

# DC Air Conditioning System

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## MD SERIES

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### Information booklet

All repairs, maintenance, and installations must be overseen by qualified air-conditioning personnel

All installations must have the Rencool Commissioning sheet filled out and returned to Rencool within 30 days of purchase to obtain a full warranty.



JUNE 23, 2020

RENCOOL

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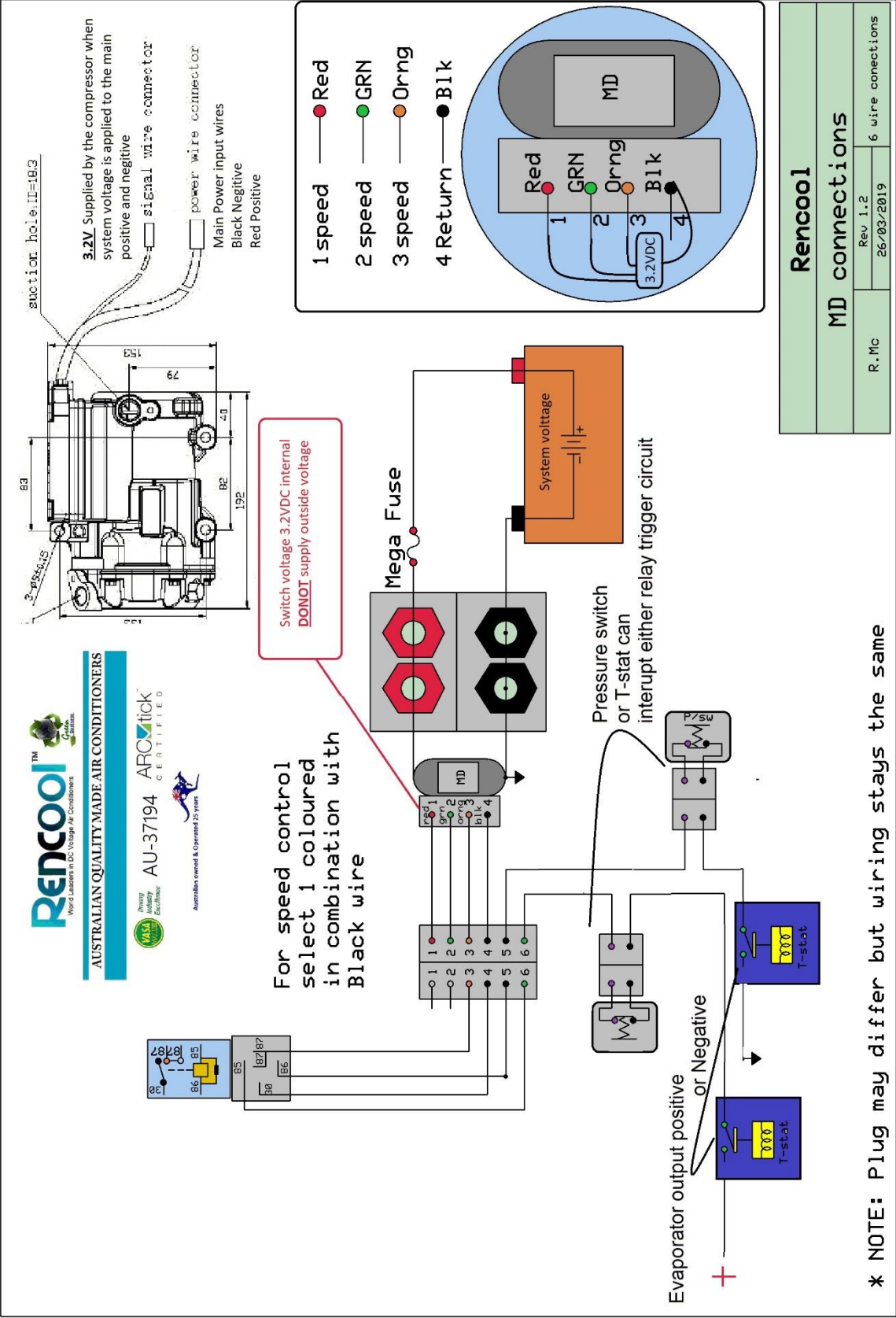
## DC Air Conditioning System

