

**ELECTRIC MOTOR
FIRE PUMP CONTROLLER
to NFPA No.20**

**Metron
Eledyne**

**High Voltage - Direct-on-Line Start
MOTOSTART TYPE MFP/NFPA/HV**

SPEC. 2/9804 Release 1.0

FEATURES

- ! The Metron Eledyne **MOTOSTART TYPE MFP/NFPA/HV** Electric Motor Controller is designed to NFPA No.20 Standards for automatic and manual starting direct-on-line (across the line) of **electric motor driven fire pumps**.
- ! The controller is suitable for motors of ratings up to 2000 HP (1500KW) at system voltages up to 6,600 Volts, 3 phase, 50/60 Hz.
- ! Components are contained in a **NEMA 2 type dust and drip-proof**, freestanding, sheet steel enclosure with lock-up front access door. A NEMA 4X type weatherproof enclosure with tropicalised components suitable for outdoor installation is available as an optional extra.
- ! The enclosure is fitted with an **Anti-Condensation Heater**, thermostatically controlled.
- ! Paint finish to Metron Eledyne Paint Spec. PS.0296

CONTROL SYSTEM

- ! **Automatic operation** is initiated by any of the following demand signals:
 - ▶ Sprinkler System Low Pressure.
 - ▶ Deluge Valve Switch.
 - ▶ Dry Pipe Valve Switch.
 - ▶ Fire Detection/Alarm Switch.
 - ▶ Remote Pushbutton Start.
- ! Manually operated door interlocked isolator switch mechanically locked in the ON position by a Castel Key type lock.
- ! Auto closing heavy duty vacuum start contactor rated at least 115% of motor full load current (FLC).
- ! **Pushbutton operation** for local manual or remote electric start.
- ! **Motor protection** by electronic overload unit which trips the start contactor.



- ! Normal setting at 300% of motor FLC with long delay trip time in excess of 60 seconds.
- ! **Stalled rotor protection** with definite trip time 20 seconds. (Max.) At 600% of motor FLC.
- ! **Short circuit protection** by High Voltage HRC Fuses with instantaneous rupture at 1200% of motor FLC.
- ! **Mains failure protection** trips the start contactor if one or more phases become disconnected.
- ! Manually operated pushbutton "Stop" control standard. "Autostop" control optional.
- ! All wiring terminates at clearly marked connector rail. External cable connections through free-standing plinth.

CONTROL AND INSTRUMENTATION

Facia Mounted:

Isolator operating Lever - Castel Key Lock.
Manual Electric Start Pushbutton.
Stop/Reset Pushbutton.
Line Current Ammeter with Phase Selector Switch.
Line to Line Voltmeter and selector switch.
Mains Phases Healthy Indicator Lamps.
Control Circuit Healthy Indicator Lamp.
Pump On Demand Indicator Lamp.
Pump Running Indicator Lamp.
Pump Failed to Start Indicator Lamp.
Pressure Switch (Adjustable Setting) for automatic start.
Operating Instructions and Warning Labels.

Remote Alarm-Volt-free Changeover Contacts:

Mains Failure.	Pump Running.
Pump on Demand.	System Fault.
Phase Sequence Start.	

Size/Weight:

Height	Width	Depth	Weight
2300 mm	735 mm	1250 mm	620 Kgms

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OPERATING INSTRUCTIONS FOR HIGH VOLTAGE MOTOR CONTROLLER

1 CAUTION

In order to avoid risk of personal INJURY or damage to the control equipment, READ THIS MANUAL VERY CAREFULLY. If after reading these instructions doubt exists, do not hesitate to contact Metron Eledyne for further clarification. In the interests of safety pay special attention to the CAUTION notes listed below:

If work has to be carried out on the motor or control equipment, ensure the control equipment is ISOLATED AND LOCKED OFF from the A.C mains supply before work commences. If possible use a temporary label which draws attention to this fact. Label suggestion: Caution **ENGINEER WORKING ON EQUIPMENT**.

The control system may start the motor at any time. Ensure all concerned are aware of this condition by means of an appropriate label, prominently displayed in the motor area. Label suggestion: **WARNING MOTOR MAY START AT ANY TIME**.

