation of new 'Wiring Rules' AS/NZS 3000:2000 and related Standards, with regard to the electrical installation of welding equipment.

Note that clause 2.4.3.4, which previously allowed a fuse or circuit breaker supplying a welder to be rated up to 2 times the rated input current of the welder, no longer exists.

This document is a *guide only*, and is not intended to replace proper electrical installation design practice.

DEFINITIONS

The input current of a welder as it affects supply cables and protection devices must be considered in two ways; as the *maximum current* and the *effective current*.

The *maximum current* is the highest amperage drawn by the machine (which will be during periods of arcing). This value should be stated on the specification plate of the welder, and may be labelled as $I_{1max}(A)$.

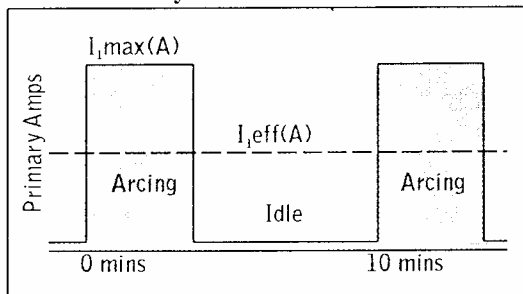
In 'Wiring Rules' terminology, *maximum current* is the "actual primary current", refer AS/NZS 3000:2000, C4.4.1(b).

The *effective current* is a calculated value. It takes into account the duty cycle of the machine, i.e. the percentage of arcing time to 'on' time. The *effective current* is the r.m.s. equivalent of the current drawn by the machine when operated at rated output current and duty cycle.

This value should also be stated on the specification plate of the welder, and may be labelled as $I_{1eff}(A)$.

In 'Wiring rules' terminology, *effective current* is the "maximum demand", refer AS/NZS 3000:2000 C4.4.2.

Primary current draw of welder



EXAMPLE

Following is a worked example of the selection process for an MCB and supply cable combination to suit a WIA Weldmatic 255s, with the specifications:

- $I_{1max} = 49$ amps
- $I_{1eff} = 25$ amps
- Duty cycle period at maximum output is 25% of 10 minutes = 150 seconds.

CIRCUIT BREAKER (MCB)

1. The I_{1eff} rating for the welder of 25 amps means that a 25 amp MCB is the smallest that could be installed.

However, data for a typical 25 amp C or D curve MCB at the I_{1max} level of 49 amps, indicates a tripping time in the range of 20 - 90 secs.

Therefore, if the welder were used at or near its full output current (255 amps) and maximum duty cycle period (150 secs), this MCB would trip during welding.

2. The next highest commercially available MCB is 32 amps.

At the I_{1max} level of 49 amps, a typical 32 amp MCB has a tripping time range of 40 - 180 seconds.

Depending on the reaction time of the individual device installed, this MCB may trip if the welder is used at or near its full output current and duty cycle.

3. The next highest commercially available MCB is 40 Amps.

At the I_{1max} level of 49 Amps, a typical 40 amp MCB has a tripping time range of 150 - 1200 seconds.

This MCB would allow the welder to be used at full output current and duty cycle without any nuisance tripping.

Comments above concerning the likelihood of MCB tripping assume that the welder is to be used at settings near its rated output current and duty cycle. In many applications however, the machine may be consistently operated at settings much lower than this point, reducing the likelihood of MCB tripping.

CABLE SELECTION

Assume a 32 amp MCB has been selected. AS/NZS 3000:2000, clause 2.4.3.2 deals with the coordination of conductors and protective devices, and in part requires;

“ $I_B \leq I_N \leq I_Z$ ”, where:

- I_B is the current for which the circuit is designed, in this example that is the $I_{eff}(A)$ rating of the welder = 25 amps.
- I_N is the nominal rating of the protective device, in this example a 32 amp MCB.
- I_Z is the continuous current rating of the cable in the situation in which it is installed. Cable ratings are found in AS/NZS 3008.1

To satisfy the requirement “ $I_B \leq I_N \leq I_Z$ ” in this example, I_Z must be greater or equal to 32 amps.

With ref. to table 9 of AS/NZS 3008.1,

- 4mm² cable is suitable if installed **unenclosed** as per column 4. In this situation it is rated at 34 amps.
- If the cable is installed **enclosed** as per column 8, 6mm² cable is required. In this situation it is rated at 37 amps.

Table A below summarises combinations of MCB and cable sizes which might be used to supply a Weldmatic 255s.