# Contents

|                                                                   |              |
|-------------------------------------------------------------------|--------------|
| <a href="#">Schematic Diagram</a>                                 | <b>3</b>     |
| <a href="#">MD Requirement</a>                                    | <b>4</b>     |
| <a href="#">Connecting Power Cables to DC Compressor</a>          | <b>5</b>     |
| <a href="#">Working with Electric Compressor system</a>           | <b>5</b>     |
| <a href="#">General Operational System Testing</a>                | <b>6-7</b>   |
| • <a href="#">Evacuation</a>                                      | <b>6</b>     |
| • <a href="#">Gross Leak Assess (Optional)</a>                    | <b>6</b>     |
| • <a href="#">Electronic Sniffer</a>                              | <b>6</b>     |
| • <a href="#">Pressurised Gross Leak Assess</a>                   | <b>6</b>     |
| • <a href="#">Oil Charge</a>                                      | <b>6</b>     |
| • <a href="#">Refrigerant Charge</a>                              | <b>7</b>     |
| <a href="#">Trouble Shooting Air-conditioning Block diagnoses</a> | <b>8</b>     |
| <a href="#">General Operational Assessment</a>                    | <b>9</b>     |
| <a href="#">TROUBLESHOOTING - STEP ASSESSMENT</a>                 | <b>10-15</b> |
| • <a href="#"><b><i>Compressor Operation-Section A</i></b></a>    | <b>11</b>    |
| • <a href="#"><b><i>Compressor Operation - Section B</i></b></a>  | <b>12</b>    |
| • <a href="#"><b><i>Compressor operation section C</i></b></a>    | <b>14</b>    |
| • <a href="#"><b><i>Compressor operation section F</i></b></a>    | <b>14-15</b> |
| <a href="#">Disclaimer</a>                                        | <b>15</b>    |
| <a href="#">Annex A - Cable guide</a>                             | <b>16</b>    |
| <a href="#">Annex B - Mount Compressor</a>                        | <b>17</b>    |
| <a href="#">Annex C - Commissioning Sheet</a>                     | <b>18</b>    |

# DC Air Conditioning System

## Schematic Diagram



# DC Air Conditioning System

## MD Requirement

### Rencool MD Series 12 & 24 DC Voltage Compressors and Units

- Rencool DC voltage HVAC systems are designed to work from the Engine Alternator and/or from other power sources such as Batteries, Solar, and Wind Turbines producing DC Voltage power from 12 to 48 VDC. The below is only a guideline for amp draw (Power Consumption) of the HVAC system using 12 / 24-VDC.
- Amp draw is dependent on head pressure, ambient temperatures, and heat load within the cabin. The below figures are based on the ambient temperature of +35 Degree C – using a HVAC system rated at 4KW
- **Note:** Head Pressure effects Amp Draw: The below are only estimates.

Cooling capacity from 1KW to 4KW.

- 12 VDC: Minimum requirement of power input of 10 VDC and max of 16 VDC.
- 24 VDC: Minimum requirement of power input of 20 VDC and max of 31 VDC
- 18cc @12 VDC @ 2000 rpm to 4000 rpm = 30 amps to 55 amps @ 12VDC – 1-3KW
- 18cc @24 VDC @ 2000 rpm to 6000 rpm = 15 amps to 50 amps @ 24 VDC – 1-3KW
- 24cc @24 VDC @ 2000 to 6000 rpm = 18 amps to 65 amps @ 24 VDC – 1- 4.2KW

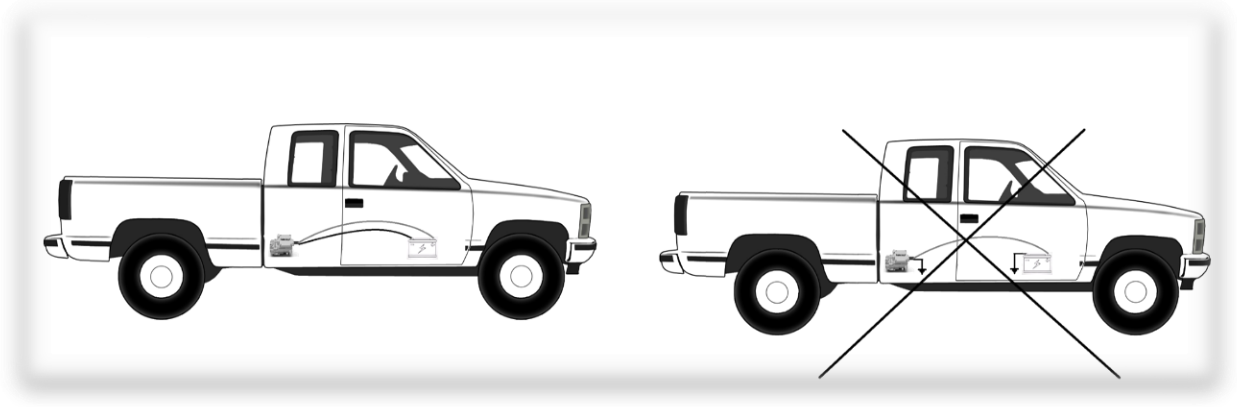
Complete Systems with Rencool DC Voltage Compressor:

- The Rencool system's current draws are dependent on three main factors, DC Compressor, Evaporator Blower/Fan, and Condenser Thermostat Fan/ AMP draw. Calculate your evaporator and condenser fans with the compressor's current consumption for an estimation of your total amp draw. Most common fans run an average of 3 to 8 amps @ 24 VDC.

## DC Air Conditioning System

### Connecting Power Cables to DC Compressor

- A minimum of 2B&S copper insulated cabling MUST BE used. Failing to use the recommended cabling could result in high current consumption, high resistance, and overall poor performance from the DC voltage HVAC system. Length of cabling MUST BE calculated so resistance is kept to a minimum.
  - **Both Positive and negative leads must go to the battery.**
  - **Do not rely on chassis connections**



### Working with Electric Compressor systems

- **Do not use test lights or analogue meters to test circuits these can cause voltage shifts which can cause damage to the control circuit of the Compressor. Use Digital Meters only**
- Conduct regular general inspections of the condition and ensure there are no broken or damaged items.
- Electronics do not like excessive heat. Please do not mount the compressor where it will be operating in temperatures of 70°C or above.
- Ensure airflow back to the compressor is achieved to provide the cooling airflow to the compressor to maintain optimal conditions.