In order to avoid the risk of serious electric shock, NEVER attempt to energise the high voltage system with the access door open. The door interlocking mechanism is designed to prevent this occurrence.

If the inner door has to be opened BEWARE of the single phase control circuit supply. This warning cannot be stressed enough.

2 GENERAL

The Metron Eledyne Electric Motor Fire Pump Controller type MFP/NFPAW/HV/DOL, is designed to operate a three phase high voltage electric motor. The system is based on the requirements of NFPA No 20, for across the line starting of electric driven pumps. The unit is self contained and self monitoring, with volt free outputs to facilitate remote monitoring.

The control system comprises of the following main components:

A manually operated door interlocked isolator.

Auto-closing vacuum or gas filled contactor with provision for manual mechanical closing for emergency starting.

Phase failure and phase sequence monitoring relays.

The three phases are monitored by Phase Failure (PFR), and Phase Sequence (PSR), relays which provides visual and remote indication should a phase fault occur. The adjustment dial located at the top of the PFR unit should be set to the HV transformer secondary phase voltage, to take into account any voltage dips during motor starting. The operating speed of the relay on energisation is approximately 200 ms.

The phase sequence is monitored by a Phase Sequence relay which provides visual and remote indication if the three phase supply is connected to the controller incorrectly. With the phases connected to the controller correctly, the LED located at the top of the unit remains unilluminated.

The following terms are defined as:-

Visual.	- Pilot lamp, meter or flag.
Volt free.	- Remote indicating volt free changeover contacts.
Standby.	- System awaiting an operational event.
Clear.	- Fault condition corrected, controller in standby.

Generally, for simplicity, only changes in status will be mentioned for the above.

THROUGHOUT THE TEXT IN TWO COLUMN FORMAT SECTIONS.

The left hand column describes initiative events. The right hand column describes resultants.

3 **MOTOR PROTECTION**

Motor protection against over current i.e. Stalled rotor is provided by the 'Overload Relay' (OLR). The trip system is calibrated in accordance with NFPA No: 20. Short circuit protection is provided by means of line fuses L1, L2 & L3.

4 **SUPPLY CONNECTIONS**

IMPORTANT NOTE

Before making any power connections to the controller ensure that the main and test isolators are open.

Connect the 'Pump Motor'.

Control circuit output terminals

A, B and C.

Connect the HV supply to the input terminals listed below:

Viewed from the rear:-

Phase 1 (Red).	Terminal L1 (Right Side of isolator)
Phase 2 (Yellow).	Terminal L2 (Centre of isolator)
Phase 3 (Blue).	Terminal L3 (Left Side of isolator)
All other connections.	As controller circuit diagram.

Control cabinet is securely connected to a reliable earthing system.

Refer to the cabinet rating label attached to the top of the front door.

Installation parameters are correct.

All system starting and running contacts are in the motor stopped, standby condition.

Set the control circuit timers as follows:

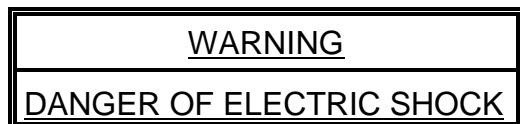
Delay start timer.	Set T1 to the desired start delay.
If a start delay is not required.	Set the Delay Start timer T1 to minimum.
Failed To Start.	Set T2 to allow the pump ample time to achieve duty.
Overload timer. energisation).	T3 Factory set to 1 second. (False alarm rejection upon

5 VOLT FREE REMOTE MONITORS

The remote monitor chart below shows the volt free contacts available with this system. Contacts marked with an asterisk '*' change state on energisation.

<u>DESCRIPTION</u>	<u>VOLT FREE CONTACTS</u>	<u>OUTPUT TERMINALS</u>
PUMP ON DEMAND	RL3/2	5 6 7
PUMP RUNNING	RL2/1	8 9 10
<u>DESCRIPTION</u>	<u>VOLT FREE CONTACTS</u>	<u>OUTPUT TERMINALS</u>
SYSTEM FAULT	* RL1/1	11 12 13
MAINS FAILURE	* PFR/2	14 15 16
PHASE SEQUENCE FAULT	PSR/2	17 18 19

6 ENERGISING AND DE-ENERGISING



Before attempting to energise the control system, ensure that all the covers and doors are securely closed and where applicable, LOCKED.

