



A Division of Transnet SOC Limited

# TECHNOLOGY MANAGEMENT

## SPECIFICATION

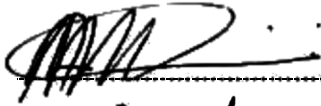
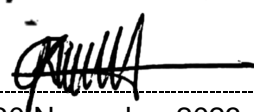
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### THREE PHASE 20kVA-500kVA DIESEL DRIVEN STANDBY GENERATOR SET

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### LIST OF AMENDMENTS TO THE SPECIFICATION

Revision No.	Date Issued	Page No.	Clause No.	Remarks
01		5	5.0.3	Full load start
		5	3.3	Voltage can fluctuate between +/-5%
		6	5.5.1	Cooling system
		6	5.7.1	Lubrication
		14	Appendix A	kVA at sea level and above sea level(1800m)
		15	Appendix B	kVA at sea level and above sea level(1800m)
		15	Appendix B	Reduction percentage if above sea level
02	November 2023	1	Heading	20kVA-500kVA
		5	4.7	Shall be rated to operate above sea level (1800m)
		9	8.4	Trailer requirement
		13	Appendix A	Prime power at sea level (REMOVED) Auto start..... yes/no
		14	Appendix B	Prime power at sea level (REMOVED) Auto sart.....yes/no

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## 1.0 SCOPE

- 1.1 This specification covers Transnet Freight Rail's requirements for the design, supply, delivery, installation, and commissioning of a 3-phase diesel driven standby generator sets of 20kVA-500kVA sizes.
- 1.2 This specification has appendices to be filled in.
- 1.2.1 Appendix A (Schedule of requirements) to be filled by project manager.
- 1.2.2 Appendix B (Technical requirements) to be filled by tenderer.

## 2.0 NORMATIVE REFERENCES

- 2.1 Unless otherwise specified all materials used, equipment developed and supplied shall comply with the latest edition of the relevant British Standard (BS), International Organization for Standardization (ISO), South African National Standards (SANS) or Transnet publications.
- 2.2 **BS standards:**
- |               |   |
|---------------|---|
| BS 2757       | Method for determining the thermal classification of electrical insulation.   |
| BS-EN 12285-2 | Workshop fabricated steel tanks. Horizontal cylindrical single skin and double skin tanks for the aboveground storage of flammable and non-flammable water polluting liquids. |
- 2.3 **ISO standard:**
- |           |  |
|-----------|--|
| ISO 3046  | Specification for Reciprocating Internal Combustion Engines. |
| ISO 9001  | Quality assurance.   |
| ISO 10816 | Specification for Mechanical Performance: Vibration.         |
- 2.4 **SANS standard:**
- |                |  |
|----------------|--|
| SANS 1535      | Glass-reinforced polyester-coated steel tanks for the underground storage of hydrocarbons and oxygenated solvents and intended for burial horizontally.  |
| SANS 10089-3   | The petroleum industry Part 3: The installation, modification, and decommissioning of underground storage tanks, pumps/dispensers and pipework at service stations and consumer installations. |
| SANS 10142-1:  | The wiring of premises, Part 1: Low-voltage installations.   |
| SANS 60034     | Electrical rotating machines.  |
| SANS 60529     | Degrees of Protection provided by Enclosures (IP Code).  |
| SANS 60947-6-1 | Low-voltage switchgear and control gear.   |
- 2.5 **Transnet publication**
- |          |   |
|----------|---|
| CEE-0082 | Low voltage distribution boards.  |
| CEE.0224 | Drawings and instruction manuals shall be in accordance to Transnet Freight Rail's specification. |

### 3.0 SERVICE CONDITIONS

#### 3.1 ENVIRONMENTAL CONDITIONS

Altitude:	0 - 1800 m above sea level.
Relative humidity:	10% to 90%.
Ambient temperature:	-10°C to +55°C.
Lightning conditions:	20 ground flashes/km <sup>2</sup> per annum.