# DC Air Conditioning System

## General Operational System Testing

- **Evacuation**

- The process of putting a vacuum on an air conditioning system to remove air and moisture. The vacuum must always be pulled from both sides of the system during evacuation.
- Caution: For those systems containing a thermal expansion valve (TXV), during the evacuation, the valve must be closed. This isolates the high and low sides of the system from each other. Failure to do so will allow air and moisture to remain in the system.

- **Gross Leak Assess (Optional)**

- Evacuate the A/C system for 30 seconds. At the end of 30 seconds, the A/C system vacuum must be 15.0 torr (20.0 mbar) or less.
- Switch OFF the evacuation process and hold the vacuum for 30 seconds. After the 30-second vacuum hold time, the system vacuum must be 30.0 Torr (40.0 mbar) or less.
- Note: Leaks detected with a gross leak Assess allow for repair early in the procedure; this saves operating time.

- **Electronic Sniffer**

- Leak Assess all refrigerant lines and component connections using an electronic leak detector capable of sniffing R134a. While the system may pass a pressurised gross leak, assess to ensure that the leak rate is less than the required sensitivity level of less than 15g/yr. machine total leak rate.
- While a sniffer test can be time-consuming. It requires proper planning to ensure each connection is Assessed and that all connections pass the sniffer test.
- Note: This includes pressure switches/sensors and service ports.
- Note: Electronic sniffer must be calibrated daily to provide accurate leak detection.

- **Pressurised Gross Leak Assess**

- This test can be conducted at the same time as the leak detection process with an electronic sniffer.
- After filling the A/C system with gas, allow enough time for the system to achieve pressure equilibrium. Experience indicates most A/C systems require 60-90 seconds to reach pressure equilibrium when using automated charging machines.
- Once equilibrium is established, perform a pressurized gross leak Assess. The system must not have a pressure loss of more than 2.5 kPa (0.36 PSI) for a 60-second duration.
- After the completion of sniffing the A/C system with an electronic leak detector, and pressurised gross leak test, recover or release the tracer gas from the low side service port to a suitable location.

- **Oil Charge**

- Charge the system's oil at the high side service port of a plumbed system, with the required quantity of Ester 68 oil.