Refer to the isolator operating label attached to the front door.

TO PUT INTO SERVICE

Insert the Castell Key and turn 70 Deg clockwise to expose the Supply Isolator controls.

Obtain the crank handle stowed on the panel behind the front inner door.

Insert the crank handle into the Earthing Switch position and rotate 180 Deg anti-clockwise. The Red sector on the earthing shaft, marked '1' is visible.

Transfer the crank handle to the Isolator position and rotate 180 Deg clockwise. The Red sector on the isolator shaft, marked '1' is visible.

Cabinet main front door cannot be opened.

Visual. Mains Phases Healthy.
 Voltmeter reads - red line.

Volt free. System fault.

Remove the crank handle and stow behind the front inner door.

Turn the 'Castell Key' 70 Deg anti-clockwise and remove.

Visual. Mains Phases Healthy.
 Control Circuit Healthy.
 Voltmeter reads - red line.

Volt free. System fault - clear.

CAUTION
Store the Castell key in a secure place since this is the operator's only means of gaining access to the isolator controls.

TO REMOVE FROM SERVICE

Refer to the isolator operating label attached to the front door.

Obtain the crank handle stowed on the panel behind the front inner door.

Insert the Castell Key and turn 70 Deg clockwise to expose the Supply Isolator controls. If the main contactor is mechanically latched closed from a previous operation, the de-latch coil is briefly energised to open the contactor.

Insert the crank handle into the Isolator Switch position and rotate 180 Deg anti-clockwise. The Green sector on the Isolator shaft, marked 'O' is visible.

Transfer the crank handle to the Earth position and rotate 180 Deg clockwise. The Green sector on the Earth shaft, marked 'O' is visible. Cabinet main front door can be opened.

Visual. All Healthy Lights - go out.
 Voltmeter reads - Zero.

Volt free. System fault.
 Mains failure.

Remove and stow the crank handle. Crank handle clipped to the panel

behind the inner front door.

Turn the 'Castell Key' fully anti-clockwise and remove.

CAUTION

Store the Castell key in a secure place since this is the operator's only means of gaining access to the isolator controls.

7 **EMERGENCY OPERATION**

If the control circuit is faulty but the incoming phases are normal, the motor may be started in an emergency as follows:

Refer to the EMERGENCY START LEVER operating label. (Situated next to the start lever on the cabinet right hand side wall).

To engage the Emergency Start:

Press the Release Button and hold.
Pull the lever quickly in the direction of the arrow.
Release the lever and button.

To disengage the Emergency Start:

Pull the Contactor Mechanical De-latch handle. (Situated to the right of the front door).

8 **MANUAL START**

Press Manual Start pushbutton.

Main contactor latches closed mechanically.
Motor starts.

Failed To Start timer.

Starts to time.

Visual.

No Change.

Volt free.

Pump on demand.

Pump discharge pressure rises above the Pump Running pressure switch set point.

Pump Running pressure switch contacts close.

Failed to start timer resets.

Visual.	Pump Running.
Volt free.	Pump running. Pump on demand.

9 **AUTOMATIC OPERATION**

STARTING

Main pressure switch falls below the set point. Pressure switch contacts open.

Visual.	Pump On Demand
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Volt free.	Pump on demand.
------------	-----------------

Delay start timer starts to time.

Delay start timer times out.	Main contactor latches closed mechanically. Motor starts.
------------------------------	--

Failed To Start timer.	Starts to time.
------------------------	-----------------

Pump discharge pressure rises above Pump Running pressure switch set point.	Pump Running pressure switch contacts close.
---	--

Failed To Start timer.	Resets.
------------------------	---------

Visual.	Pump Running. Pump On Demand.
---------	----------------------------------

Volt free.	Pump running. Pump on demand.
------------	----------------------------------

Pump runs on until stopped by the operator.

Visual.	Pump running - goes out. Pump On Demand - goes out.
---------	--

Volt free.

Pump Running - clears.
Pump On Demand - clears.

<u>WARNING</u>
THE MOTOR CANNOT BE STOPPED MANUALLY WHILST A PUMP ON DEMAND SIGNAL IS PRESENT

PUMP FAILS TO START

Motor contactor closed but running pressure switch contacts do not close.

Pump On Demand indications established.