Table A

Mains Circuit Breaker	Cable unenclosed as per AS/NZS 3008 Table 9, column 4	Cable enclosed as per AS/NZS 3008 Table 9, column 8	Comment
25 Amp	2.5 mm ² (26 amps)	4.0 mm ² (29 amps)	MCB will trip if Weldmatic 255s is used at maximum output current and duty cycle
32 Amp	4.0 mm ² (34 amps)	6.0 mm ² (37 amps)	MCB may trip if Weldmatic 255s is used at maximum output current and duty cycle.
40 Amp	6.0 mm ² (44 amps)	10.0 mm ² (50 amps)	MCB will not nuisance trip

Table B

Cable	Drop 10 m	Drop 20 m	Drop 30 m	Drop 40 m
2.5 mm ²	8.8 Volts	(17.6 Volts)	(26.4 Volts)	(35.2 Volts)
4mm ²	5.5 Volts	11 Volts	(16.5 Volts)	(22 Volts)
6mm ²	3.7 Volts	7.4 Volts	11.1 Volts	(14.8 Volts)
10mm ²	2.2 Volts	4.4 Volts	6.6 Volts	8.8 Volts

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WELDING INDUSTRIES OF AUSTRALIA

VOLTAGE DROP.

AS/NZS 3000:2000, clause 1.8.4. states the voltage drop in a circuit may not exceed 5% of the supply voltage, i.e. 5% of 240 V = 12 V.

Worst-case voltage drop will occur during welding at maximum output, when the current draw is at I_{1max} .

Table 42 of AS/NZS 3008.1 shows the three-phase voltage drop for various cables at selected operating temperatures. The three phase voltage drop figures given in Table 42 are multiplied by 1.155 to convert to single phase (ref. AS/NZS 3008.1, Table 9, note 4).

Table B below shows voltage drops for sample run lengths of various cables. The table assumes V-75 cable operating at its maximum temperature of 75 C, and current at the I_{1max} level of this example, i.e. 49 amps.

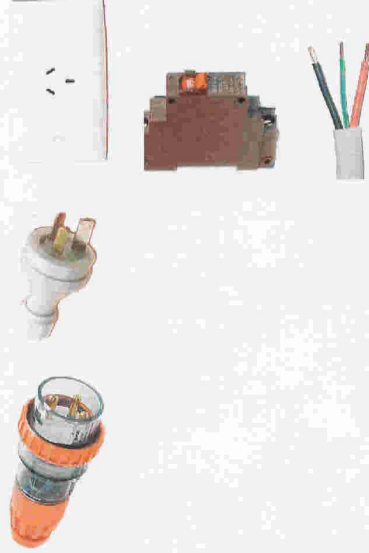
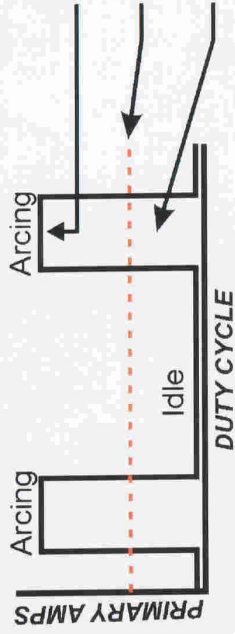
Voltage drops greater than 12 volts, (which therefore fail clause 1.8.4) are shown in brackets.

SUPPLY PLUG

The supply plug is normally selected to suit the *effective current* of the welder.

In this example, the *effective current* rating of the Weldmatic 255s is 25 amps. The nearest rated commercially available single phase plug is 32 amps.

CIRCUIT BREAKERS & WIRING for SINGLE PHASE WELDERS



This note is a guide only, and is not intended to replace proper electrical design procedures. Refer AS3000:2000

WELDMATIC models

150s



175s



215s



255s



WELDER DATA

Maximum primary amps	28 Amps	30 Amps	42 Amps	49 Amps
Effective primary amps (1)	12 Amps	12 Amps	16 Amp	25 Amps
Duty cycle time <small>Max. arc time at max. output</small>	60 secs	48 secs	90 secs	150 secs

PLUG & SOCKET

Current rating	15 Amp	15 Amp	15 Amp	32 Amp (2)
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SUGGESTED CIRCUIT BREAKER & WIRING

Nominal rating	16 Amp	16 Amp	20 Amp	25 Amp (4)
Trip time range <small>when arcing at max. output</small>	25-110 secs	23-100 secs	20-90 secs	20-90 secs
Mains wiring (3)	≥ 16 Amp	≥ 16 Amp	≥ 20 Amp	≥ 25 Amp

Note (1) The effective primary amps rating is a calculated value based on the *Maximum primary amps* and the *Duty cycle percentage*.

Note (2) A 25 Amp plug & socket would be electrically suitable, but these are not commercially available. A 15 Amp plug is fitted to allow initial commissioning only.

Note (3) The current rating of the mains wiring depends on cable size and method of installation. Refer AS/NZS 3008.1, Table 9.

Note (4) 32 Amp circuit breaker and wiring suggested if equipment is to be operated at max. output current and duty cycle.

