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## **About This Standard**

This specification is for the design, manufacture and delivery of diesel driven mains failure plant complete with control panel. The apparatus is required to automatically start up and provide an alternative supply to the load in the event of loss of normal supply, and shut down on the restoration of the normal supply. Auxiliary functions as set out herein are required to be incorporated in the apparatus.

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## Document History

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## 1. General

This specification is for the design, manufacture and delivery of diesel driven mains failure plant complete with control panel. The apparatus is required to automatically start up and provide an alternative supply to the load in the event of loss of normal supply, and shut down on the restoration of the normal supply. Auxiliary functions as set out herein are required to be incorporated in the apparatus.

The specification covers plant required for either fixed or portable installation. All parts of this specification apply equally to either, except where specifically stated otherwise.

## 2. Information to Be Provided With Supply

Suppliers shall include a completed copy of the questionnaire provided in Appendix-1 of this Specification, showing full details of the equipment to be supplied. This should include the quantity, make and type of all components offered, particularly where it is intended to deviate from that specified herein.

Information submitted shall also include a fully dimensioned drawing of the mounting base requirements, showing overall dimensions, the exact location of anchor-bolts, structural requirements of the concrete mounting pad, and in the case of a portable installation the position of the cable access space.

## 3. Control Requirements

The control arrangements shall meet the following requirements:-

### 3.1. Starting

Provision shall be made for manual and automatic starting of the plant. Automatic start isolation shall be provided to allow maintenance to be safely carried out. A manual over-ride stop facility shall also be provided.

### 3.2. Automatic Operation

- In automatic mode, the set shall start upon failure of normal supply for more than ten seconds, or upon tripping of the normal supply circuit breaker. Failure of supply shall be either total loss, or a reduction of the normal supply voltage to less than 100 volts.
- Up to three attempts shall be made to automatically start the motor-alternator set. These shall be of approximately 10 seconds duration each at 15-second intervals; after this further starting attempts shall be prevented. There shall be provision made for resetting the three-start timer by a contact closure external to the control panel.
- Alternator voltage shall be connected to the bus bar when it has reached approximately 110 volts.
- When normal supply has returned for at least ten minutes, the load shall be transferred back to the normal supply.

### 3.3. Emergency shut-down

In addition to the orderly shut-down on restoration of normal power supply, the set

will shut down under the following conditions:

- Low lubricating oil level.
- Lubricating oil pressure falls to a dangerous level.
- Engine overheats.
- The alternator output circuit breaker trips. The circuit breaker shall have to be manually reset before the set can attempt a restart.

### **3.4. Manual & Remotely initiated Reset**

When the set has been shut down due to any of the conditions stated in 3.2. or 3.3 it will remain shut down, until the control circuit is reset manually by means of a push button on the control panel.

When the shutdown is due to the conditions in ???, it shall be possible to carry out a remotely-initiated reset, after which a further set of three attempts shall take place.

### **3.5. Remotely-Controlled Operation**

It shall be possible to carry out a remotely-controlled manual start and shut-down by means of a contact closure and opening, respectively, external to the control panel.

## **4. Diesel Alternator Set**

The engine and alternator shall be close coupled and mounted on a rigid steel chassis provided with resilient vibration absorbing mounts suitable for bolting to a concrete floor. The mounting arrangements shall allow for the easy draining of lubricating oil.

Where the unit is specified as being for a portable installation, the motor/alternator sub-chassis shall be resilient mounted to the main chassis, which forms the base of the self-contained housing.

All rotating parts shall be fitted with guards to prevent inadvertent contact by maintenance personnel.

All control and indication connections on the motor and alternator shall be terminated on a single terminal block mounted on the motor/alternator unit. All terminals shall be clearly identified with the numbers of the corresponding terminals in the control panel.

Alternator output terminals should be separately provided and identified.

All wiring to external terminals shall be clearly identified by the use of beads located adjacent to the point of termination. The identification of each wire shall be identical to the designation of the terminal to which it is connected.

The equipment will be required to operate reliably over a wide range of atmospheric conditions. Ambient temperatures may range from -10C to 50C, and relative humidity up to 95%. Due allowance shall be made for additional temperature rise within housings or buildings.