Failed To Start timer starts to Time.

Failed To Start timer times out.

Visual.

Failed To Start.

Volt free.

Failed to start.
System fault.

When the system is ready for operation, re-energise the controller.

10 **STOPPING THE PUMP**

LOCAL STOP

<u>WARNING</u>
THE MOTOR CANNOT BE STOPPED MANUALLY WHILST A PUMP ON DEMAND SIGNAL IS PRESENT

Press the Stop/Reset button.

Motor contactor de-latches and opens.
Motor stops.

Visual.

Pump Running - goes out.

Volt free.

Pump running - clear.

11 **MOTOR CURRENT MONITORING**

Set the Ammeter Selector switch to any desired position. Ammeter reads motor current flowing in the selected phase lead.

Motor running with more than three times Full Load Current flowing due to any unspecified fault. Overload unit trips in a time depending upon the degree of overload in accordance with the NFPA No 20 characteristic.

Motor contactor opens.

Motor stops.

Motor contactor cannot re-close electrically.

Visual.

Overload.

Volt free.

System Fault.

If Pump On Demand is present, then Failed To Start occurs.

When the system is ready for operation, re-energise the controller.

NOTE
The overload unit has been factory set to be compatible with the motor parameters and the provisions of NFPA No 20. In case of difficulty contact Eledyne Ltd for advice. Do not make unauthorized adjustments.

12 **PHASE FAULT****PHASE FAILURE**

If any phase fails when the motor is stationary. energised.

Phase Failure Relay trips. Motor Contactor cannot be

Visual.

Mains Phases Healthy - goes out.

Volt free.

System Fault. Mains failure.

Phase restored.

System returns to normal operation automatically.

If any phase fails when the motor is running.	Phase Failure Relay trips. Motor contactor remains mechanically latched.
Visual.	Pump Running. Mains Phases Healthy - goes out.
Volt free.	Mains failure. System fault. Pump running. Motor continues to run until shut down by either the overload unit or the operator.
Phase restored.	Control system returns normal operation.

PHASE REVERSAL

If a phase reversal occurs.	
Visual.	Phase Sequence Fault.
Volt free.	Phase sequence fault. System fault.
Normal motor starting is inhibited.	
When the phase sequence is correct.	
Visual.	Phase Sequence Fault - goes out.
Volt free.	Phase sequence fault - clear. System fault - clear.
Normal motor starting is available.	

13 **CABINET AND MOTOR HEATERS**

Anticondensation Heater Switch on.
With thermostats set to 30°C. Heaters operate only when the cabinet temperature is below 30°C.

Motor Heater with the motor stopped. Motor heater on.

Motor Heater with the motor running. Motor heater off.

14 **TEST SUPPLY**

Main Isolator Closed. Test Supply continuous.

Main Isolator Open. High voltage off.
Test Supply available only when the Test Isolator is On.

With the high voltage off, the control circuit may be tested using the Test Supply.

Close the Test Isolator Key Switch.

Open the inner front door and set the Test/Normal switch to Test.

Visual. Voltmeter reads - zero.
Mains Phases Healthy - out.
Control Circuit Healthy.

Volt free. Mains failure.
System fault - clear.
(PFR bypassed)

Motor control logic can be tested without running the motor.

ABNORMAL OPERATION

UNDER ABNORMAL CONDITIONS, it is possible to use the test supply to power the control circuit with the high voltage on to run the motor. This could be done if the phase monitor transformer circuit supplying the control voltage was faulty, for instance.

CAUTION
The above abnormal operation should be attempted only if absolutely necessary since phase voltage monitoring might NOT be available. Overload protection and current monitoring would be available.

To restore the system to normal, set the Test/Normal switch to Normal and close the inner door.