#### 3.2 ELECTRICAL SERVICE CONDITIONS

Nominal system voltage:	230 / 400V
Highest system voltage:	230 / 400V (+5%)
Lowest system voltage:	230 / 400V (-5%)
Number of phases:	3 phase, 4 wire
Frequency:	50Hz
Neutral Point:	Solidly earthed

### 4.0 RATING REQUIREMENTS

- 4.1 The diesel generator Units shall be rated for: 400 V AC, 3 phase, 50 Hz at all environmental conditions of clause 4.1 as per schedule of requirements.
- 4.2 Voltage regulation:  $\pm 0.5\%$
- 4.3 Frequency regulation: Random frequency variation with any steady load from no load to full load shall not exceed  $\pm 0.25\%$ .
- 4.4 Wave form distortion: No load  $< 1\%$  to full load  $< 5\%$
- 4.5 Prime power with 10% overload in accordance with ISO 3046:
- 4.6 Contractor should propose generator capacity (KVA) to obtain required prime KVA ratings at the maximum outdoor operating temperature and altitude. All the diesel generator units shall be rated to operate at an altitude of 1800m above sea level. No derating will be allowed between sea level and any other altitudes above sea level.

### 5.0 REQUIREMENTS OF DIESEL ENGINE

- 5.0.1 The diesel engine shall be of 'generator set' application type and comply with the specified ISO 3046 or an equivalent international standard.
- 5.0.2 The diesel engine shall be of the four-stroke, multi-cylinder, water-cooled or air-cooled, cold start, direct fuel injection, compression ignition. The crankshaft speed shall not exceed 1500 r.p.m.
- 5.0.3 After start up, the generator should be able to take over (100%) full load.

#### 5.1 Starting System:

The diesel engine shall be supplied with a completely self-contained starting system including an engine driven dynamo, dummy loads, a maintenance free lead acid battery and battery charger.

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The engine must have cold starting capability of  $-10^{\circ}\text{C}$ .

The starting system shall preclude excessive consecutive starting attempts. It shall be adequately rated to provide three automatic starts, if fails it shall allow manual start.

The battery shall be placed on suitable plastic lined battery stand which shall stand in a suitable acid resistant tray resting on the standby plant room floor. The battery terminals shall be greased with white lithium grease or equivalently approve grease to minimize chemical corrosion.

## 5.2 **Battery Charger:**

The battery charger shall be connected so that the battery is normally charged from the mains, but is also charged under mains failure conditions from the diesel generator plant via an inhibitor relay to prevent dual charging. The charging equipment shall include a suitable ampere meter and protection equipment.

The battery charger shall incorporate the trickle and booster charging in the standby plant switchboard.

## 5.3 **Speed Governor:**

The diesel engine shall be fitted with a speed governor as stipulated ISO 3046. The governor is to be fitted with speed control facilities to enable the engine speed to be adjusted from the local control panel.

## 5.4 **Shutdown Safety System:**

The engine shall be fitted with a mechanically operated device which will shut off the fuel supply to engine when any of the specified alarm conditions occur i.e. clause 13.

## 5.5 **Cooling System:**

5.5.1 The engine manufacturer shall provide not only the recommended coolants but the equivalents to these, including the manufacturer and supplier details.

5.5.2 In case the engine is water-cooled, the cooling system shall be filled with chemically treated water mixture by the equipment supplier. Rotating parts shall be guarded against accidental contact in accordance with standard requirements.

5.5.3 In case the engine is air-cooled, the suitable ducting shall be provided between the room air intake louvre and the cooling air intake of the engine.

5.5.4 A vertical fan cooled sectional radiator, shall be mounted at the end of the combined under base and driven from the diesel engine. The radiator shall be arranged to cool the engine jacket water (for water-cooled) and lubricating oil. The radiator must be generously sized to permit operation at full load and overload in the specified ambient conditions. The radiator shall be integral with the generating set. The radiator shall be provided complete with fan claw and guards.

## 5.6 **Pumps:**

Cooling water (for water-cooled), lubricating and fuel oil pressurizing pumps shall be provided and mounted on the engine and shall be gear driven from the crankshaft.

## 5.7 **Lubrication:**

5.7.1 The engine manufacturer shall provide not only the recommended lubricants but the equivalents to these, including the manufacturer and supplier details.