## 5. Alternator

The alternator is to be self exciting, self regulating, single phase, 1500 R.P.M. class E insulated, 3% wave form distortion, 10% regulation (no load cold to full load hot) with output adjustable between + 10% of nominal voltage.

Brushless alternators are preferred provided they are suitable for the load conditions specified.

In the case of 120v alternators the output is to be isolated from earth, and spark suppression capacitors shall not be used.

## 6. Engine

The engine, depending upon set rating, shall be a "Lister" ST or HR series air-cooled diesel or similar. An axial type heavy-duty ring gear starter motor shall be provided. A centrifugal switch shall be fitted in addition to voltage sensing to disconnect the starter motor. The sets are required to start in conditions down to -10C and suppliers shall include starting equipment of adequate rating to meet this requirement. Suppliers shall specify if the equipment requires the use of sump oil heaters to guarantee reliable starting at extreme low temperatures and shall also provide tables of output derating factors for elevation above sea level, and for ambient temperature.

The engine should be provided with vertical duct take-off facilities for easy connection of exhausted cooling air ducting. The actual ducting is not to be supplied.

The engine shall be fitted for hand starting including manual decompression facilities. This applies equally to fixed and portable installations.

A starting handle, air cleaner, external replacement lubricating and fuel oil filters and an exhaust silencer of efficient cylindrical type shall be provided. Exhaust pipes are required to be supplied. No products containing asbestos shall be used in any lagging or insulation.

## 7. Fuel Tank

A fuel tank with capacity for approximately 48 hours running shall be installed. The tank shall be provided with the following:

- a) A visual indication of fuel level.
- b) A contact to provide an indication that only 12 hours fuel supply remains.
- c) A contact to indicate only 30 minutes fuel supply remaining.

A drain cock and a control cock for the fuel supply line shall be provided on the bottom of the tank and a connection for the fuel return line on the top. The tank shall have a large diameter filler hole fitted with a fine gauge bronze wire strainer.

Where equipment is specified for a fixed installation, the tank shall be supplied with a floor stand of sufficient elevation for gravity fuel feed to the engine. All necessary cocks and fittings are to be supplied and 4m of copper pipe each for the feed and return fuel lines. Facilities for refuelling shall be located within the equipment location.



## **8. Control Panel**

The control and indication equipment shall be contained in a wall mounting sheet metal case, the contents of which shall be readily accessible for maintenance and adjustment purposes. The control equipment shall provide at least the facilities shown in Drawing C9848.

In the case of 120 volt plant, the requirement to maintain complete isolation of the 120 volt supply from earth shall be observed within the control equipment. If proprietary control circuitry is used which incorporates any connection of the AC supply to earth, then an isolating transformer shall be provided.

Panel equipment such as meters, switches, indicator lamps, and circuit breakers shall be surface mounted on the front of the case and labelled.

All terminals shall be numbered. Wiring shall be colour coded and numerically identified using a numbering system related to the terminals to which each wire is connected. External connection terminals should be designated as to their function.

While detailed arrangements of the control section are the responsibility of the manufacturer the following facilities are to be incorporated.

### **8.1. Circuit Breakers**

One each for the normal and alternator supply to be double pole fully magnetic Heinemann type.

The alternator supply breaker shall be fitted with one auxiliary contact to indicate when the breaker has tripped.

### **8.2. Changeover Contactors**

Telemecanique LC series or equivalent shall be supplied.

Where separate normal and alternator supply contactors are provided, they shall be mechanically and electrically interlocked.

Where normally-closed contacts are used to carry load current, they shall be derated to 50% of their rated inductive load capacity.

### **8.3. Indicating Relays**

One relay each for the following functions:

- normal supply on line,
- alternator supply on line,
- engine lubricating oil pressure loss,
- engine overheating,
- 30 minutes fuel supply remaining, and
- 12 hours fuel supply remaining.
- alternator circuit breaker tripped

Where possible, relays incorporated in control functions should be used for the above purpose.

Relays shall be Fuji type HH23PW-T or an approved pin-compatible equivalent. Coil operating voltages shall be 12, 24 or 48 volts DC, or 120 volts AC.