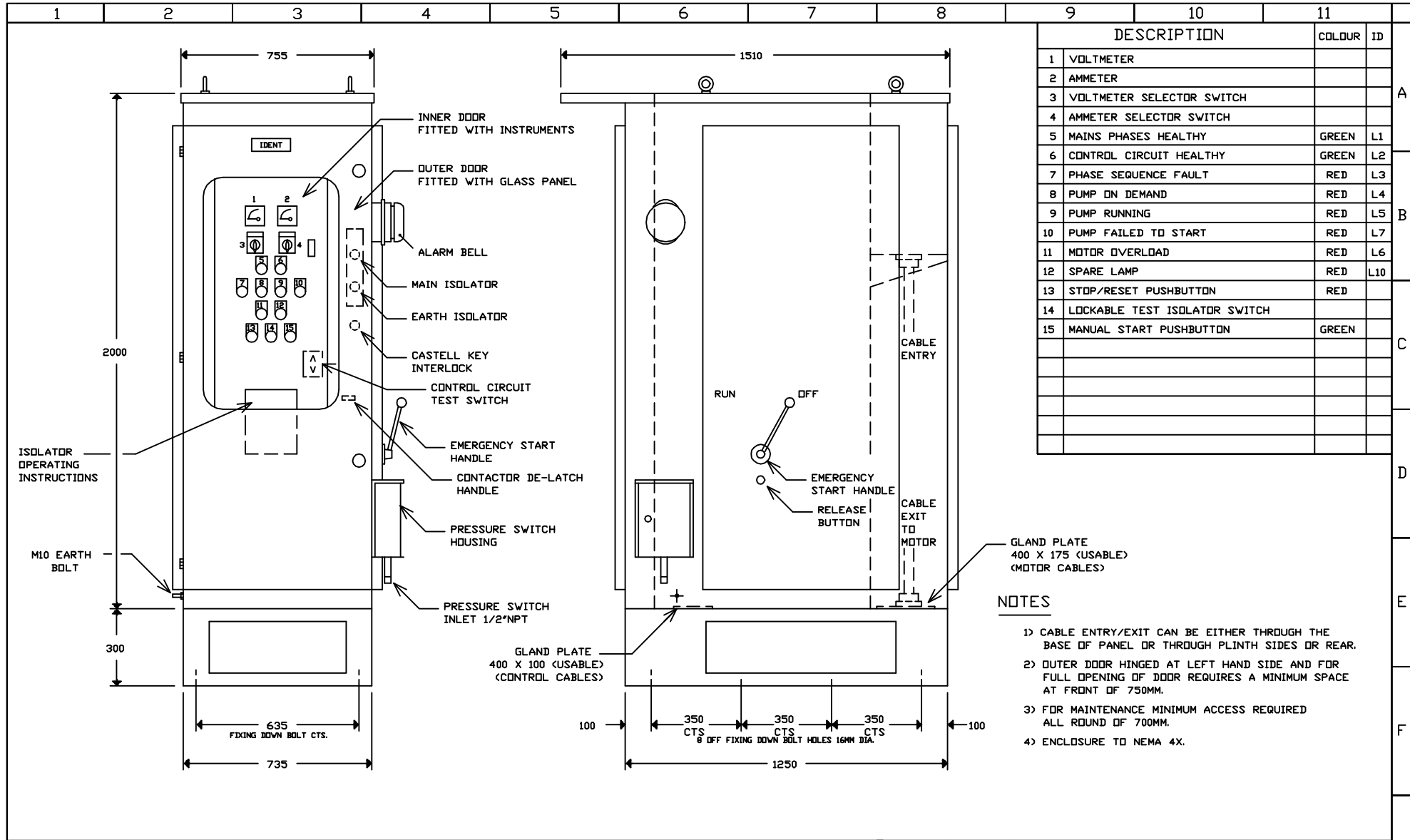
Close the main isolator.

The high voltage is on.

NOTE
The inner door cannot be closed with the Test/Normal switch in the Test position.

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	DESCRIPTION	COLOUR	ID
1	VOLTMETER		
2	AMMETER		
3	VOLTMETER SELECTOR SWITCH		
4	AMMETER SELECTOR SWITCH		
5	MAINS PHASES HEALTHY	GREEN	L1
6	CONTROL CIRCUIT HEALTHY	GREEN	L2
7	PHASE SEQUENCE FAULT	RED	L3
8	PUMP ON DEMAND	RED	L4
9	PUMP RUNNING	RED	L5
10	PUMP FAILED TO START	RED	L7
11	MOTOR OVERLOAD	RED	L6
12	SPARE LAMP	RED	L10
13	STOP/RESET PUSHBUTTON	RED	
14	LOCKABLE TEST ISOLATOR SWITCH		
15	MANUAL START PUSHBUTTON	GREEN	

NOTES

- 1) CABLE ENTRY/EXIT CAN BE EITHER THROUGH THE BASE OF PANEL OR THROUGH PLINTH SIDES OR REAR.
- 2) OUTER DOOR HINGED AT LEFT HAND SIDE AND FOR FULL OPENING OF DOOR REQUIRES A MINIMUM SPACE AT FRONT OF 750MM.
- 3) FOR MAINTENANCE MINIMUM ACCESS REQUIRED ALL ROUND OF 700MM.
- 4) ENCLOSURE TO NEMA 4X.