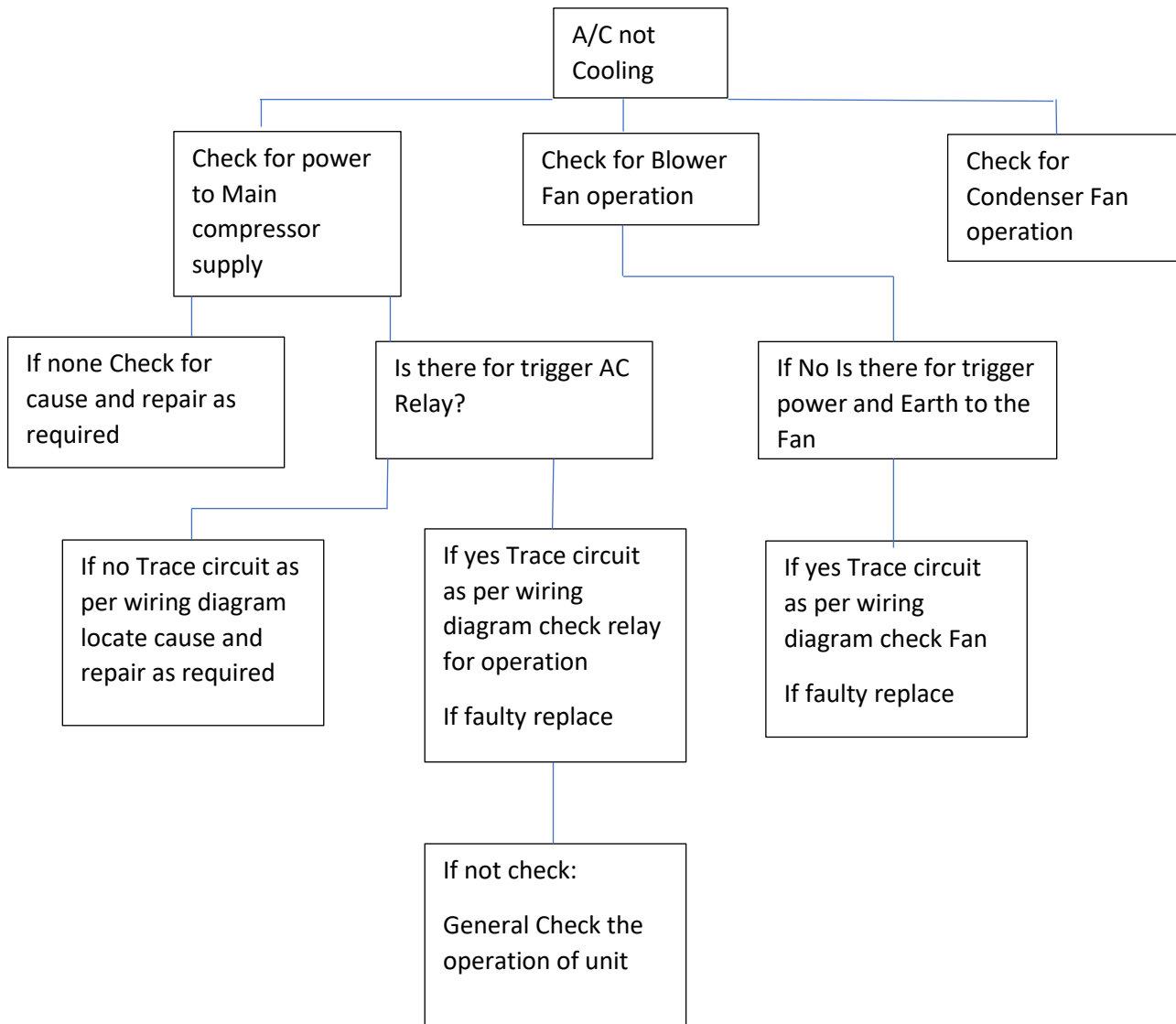
## DC Air Conditioning System

- **Refrigerant Charge**

- Charge the system refrigerant at the high-pressure service port with the desired quantity of refrigerant for the leak test and to switch the safety pressure switch to activate the run circuit.
- It is recommended to Vapour fill the system to avoid any liquid compression in the compressor, as this WILL cause damage. If vapor feed is not available then , pressurise with liquid to leak test and let sit for 10 minutes, liquid feed while the compressor is running with pressure no HIGHER than 50-60 PSI at the feed-in.
- While the system is running up Assess for exchange heat across the condenser and the evaporator in the airflow Gassing

## DC Air Conditioning System

### Trouble Shooting Air-conditioning Block diagnoses



# DC Air Conditioning System

## General Operational Assessment

- Assess the engine is running when testing
- Ensure the Alternator is charging above 12VDC or 24VDC depending on system voltage while the unit is turned on
- Ensure the Internal fan working at all speeds
- Ensure the Thermostat turns on to full cold
- Assess the Condenser fans working?
- Our units have a voltage cut out at low voltage and will cut out with quick voltage drops.
  - To Assess this “a voltage Assessment” should be performed, if it is a 24VDC system the voltage must always be above for a 24VDC fully loaded or the battery will not charge.
  - If the battery is not charged enough the system will cut out the main current draw, in this case, the compressor will stop working, however, the rest of the system will still work, therefore is no cooling but the fans are working.
  - The power draw of the system may be more than the charging circuit can provide. To see if the supply is enough the engine needs to be running and the charging voltage assessed. If the charge is not OK fix the charging circuit, so it is at the required level. If the charge level is OK, then turn the unit on and see if the voltage is above the required level.
  - If there is insufficient voltage, assess belts for slippage or wear, if OK, the Power supply may not be enough, and action needs to be taken to get the power source to the required level.
- Note: power cables to the Alternator should be at least the size of the cabling to support the full current rating of the alternator to the battery circuit to avoid voltage drop.
- Other things to consider if performance is unsatisfactory:
  - Assess all fuses
  - Assess all plug connections
  - Assess for gas leaks (look for fresh oil marks)
  - Condenser fans not working
  - Assess for physical obstruction (sticks etc.)
  - Assess all system fans are working
  - Assess relays
  - Assess terminal connections
- Ensure airflow back to the compressor is occurring and keep the Compressor cool and operating in optimal conditions.
- Continually running the compressors on full cooling is **not** the best way to make your compressor last, to achieve less wear to your unit set the cooling to the most energy-efficient thermostat setting.
- Electronics do not like excessive heat. Please do not mount the compressor where it will be working in temperatures above 70°C.

# DC Air Conditioning System

## TROUBLESHOOTING - STEP ASSESSMENT

### 1. Fit gauge couplings and Assess whether gas pressure is over 30 PSI

- Yes, continue to step: 2.
- No, then leak-detect for leaks including - connections/ hoses/ valves/ pressure switches/ sight glass/ coils and take note

### 2. Assess system voltage, see if system voltage is at an acceptable level

- For example, if the battery is charged and is in good order there should be approximately 24 Vdc with the suggested 35mm<sup>2</sup> battery cable.
- Assess the battery is correctly connected to the compressor with the correct polarity (**Red Positive** Black Negative)
  - Yes, continue to step: 3.
  - No, Acquire a new power source.

### 3. Assess Blower fan

- Most compressor trigger circuits will not activate unless the blower fan is first running.
- Assess All speeds and airflow and cleanliness through the evaporator
  - Yes, continue to step: 4.
  - No, if not working assess the fan switching circuit, fuse, and fan motor, and for airflow restrictions.