5.7.2 Lubrication shall be by means of an engine-driven gear pump and the system shall include full flow oil filters with replaceable elements. A pressure sensitive device shall be fitted to prevent operation of the engine at low engine oil pressure.

**5.8 Fuel:**

The engine shall be designed for operation on diesel fuel.

**5.9 Air Filters:**

Air filters shall be suitable for use in the environmental conditions which are likely to arise at installation site and the service conditions described in clause 4.1.

**5.10 Exhaust System:**

The engine shall be efficiently silenced and be complete with primary and terminal silencer arrangements.

During the site briefing, the Tenderer shall determine any extension lengths, enclosure, protection, and other installation requirements that is location specific.

**6.0 ALTERNATOR:**

6.1 The alternator shall be synchronous, four pole, brushless rotating field, self-exciting and self-regulating type complete with permanent magnets and fully connected damper windings and shall comply with the relevant requirements of specification SANS 60034.

6.2 The temperature rise of the windings for continuous full load operation of the alternator under rated conditions shall not exceed the limits laid down in SANS 60034. Thermistor detection equipment, when called for in the Schedule of Requirements, shall be incorporated with warning and shut down facilities.

6.3 The stator winding shall be star-connected and shall be brought out together with the neutral point to terminals located in a sheet steel box mounted on top of the generator to facilitate connection of a power cable of suitable capacity.

6.4 The alternator shall be designed for operation of 10% engine overload at any power factor between unity and rated power factor for a maximum period of one hour in any 12 hour period as according to ISO 3046.

6.5 The alternator shall be rated for IP-23 protection as in accordance with SANS 60529 clause 5. The insulation of the windings shall be class H or better as given in BS 2757. All windings shall be tropicalized and suitably impregnated to withstand the site ambient conditions.

6.6 The alternator shall be complete with all necessary cooling fans, excitation and voltage regulating equipment. The alternator shall be capable of maintaining its continuous maximum rated output when operating within + 5% of rated voltage and at rated power factor.

**7.0 CONTROL PANEL/DISTRIBUTION BOARD**

7.1 The distribution board shall be designed and manufacture according to CEE-0082 clause 7.0 and 8.0.

7.2 The board, suitably labelled, shall be fitted with all the equipment necessary for control, protection, automatic operation and proper functioning of the complete plant and it shall be fully wired to suitably accessible terminals and terminal strips.

7.3 Indication instruments on the distribution board shall be manufactured according to CEE-0082 clause 12.0.

7.4 Current transformer shall be selected according to CEE-0082 clause 13.0.

- 7.5 A mimic diagram of the feeders, breakers and change-over breakers shall be painted onto the front panel of the switchboard.
- 7.6 A Four pole circuit breaker and Auto Transfer Switch (ATS) should be provided rated for full load current (+ 10% overload).
- 7.7 The ATS equipment shall be of 3 attempt type and capable of sensing single phase and three phase failure of main supply or any variation in main supply voltage. The main supply and generator supply contactors or Solenoid/Motor operated change over switch shall be of fool proof design with mechanical and electrical interlock.
- 7.8 The ATS shall comply with SANS 60947-6-1.
- 7.9 Earthing, cabling and wiring shall be arranged according to CEE-0082 clause 16.0 and 17.0.
- 7.10 The control panel shall be referred to CEE-0082 and have the following additional provisions for the control of Diesel Generator Set:
- Master engine control which for OFF/AUTO/MANUAL/TEST with a facility for starting and stopping of the set.
  - Selectable Multifunction meter display.
  - Combined frequency and tachometer.
  - Emergency stop push button.
  - By-pass switch.
  - Changeover breaker.
  - The ammeter, voltmeter frequency meter shall be energised even with the isolator or circuit breaker open.
  - Where provision is requested for a dummy load, a manual change over switch of sufficient current carrying capacity shall be supplied to switch between the rated load and the dummy load.
  - The dummy load position of the change-over switch shall be indicated by a red warning lamp.

**The following protection shall be provided for the alternator:**

- Overload/ over current protection
- Over and under voltage protection
- Reverse power
- Loss of field/excitation
- Earth Fault Protection.