ISSUE 1	ISSUE 2	ISSUE 3	C.A.D. Software SCHEMA III	3RD ANGLE PROJECTION	ISSUE No.	DRN	CHK	TITLE	Metron - Eledyne
INITIAL ISSUE			SERIAL No.		1 10.05.99	DWT		GENERAL ARRANGEMENT OF CONTROLLER TYPE MFP/NFPAW/HV/DOL/	
10.05.99				© THIS DRAWING IS THE COPYRIGHT OF METRON-ELEDYNE AND MUST NOT BE LENT, COPIED OR REPRODUCED WITHOUT PRIOR PERMISSION.				DRG. No. CM1757W	

Typical Recommended Consumable Spares Package for Controller Type MFP/NFPA/HV/3.3KV/350KW

DESCRIPTION	STOCK NO.	QTY	UNIT PRICE	TOTAL PRICE
Relay, 115V, 2 pole	19278	1	£ 13.12	£ 13.12
Main Phase Fuse	TBA	3	£259.80	£779.40
Fuse 3.15A ABWNA	28040	3	£ 76.96	£230.88
Fuse 2A	09034	3	£ 4.18	£ 12.54
Fuse 4A	09035	3	£ 3.94	£ 11.82
Fuse 10A	09037	3	£ 3.94	£ 11.82
Lamp, 6V 0.3A	12021	10	£ 1.43	£ 14.30

Metron-Eledyne reserve the right, at the time of order placement, to offer an alternative item; on the understanding that it fulfils the conditions of FIT, FORM and FUNCTION.

Typical Recommended 5-Year Spares Package for Controller Type MFP/NFPA/HV/3.3KV/350KW

DESCRIPTION	STOCK NO.	QTY	UNIT PRICE	TOTAL PRICE
Pushbutton ABW110	12115	1	£ 13.21	£ 13.21
Transformer Lamp	12143	1	£ 27.19	£ 27.19
Ammeter 0-100A	14675	1	£ 47.07	£ 47.07
Thermostat	18022	1	£ 24.38	£ 24.38
Phase Failure Relay PFR501	19071	1	£231.53	£231.53
Overload Relay OLR500	19073	1	£357.83	£357.81
Phase Sequence Relay	19251	1	£291.06	£291.06
Anti-cond. Heater 40W	21153	1	£ 49.32	£ 49.32
Anti-cond. Heater 100W	21157	1	£ 59.19	£ 59.19
Switch, RQ3242	24135	1	£110.67	£110.67
Switch, CT2-MR3-A2	24161	1	£ 27.37	£ 27.27
Switch, N16/EV/O	24437	1	£ 58.89	£ 58.89
Switch, N16/EM/31	24447	1	£ 82.08	£ 82.08
Pushbutton ABW112R	24724	1	£ 27.58	£ 27.58
Keyswitch ASW2K20	24733	1	£ 40.53	£ 40.53
Timer	80018	1	£ 69.67	£ 69.67
Voltmeter 0-3.3KV	80064	1	£127.52	£127.52

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DESCRIPTION	STOCK NO	QTY	UNIT PRICE	TOTAL PRICE
Relay, 115V, 2 pole	19278	1	£ 13.12	£ 13.12
Main Phase Fuse	TBA	3	£281.45	£844.35
Fuse 3.15A ABWNA	28040	3	£ 76.96	£230.88
Fuse 2A	09034	3	£ 4.18	£ 12.54
Fuse 4A	09035	3	£ 3.94	£ 11.82
Fuse 10A	09037	3	£ 3.94	£ 11.82
Lamp, 6V 0.3A	12021	10	£ 1.43	£ 14.30

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