### 4. Assess Condenser Fan

- Assess for physical obstruction (sticks etc.), airflow, direction, and cleanliness through the Condenser. The condenser fan should come on with the compressor activation circuit with or without 30 PSI in the system
  - Yes, continue to step: 5.
  - No, if not working assess the fan switching circuit, relay, fuse, and fan motor and for airflow restrictions and take note

## DC Air Conditioning System

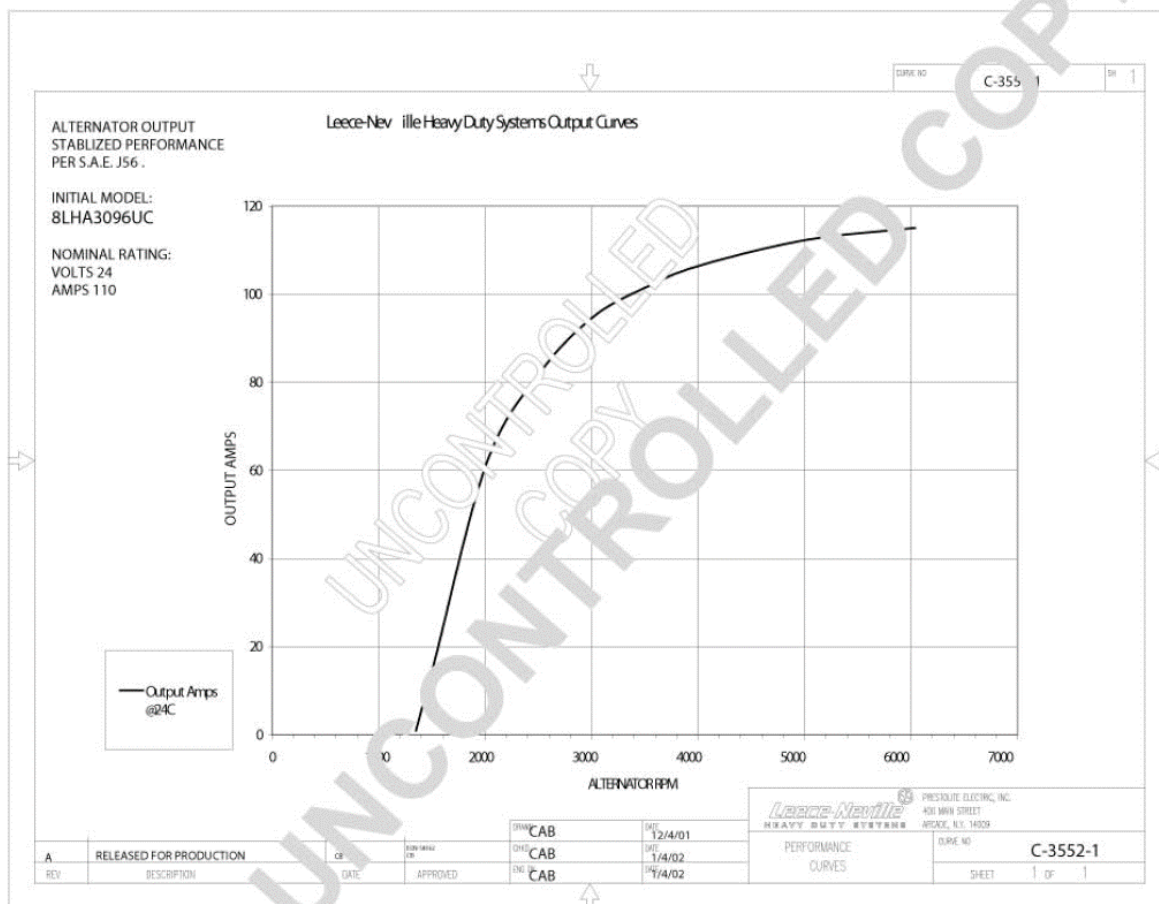
### 5. Compressor Operation

- Activate the compressor by switching the circuit on and waiting for the compressor to start within 40 seconds.
  - Yes, continue to step: 6.
  - No, Assess Compressor's operation and refer to the best description below, in Sections A, B, C, F
  - - A -the compressor does nothing
      - Go to section Compressor operation section A
    - B -the compressor makes a quick noise and then stops
      - Go to section Compressor operation section B
    - C – the compressor runs for a while and then cuts out, but the system is not cold enough.
      - Go to section Compressor operation section B
    - D – the compressor runs but the gauges do not move.
      - Go to section Compressor operation section C
    - E – the compressor runs but is making an unusual noise
      - Go to section Compressor operation section C
    - F – small rattle on start-up
      - Go to Compressor operation section F
- **Compressor Operation-Section A**
  - The compressor does nothing
    - Refer to the wiring Diagram and test with a multimeter that there is compressor activation
  - Switching the electronic thermostat control when the fan speed switch is on
    - Yes, Assess through the switch for activation power.
    - No, locate switching issue
  - Turn the thermostat on full and Assess power goes from the electronic thermostat to the Device thermostat
    - Yes, Assess through the switch for activation power
    - No, locate switching issue
  - With power coming from the Device Thermostat Assess power is going to the pressure switch or compressor relay (Ref to Schematic diagram)
    - Yes, Assess through the switch for activation power
    - No, locate switching issue
  - Assess the circuit diagram. If power/ earth (Ref to Schematic diagram), goes through the Pressure Switch.
  - Pressure switch Assess for continuity
    - Yes, assess through the Relay for activation power going to the switching of the compressor relay
    - No, locate the switching issue.