**8.0 MOUNTING:**

- 8.1 Complete unit to be mounted on robust skid frame. Anti-vibration mountings to be used where required and shall conform to ISO 10816.
- 8.2 Skid frame to be dimensioned to accommodate generator/alternator assembly, all accessories, soundproof canopy. Skid frame to be of rigid construction suitable for locating on level ground surfaces ranging from compacted earth, crushed rock, or a concrete pad.
- 8.3 All exposed moving parts and belts shall be suitably protected by removable guards.



- 8.4 When a mobile unit is required, the trailer and the generator shall be designed to be one unit. It is the manufacture's responsibility to ensure that the trailer is roadworthy prior to installation of the generator set.

## **9.0 FUEL TANKS:**

### **9.1 Built-in Fuel Tank:**

A minimum capacity of not less than 12 hours full running time built in fuel tank shall be provided. Design shall be capable of preventing accidental spilling of fuel and hand pump feeding on emergencies shall be possible.

### **9.2 External/bulk Fuel tank:**

The external/bulk fuel tank capacity shall be provided as per appendix A. Provide pre-engineered aboveground or underground atmospheric tank system complete with tank, piping, secondary containment, gauges, and other accessories specified herein as a complete assembled system.

### **9.3 Tank construction:**

- 9.3.1 The above-ground tank construction shall conform to BS-EN 12285-2 standard and the underground tank construction shall conform to SANS 1535 standard.

- 9.3.2 Fuel tank to have, lowest point drain facility for water and sludge, fuel level gauge direct mounted or remote electric, filler pipe and locking cap.

- 9.3.3 Tank shall carry at least a ten (10) years warranty including materials and workmanship.

### **9.4 Test:**

The tank shall withstand an internal air pressure test of 35 kPa, and test certificate shall be submitted to Transnet Freight Rail.

### **9.5 Fuel Distribution Pipe and Pipe Fittings:**

The design criteria shall conform to the minimum requirements of SANS 10089-3 or equivalent international standard.

### **9.6 Fuel Pumps**

Automation feed pumping system with fuel level feedback to control system.

### **9.7 Drawings:**

The contractor should submit design drawings for the tank and fuel pipe distribution, location of fittings and accessories with specific dimensions, for approval by Transnet Freight Rail prior to product fabrication.

## **10.0 CONCRETE FOUNDATION / PAD DRAWINGS**

Detailed drawings of the concrete/pad foundations required for mounting/installation of all equipment including generator shall be provided with all necessary details to Transnet Freight Rail for approval.

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**11.0 OUTDOOR WEATHER PROTECTIVE SOUND ATTENUATING ENCLOSURE**

- 11.1 The generator set shall be provided with a sound attenuated housing which allows the generator set to operate at full rated load in the ambient conditions. The enclosure shall reduce the sound level of the generator set while operating at full rated load to below 95 dB at 1 meter from the generator set. Housing configuration and material used shall be oil and water resistant. No foam materials shall be used.
- 11.2 The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment. A panel viewing window shall be provided. Key locking door latches shall be provided for all doors. Door hinges shall be stainless steel.
- 11.3 The enclosure shall be provided with an exhaust silencer, which is mounted outside of the enclosure, and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a rain cap and rain shield.
- 11.4 If indicated on the schedule of requirements, further sound reducing measures must be taken to reduce the sound level at full load.

**12.0 FIRE DETECTION**

Diesel generators housing shall have fire detection system suitable for use in an area containing diesel fuel. The fire detection system shall cut off the fuel supply from the tank in the event of a fire. The fire detection system shall operate an alarm system and be integrated to operate the diesel generators protection.

**13.0 OTHER REQUIREMENTS**

Generator set shall have Forklift Pockets within Base Frame (up to 350 kW).

Earthing studs need to be provided.

The diesel generator protection shall trip under following conditions.

- Low Oil Pressure
- High Engine Temperature / high coolant temperature
- Low Fuel Level
- Fail to start/crank
- Sensor fail
- Over/Under Speed
- Battery/Battery Charge Fail

**14.0 TESTING AND INSPECTIONS**

- 14.1 Transnet reserves the right to be present at all tests and inspections as called for in this clause.
- 14.2 The complete diesel generator unit shall be subjected to routing tests as per the standards specified, at the manufacturer's premises to verify that its performance is in accordance with the specifications. The supplier shall submit full details of the methods of testing including connection diagrams for approval.
- 14.3 The responsibility of arranging the tests called for in this clause rests with the successful tenderer.
- 14.4 A Transnet Freight Rail, Technology Management (Electrical Technology) representative may request any additional test deemed necessary to ensure compliance.