#### **8.4. External Indicating Circuit**

One changeover set of contacts shall be wired (3 wires) from each indicating relay listed in 8.3 to a terminal block in the panel.

#### **8.5. Battery Charger**

A battery charger suitable for fully adjustable trickle charging from 0 to 1 amp plus standing load and boost charging to 6 amps via a manual changeover switch shall be provided in the control panel case.

#### **8.6. Meters**

Separate meters shall be provided for the following functions:

- 120v AC supply voltage (Patons Model CP4 or equivalent)
- 120v AC load current (Patons Model CP4 or equivalent)
- DC battery charging current. (Patons Model CP4 or equivalent)
- Elapsed time meter, showing total motor hours running. (Siemens LT3 6 digital or equivalent)

The AC meters shall register with either normal or stand-by supply connected to the load. The meter types listed are the preferred types, but alternatives may be accepted subject to prior technical approval.

#### **8.7. Indicator Lamps**

Red indicator lamps shall be provided on the control panel and shall be illuminated for each of the following malfunctions:

- Starting circuit locked out due to failure to start after three attempts.
- Engine shut down due to overheating.
- Engine shut down due to low oil pressure.
- Engine shut-down due to fuel being nearly exhausted.
- Fuel low (only 12 hours remaining.)
- Alternator circuit breaker tripped.

Any red indicator lamp having been illuminated due to a malfunction shall remain lit until the reset button is operated.

#### **8.8. Terminals**

Termination of control and indication wiring on the panel and motor alternator shall be on screw clamp tunnel terminals or terminal strips. These shall be "Klippon"

SAK2.5 or Klippon MK-series or equivalent.

Supply and load cables shall be terminated on bolt-connected feed-through terminals, "Klippon" type SAKG or equivalent .

Suppliers shall specify the types of terminals proposed for use.

### **8.9. Labelling of Wiring**

All control panel wiring shall be clearly identified by the use of beads located adjacent to each point of termination. The identification of each wire shall be identical to the designation of the terminal to which it is connected.

## **9. Portable Housing**

Where the plant is specified as being for a portable installation, the motor/alternator subchassis shall be supplied as part of a complete functional unit including fuel tank and control panel, mounted in a completely enclosed self-contained housing. This housing shall be of similar design to, and provide at least the same degree of protection as, the standard all-steel substation 'kiosk' used by electricity supply authorities.

The housing shall provide a well-ventilated, vandal- and weather- proof enclosure for the motor alternator plant, and shall require no additional form of external protection. These units are generally installed in remote locations not subject to regular supervision.

The base of the housing shall be suitable for installation by bolting directly to a flat-topped concrete pad. Holding down bolts shall be accessible only from inside the enclosure. The supplier shall provide all necessary installation hardware, and any gaskets or sealing material required between base and mounting pad. Except where the unit is ordered for storage, holding down bolts and a detailed plan of the required pad design shall be supplied to the nominated delivery point within three weeks of the date of the order for the plant.

The base shall be of a design suitable to act as a sled for moving the unit, and shall be provided with loops or cut-outs to enable the unit to be winched onto or off a tilt-bed truck or trailer. The housing shall incorporate one or more lifting eye-lugs suitable for lifting the entire unit onto or off a truck by truck-mounted crane ('Hiab' or similar).

The housing shall be provided with sufficient doors to enable free access to all parts of the installation for maintenance and repair. All doors shall be fitted with cylinder type locks able to be fitted with standard ARTC lock barrels. While not mandatory, it is preferred that doors be hinged from the top edge and provided with suitable stays, so as to provide a measure of protection from the elements for staff while doing maintenance.

The enclosure shall provide adequate ventilation for proper operation of the plant under all probable weather conditions. Electric fans should not be necessary for effective ventilation.

The exhaust system and muffler shall be contained within the enclosure, and the outlet shall be provided with simple protection against the ingress of vermin, rain and other foreign matter.

Provision shall be made for the engine lubricating oil drain to vent outside the

enclosure, with the drain outlet placed to allow for convenient collection of the drained oil for removal. It shall not be possible to drain the oil without first opening up the housing.