## DC Air Conditioning System

- With power going to the Compressor Relay is the compressor relay working. This can be Assessed by electrically disconnecting the compressor switching four-way plugs found at the compressor wrapped in wax tape and Assessing for continuity at pins 87 and 30 when the relay is activated.
  - Yes, assess through the four-way plug DTM06-04 sockets 3 and 4 for continuity when the relay is on - No locate switching issue (ref to schematic diagram)
  - With continuity, when the relay is on with the four-way plug disconnected and make sure there is system voltage at the compressor battery terminals.
  - Assess a four-way Plug on the compressor side (DTM04-04) for 3.2 Vdc between pins 3 and 4
    - Yes, continue step 7
    - No
      - Disconnect battery
      - Unplug compressor control lead (4 wire plug) DTM 4 Way
      - Disconnect the heavy positive and negative leads (Red and Black)
      - Ensuring the leads are NOT connected to anything else touch the two leads together for one second
      - Refit leads to the circuit
      - Re-Assess Voltage
  - If the unit has not changed then the controller is Faulty
  - If the unit has returned to 3.2 Vdc then reconnect and test
  - In the unlikely event of the compressor still is not working a replacement compressor is required.
- **Compressor Operation - Section B**
  - Our units have a voltage cut out at Low/High voltage and will cut out with quick voltage movements.
  - The quickest and easiest Assessment can be done with a completely independent battery supply and heavy jumper leads. Remove your battery supply and connect a reliable fully charged and in good order as partly charged faulty batteries can cause false results.
  - To Assess this “a voltage Assess” should be performed, it always needs to be above the sitting voltage of a charged battery system.
    - E.g. if it is a 24 VDC system the voltage must be above 24 Vdc fully loaded electrically or the battery will not charge.
  - If the battery is not charged enough the system will cut out the main current draw. In this case, the compressor will stop working, however, the rest of the system will still work, therefore is no cooling but fans are working.
  - Depending on the unit in which the system is fitted, the power draw of the system may be more than the charging circuit can provide.
  - To see if the supply is enough, the engine needs to be running and the charging voltage Assessed.
    - If not OK, modify the charging circuit to the new required level,
    - If ok, then turn the unit on and see if the voltage is above required.
  - If there is insufficient voltage, Assess belts for slippage or ware,
    - If OK, the Power supply may not be enough, and action needs to be taken to get the power source to the required level.

## 8LHA3096U Performance Curve



- Note:
  - See the diagram of the Alternator charge graph and notice the difference in available current at different RPM (RPM of alternator, not engine) this will have to be considered in your calculation. Power cables to the Alternator may need to be upgraded with any upgrades done.
- Batteries
  - Batteries in poor condition can cause irregular voltage movements that are not identified on a standard multimeter; however, the protection circuit will pick these movements up and see them as a problem. This will result in shutting the compressor down to save damage.
    - However, if the problem continues this will cause damage to the controller, resulting in replacement. If the problem is not fixed it will continue to cause this issue and this is a condition not covered by a warranty.
    - To reduce these problems, replace batteries with recommended MTBF as a guide.

- **Compressor operation section C**

- In the unlikely event that the electric motor runs but the compressor does not seem to pump.
  - Assess for gauge valve depression. Make sure the service ports are in good order,
    - if not replace the faulty component
    - If the tools and equipment are accurate then the most likely cause is the compressor is faulty.
    - Remove the compressor and inspect for possible reasons which have maybe caused this fault.
  - If the Compressor is unusually noisy or has high amounts of vibration.
    - Replace as per A/C handler protocol.
    - Ensure airflow back to the compressor is achieved to provide the cooling to the compressor to maintain optimal conditions.
    - When Gassing the compressor systems, it is recommended to Vapour fill the system to avoid any liquid compression in the compressor as it WILL cause damage. If vapour feed is not available then pressurise with liquid to leak test and let it sit for 10 minutes, then liquid feed while the compressor is running. The feed should have a feed of no HIGHER than at a pressure of 50-60 PSI.

- **Compressor operation section F**

- A small rattle on start-up is quite normal with the soft start process on these compressors.
- If it is a concern inject 50ml of ESTER 68 into the system to ensure continued lubrication. This can only be done once. If this does not stop the rattle the system oil-catching component needs to be replaced (Drier/ Condenser/ Evaporator) or oil has been let out.

**6. Assess the list of faults and repairs as required.**

- Continue to step 7.

**7. Running the system up**

- Once all repairs have been completed start the system and Assess Head pressures.
  - The High pressure should be between 130-220 PSI.
  - The low pressure should be between 20-35 PSI
  - This will depend on the application and the day. If the Cabin temperature is up, then so will the suction pressure. However, the discharge pressure should not go over 220 PSI.
  - The higher the liquid temperature the less effective the system will be.