**15.0 DOCUMENTATION REQUIREMENTS**

- 15.1 Drawings and technical documentation shall be submitted with tender.

- 15.2 The manufacturer must provide one soft copy and two hard copies of the technical specification of the capacitors.
- 15.3 The manufacturer must provide one soft and two hard copy of the method of installation and mounting details.
- 15.4 The manufacturer must provide one soft copy and two hard copies of maintenance manual.
- 15.5 The manufacturer must provide design and type test certificates to verify conformance to the requirements and these must be submitted with tender documents.
- 15.6 The manufacturer shall provide training to Transnet Freight Rail's staff where the generator set is installed.
- 15.7 The manufacturer shall provide documentation on handling the equipment at the end of its operating life, taking into consideration environmental requirements and regulations.

## **16.0 QUALITY ASSURANCE**

- 16.1 The supplier must indicate what steps have been taken to implement a quality assurance system in terms of SANS 9001.

## **17.0 SPARES AND TOOLS**

- 17.1 The contractor shall submit a separate list of recommended spares to cover the probable requirements for two years maintenance of the generating plant. The list of spares should include adequate information regarding each item to facilitate ordering of replacements as spares are used. In addition to the supplier's ordering description the original manufacturer's ordering number and the original manufacture's catalogue description must be stated in all cases where the tenderer is not the manufacturer.
- 17.2 A suitable spares cupboard shall be provided to store spares and special tools, if required.
- 17.3 The contractor shall submit a list of special tools which shall be included in the tender price. "Special tools" in this instance, shall be defined as non-standard tools especially required for overhaul of the engine or alternator.

## **18.0 GUARANTEE AND DEFECTS**

- 18.1 The Contractor shall guarantee and maintain the diesel driven standby generator set and 'the works' for a period of twelve months after notification of taking over. During this period the Contractor's works shall be maintained as set out in the maintenance manual supplied by the Contractor and any defective material, equipment or workmanship (excepting only proven wilful or accidental damage, or fair wear and tear) shall be made good without inconvenience to the Client at the Contractor's expense and to the satisfaction of the Transnet Freight Rail.
- 18.2 Should the Contractor fail to comply with the requirements stipulated above, Transnet will be entitled to undertake the necessary repair work or effect replacement of defective apparatus or materials, and the Contractor shall reimburse Transnet the total cost of such repair or replacements, including the labour costs incurred in replacing defective material.
- 18.3 Warrantee of the diesel driven standby generator set shall carry a one year period except the parts which may become worn through fair wear and tear.
- 18.4 The battery shall carry a warrantee of at least 5 years.

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**19.0 INSTALLATION**

The installation shall be done with recommendations of the relevant standards, SANS 10089-3 and SANS 10142-1

**20.0 COMMISSIONING**

Commissioning of the generator set and the entire plant shall be done by the contractor and Transnet Freight Rail's Infrastructure department.

**21.0 METHOD OF TENDERING**

- 21.1 Tenderers shall indicate compliance to this specification by completing the technical questionnaire to be provided with the tender documentation. Proof of compliance in the form of technical specifications, data sheets, brochures, manufacture's confirmation letter etc. shall be submitted as called for in the technical questionnaire to substantiate the responses to the technical questionnaire.
- 21.2 If the tenderer does not comply with the requirements of the technical questionnaire, the tenderer shall provide a motivation in the form of a statement of non-compliance.
- 21.3 Tenderers shall submit comprehensive literature consisting of detailed technical specifications, general constructional details and principal dimensions, maintenance schedules, datasheets, together with clear illustrations of the equipment offered.
- 21.4 Any items offered in accordance with other standards will be considered at the sole discretion of Transnet. The tenderer shall supply full details stating where the item differs from these specifications as well as supplying a copy (in English) of the recognized standard specification(s) with which it complies. Any deviations must be approved by the relevant Transnet, Technology Management department in writing.
- 21.5 Failure to comply with clauses 21.1, 21.2, 21.3 and 21.4 could preclude a tenderer from consideration.
- 21.6 In the event of any conflict between the various submitted relevant documents, the order of precedence shall be, and in consultation with Technology Management:
- a) Legal and safety requirements.
  - b) This Specification.