Control equipment shall be suitably arranged, and the housing so constructed, to provide for the entry of control and power cable conduits through the mounting pad, in the position shown on the attached sketch. A clear space of at least 150mm by 300mm shall be allowed in the base for this access. Cable terminals shall be mounted at least 300mm above the inner edge of this space. The drawing M08-420 shows the required position of the cable access.

The starter battery shall be provided with suitable mounting arrangements to protect the housing from damage by spilt electrolyte.

Portable installations may incorporate fuel tanks set lower than the engine, provided that the fuel pumping system fitted does not require priming either after a prolonged period of storage or non-use, or after the fuel system has been drained.

Provision shall be made for the convenient draining of the fuel tank to empty out any condensation or contaminated fuel. The stopcock for this drain shall also be located within the housing.

Sufficient exhaust muffling and soundproofing shall be applied to enable the unit to comply with current environmental noise requirements.

## 10. Instruction Manuals

Each motor alternator set shall be supplied complete with three copies of a detailed instruction manual, which will be available for inspection when the plant is to be tested. The manual shall include the following:

- engine instruction book
- alternator instruction book
- complete circuit diagrams, covering in detail the alternator, regulator, control board and control board component modules diagrams
- control panel component parts list, showing the rating, brand name and part number of all components and modules, and the source of supply of each
- instructions for preparation for service after storage (where the set has been specified for storage prior to use).
- instructions for commissioning the plant.
- maintenance instructions, including procedures for adjusting settings of voltage sensing and timing units.

Manuals should be preferably in A4 format. Each copy shall be bound in a sturdy cover which will give adequate protection to the documentation enclosed. Ring binders, where used, shall be at four-ring construction.

Manuals should be individually packed in sealed or resealable plastic bags.

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## 11. Equipment to Be Supplied

The following equipment is to be supplied with each set: - necessary tools for installation and maintenance,

- holding down bolts,
- resilient mounting blocks (for fixed installations)
- base sealing materials (where necessary, for portable installations) - instruction manuals (3 sets)

## 12. Testing

Motor alternator sets shall be tested prior to delivery

Tests shall include, but not necessarily be restricted to, all of the operating functions specified in clause 3 of this Specification, and the measurement of output voltage and frequency under load conditions of 0, 100% and 150%, at 1.0 and 0.8 power factor.

The final test shall be a load-test of three hours duration under 100% load, ending with a measurement of output voltage and current.

Test results shall be documented and included with delivery.

**13. Appendix A: Information To Be Provided With Supply**

Rating: .....KVA

Equipment Specifications:

Item	Qty	Make	Model	Cat No	Rating
Engine	-----				
Start Battery	-----				
Alternator	-----				
Circuit Breakers					
Contactor(s)					
Relays					
Switches					
Indic Lamps					
Timers					
Engine Hr Mtr					
AC Voltmeter					
AC Ammeter					
DC Ammeter					
Fuel Filter					
Lub Oil Filter					
Silencer	-----				

Operation

Auto start 'on' delay: \_\_\_\_\_ sec  
Adjustable Range: \_\_\_\_\_ sec  
Alternator voltage sensing setting: \_\_\_\_\_ volts  
Adjustable Range: \_\_\_\_\_ volts  
Auto shut down 'off' delay: \_\_\_\_\_ min  
Adjustable Range: \_\_\_\_\_ min  
Control Panel Housing dimensions \_\_\_\_\_ (W) \_\_\_\_\_ (H) \_\_\_\_\_ (D)  
Battery charger –  
Type: \_\_\_\_\_  
Output – trickle: \_\_\_\_\_ V. \_\_\_\_\_ A  
- boost: \_\_\_\_\_ V. \_\_\_\_\_ A

Circuit Board

Proprietary circuit boards used in the equipment are as follows :

Part No	Supplier	Version
_____	_____	_____
_____	_____	_____
_____	_____	_____

Fuel Tank

Capacity: \_\_\_\_\_ litres

### Housing

Dimensions: \_\_\_\_\_ (L) \_\_\_\_\_ (H) \_\_\_\_\_ (W)

Total Weight : \_\_\_\_\_ Kg

Operating Noise Level : \_\_\_\_\_ dB at \_\_\_\_\_ metres

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## 14. Drawings

M08-420 Portable Mains Failure Plant (Base & conduit access details)