- The evaporator temperature should cut out at a comfortable level where the compressor will cut out to stop freezing up. Do not overwork the compressor, it is suggested the cut-out should be about 10°C at the vent. This should be controlled by the device's thermostat.
- Clean coils for maximum heat exchange
- Always ensure coils are clean for designed performance
- Finally perform a voltage Assess as described in section compressor Operation - Section B.

## Disclaimer

### Please Note:

Rencool takes no liability for improper calculation on power inputs from alternators or any other such power supplies including **AC** (Alternating Current) to supply to any Rencool DC HVAC compressor and/or full competition for units containing our MD or DRK7/& 8 series compressors on complete unit systems.

Your alternator must be above 100 amps on @12 VDC and 24 VDC and able to cope with your calculated other power consumptions on the truck, machine, Van, or any type of vehicle mobile or stationary, etc used while in use must be sufficient to do all is required to run the truck, machine, Van or any type of vehicle mobile or stationary, etc. We recommend always best to consult Auto-Electrician for these calculations. Original power cables, the electrical system installed on the truck, machine, Van, or any type of vehicle mobile or stationary, etc must also be sufficient to handle the extra load from the Rencool compressor and/or complete system.

Rencool staff will share any information on our systems they made need answering regards to the compressor and/or complete system/s you are considering purchasing so you or your Electrician/s can be sure the calculations are correct.

The design of the installation is the responsibility of the installer and Rencool will not be held responsible for incorrect or mishandled installations.

*Rencool DC HVAC Systems*

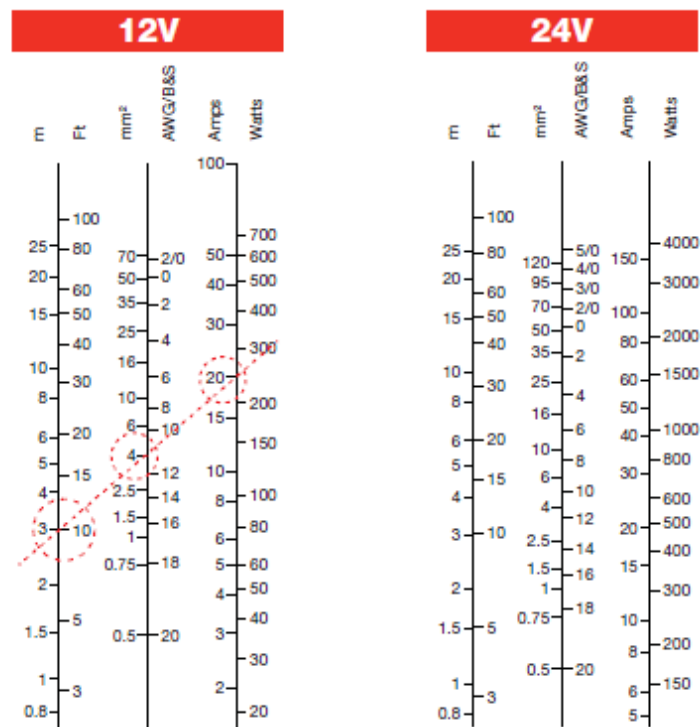
A better shade of green

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## Annex A - Cable guide

The below diagram will advise the minimum required wire gauge for a given cable length and the current draw or wattage. Simply draw a line from the required cable length (meters or feet), to the required current draw or wattage figure. Where the line passes through the gauge column will indicate the required wire gauge.