**END**

## APPENDIX A:

### SCHEDULE OF REQUIREMENTS (to be completed by depot/project manager)

#### 1.0 GENERATOR SET

- 1.1 Name of depot and the place where the generator will be installed .....
- 1.2 Prime Power rating (Nominal Power).....kVA
- 1.3 Thermistor detection equipment..... Required/not required
- 1.4 Temperature range of operation.....°C
- 1.5 Is additional acoustic measures required.....
- 1.6 Is remote control and monitoring required.....
- 1.7 Is (20-80kVA) Gen. set requires auto start. ....yes/no
- 1.8 External/Bulk Fuel tank: above ground or underground.....
- 1.9 Required fuel day tank capacity.....liter
- 1.10 Required bulk fuel tank capacity.....liters
- 1.11 Must the generator be fixed on a trailer? (Mobile Unit) .....yes/no

#### 2.0 DISTRIBUTION BOARD

- 2.1 Indicating instruments:
- 2.2 Analog or Digital voltmeter.....
- 2.3 Analog or Digital ammeter.....
- 2.4 Will the board be a floor, wall or set mounted .....

#### 3.0 SPECIAL REQUIREMENTS

.....

.....

.....

.....

**APPENDIX B:****TECHNICAL REQUIREMENTS (to be completed by contractor)****1.0 ENGINE**

- 1.1 Name of manufacture.....
- 1.2 Rated output (continuously) power at rated speed.....kW
- 1.3 Can be operated in temperature below - 10°C.....
- 1.4 Is additional Acoustic Enclosure provided for .....
- 1.5 Is remote control and monitoring capable .....
- 1.6 Is auto start provided. ....yes/no
- 1.7 External/Bulk Fuel tank details attached .....
- 1.8 Fuel day tank capacity.....liter
- 1.9 Bulk fuel tank capacity.....liter
- 1.10 Fuel consumption of generator set:
- 1.10.1 Full load l/kW/h .....
- 1.10.2 1/2 load l/kW/h .....
- 1.10.3 3/4 load l/kW/h .....
- 1.11 Is the engine water-cooled or air-cooled.....
- 1.11.1 If water-cooled, make and type of jacket water heater fitted.....
- 1.11.2 If water-cooled, rating of water heater jacket.....
- 1.11.3 If air-cooled, make and model of outlet air louvres.....
- 1.11.4 If air-cooled, recommended gross cross-sectional area of ventilation and combustion air inlet louvres into standby plat room.....
- 1.12 Method of protection against high engine temperature.....
- 1.13 Generator Set sound level.....

**2.0 ALTERNATOR**

- 2.1 Rated Maximum prime power.....kVA
- 2.2 Nominal speed.....rpm
- 2.3 Efficiency at 100%.....%
- 2.4 Efficiency at 50%.....%
- 2.5 Temperature rise of windings at rated output not more than.....°C

**3.0 DISTRIBUTION BOARD**

- 3.1 Type and manufacture.....
- 3.2 Thickness of sheet steel.....
- 3.3 Degree of protection to SANS 60529.....
- 3.4 Form of segregation of circuits.....
- 3.5 To what standards have the following been tested?
- 3.5.1 Thermal rating.....

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3.5.2	Short time rating.....
3.6	Indicating instruments:
3.6.1	Type, size and manufacture of voltmeter.....
3.6.2	Type, size and manufacture of ammeter.....
3.7	Is the board a floor, wall or set mounted.....
3.8	Current transformers:
3.8.1	Metering - Type: ..... VA: ..... Class: .....
3.8.2	Protection - Type: ..... VA: ..... Class: .....
<b>4.0</b>	<b>GENERATOR SET BATTERY</b>
4.1	Type of battery.....
4.2	Battery voltage .....V
4.3	Battery Amp-hour rating.....A-h