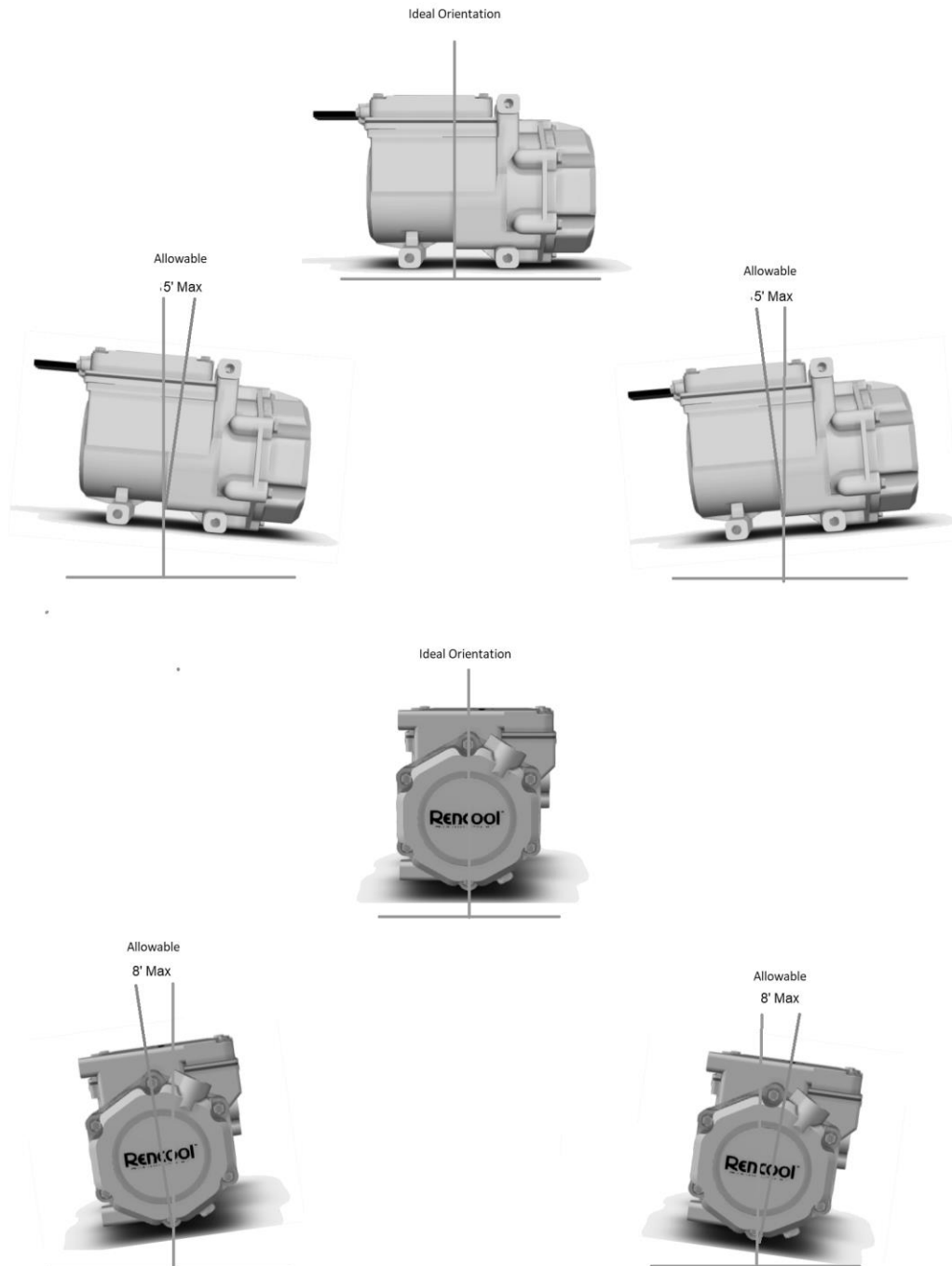
The example shows a BCDC1220 install with a total cable length of 3 metres. The chart suggests a 4mm<sup>2</sup> cross sectional area to handle the 20A maximum current draw.



## Annex B - Mount Compressor

Mount Compressor with the controller to the top.

Not any other way



## Annex B - Commissioning Sheet



### RENCOOL COMMISSIONING AND CERTIFICATION SHEET

|                                                                                                     |                                      |                                                                                 |
|-----------------------------------------------------------------------------------------------------|--------------------------------------|---------------------------------------------------------------------------------|
| DATE .....                                                                                          | ARC AU NO. (For gassing only) .....  | <b>Comments:</b><br>.....<br>.....<br>.....<br>.....<br>.....<br>.....<br>..... |
| SERIAL NO OF COMPRESSOR.....                                                                        |                                      |                                                                                 |
| FLEET /REGO/ Unit ID NO.....                                                                        |                                      |                                                                                 |
| COMPANY .....                                                                                       |                                      |                                                                                 |
| TECHNICIAN .....                                                                                    |                                      |                                                                                 |
| EMAIL .....                                                                                         | PHONE .....                          |                                                                                 |
| R134A CHARGE (WEIGHT) .....                                                                         |                                      |                                                                                 |
| SUCTION PRESSURE (LOW SIDE) .....                                                                   | DISCHARGE PRESSURE (HIGH SIDE) ..... |                                                                                 |
| INPUT VOLTAGE (A)ENGINE OFF..... (B)ENGINE RUNNING..... (C)FULL ELECTRICAL LOAD ENGINE RUNNING..... |                                      |                                                                                 |
| CURRENT CONSUMPTION(A)ENGINE OFF.....(B)ENGINE RUNNING..... (C)FULL LOAD WHILE RUNNING.....         |                                      |                                                                                 |
| AMBIENT AIR TEMPERATURE .....                                                                       |                                      |                                                                                 |
| RETURN EVAP AIR TEMPERATURE .....                                                                   |                                      |                                                                                 |
| AIR EVAP OUTLET TEMPERATURE .....                                                                   |                                      |                                                                                 |
| CONDENSER AIR OFF TEMPERATURE .....                                                                 |                                      |                                                                                 |

**This form is to be returned within 30 days of purchase, if not returned warranty will be reduced to a 30-day basis.**

I ..... HAVE TESTED AND CHECKED OVER THE HVAC SYSTEM AND BATTERY/CHARGING CIRCUIT AND ALL CERTIFY IT TO BE WORKING CORRECTLY. I HEREBY AGREE THAT THE AIR CONDITIONING SYSTEM HAS BEEN COMMISSIONED AND TESTED AND ALL INFORMATION IS TRUE AND CORRECT  
THE SIGNATURE BELOW CERTIFIES THE AIR CONDITIONING SYSTEM OPERATIONAL.

SIGN ..... DATE .....

RENCOOL.PTY.LTD  
2020