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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

TECHNICAL SPECIFICATION FOR
ROOF MOUNTED AIR CONDITIONING SYSTEM IN THE
CABS OF ELECTRIC LOCOMOTIVES

SPECIFICATION No. RDSO/2007/EL/SPEC/0055 (Rev. ²/₁)

ISSUED IN NOVEMBER' 2007

(REVISED ON 07.10.2014)

Approved by	Signature
Sr. EDSE	<i>P. S. Sharma</i>

ELECTRICAL DIRECTORATE
RESEARCH DESIGNS AND STANDARDS ORGANISATION
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

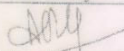
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Status of Revision

SN	Date of Revision	Page No.	Revision	Reasons for Revision	Signature
1.	07.10.2014	All	1	<ul style="list-style-type: none"> - Edition of description of the system, environmental conditions, scope of supply, shock and vibration test details, field trial, Training of Indian Railway Personal and Field trial etc. - Specified the procurement of components/spares and Refrigerant - Modification in heating arrangement - Deletion of warranty clause - Standardization of outer dimensions of AC unit, Control panel & Switching panel - Some more other changes/editions which are required to be done for increasing the reliability and better performance of the system. 	
2.	22.05.19	12	2.	<p>a. High temp. start up test in cl. no. 7.1.3.5 and</p> <p>b. 8 hrs running test in cl. no. 7.1.7 shall be conducted on single unit of the lot offered (selected at random) during every routine test.</p>	<p><i>Ambar</i> 22.5.19</p>
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<i>Gay</i>		<i>Vaid</i>		<i>AMU</i>	

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

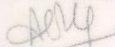
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1.0 INTRODUCTION:

- 1.1 Presently, the cabs of electric locomotives are equipped with 2 nos. cab fans and 2 nos. heaters for the crew. In extreme summer and winter condition the existing system is inadequate for reasonable level of comfort to the crew. This document shall establish the basis and minimum criteria of design, manufacturing, performance and maintainability of the air conditioning system and its components.

1.2 DESCRIPTION OF THE SYSTEM

- 1.2.1 **Fabrication:** The AC unit shall be fabricated out of stainless steel SS-304.
- 1.2.2 **Evaporator Coil:** The evaporator coil should be made of copper tubes as per IS: 10773 – 1983 or latest and fins should be made of Aluminium of suitable design to meet the system requirement. Fins shall be pre – coated with hydrophilic anti corrosive coating and shall pass 1000 hours salt fog test as per ASTM B-117. A test certificate from OEM/NABL accredited lab shall be provided.
- 1.2.3 **Condenser Coil:** The condenser coil should be made of copper tubes as per IS: 10773 – 1983 or latest and fins should be made of Aluminium of suitable design to meet the system requirement and should be able to withstand the heavy vibrations faced by the unit. Fins shall be pre – coated with hydrophilic anti corrosive coating and shall pass 1000 hours salt fog test as per ASTM B-117. A test certificate from OEM/NABL accredited lab shall be provided.
- 1.2.4 **Compressor:** Scroll compressor should be used to obtain the required cooling capacity. The compressor should be protected against high pressure, low pressure etc. using appropriate safety devices.
- 1.2.5 **Air conditioning Parts:** The AC unit should incorporate the thermostatic expansion valve with external equalizer; sight glass, filter dryer, HP/LP cut outs, service valve/pump down valve, charging valve etc. in the air conditioning circuit.
- 1.2.6 **Evaporator Fan:** The evaporator fans should be selected to have adequate capacity of air flow using 2 blowers driven by the motor. Frame size and shaft diameter of the evaporator motor should be 63 & 12.7mm respectively.
- 1.2.7 **Condenser Fan:** The condenser fan should be also selected to have adequate capacity of air flow using a good quality low noise fan blade. Frame size and shaft diameter of the condenser motor should be 63 & 12.7mm respectively.
- 1.2.8 **Filter & Air Deflector Assembly:** The unit should have at its bottom an assembly consisting of filter in return air path & a deflector for the supply air. The filter should be so chosen so as to protect the unit from dust & particles flowing in through the return air. Grill should be made of fire retardant fiber glass material. The Grill

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

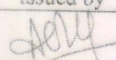
arrangement should be fixed from the bottom of the unit as per fixing arrangement given in CLW drawing no. CLW/ES/SK-4/A-15 (latest alteration), by which the filter assembly can be easily taken out from the cab for routine filter cleaning.

- 1.3 This document is a basic guideline to the suppliers. However the outer dimensions are restricted as per latest alteration of CLW drawing nos. CLW/ES/SK-1/A-15(Air Conditioning M/c), CLW/ES/SK-2/A-15(Trough for AC unit), CLW/ES/SK-3/A-15 (Control Cubical and Switch Panel) and CLW/ES/SK-4/A-15 (Grill Arrangement).

1.4 **ENVIRONMENTAL CONDITIONS:**

The system will be fitted in locomotives where the environmental condition will be:-

Ambient temperature	Under sun 60°C max.
	In shed 50°C max.
	Minimum temperature - 10°C (Also snow fall in certain areas)
Humidity	Up to 100% during rainy season
Altitude	Up to 1776 m above mean sea level
Rainfall	Very heavy rainfall in certain areas. Annual rainfall ranging between 1750 to 6250 mm.
Wind speed	High wind speed in certain areas, with wind pressure reaching 150 kg/m ²
No. of thunderstorms day / year -	May be as high as 85 days.
Solar radiation	1 kW/m ²
Atmospheric conditions	Extremely dusty and desert terrain in certain areas. The Dust concentration in air may reach a high value of 1.6 mg/m ³ . In many iron ore and coal mine areas, the dust concentration is very high affecting the filter and air ventilation system. The system shall be able to work at the max. specified ambient temperature inside the locomotive without any pre-cooling requirement.
The equipment shall be designed to work in coastal areas in humidity and salt laden and corrosive atmosphere. The maximum value of the some of the parameters will be:	i- Maximum PH value - 8.5 ii- Sulphate concentration - 7 mg / litre iii- Max. concentration of Chlorine - 6 mg/litre iv- Max. conductivity - 130 micro siemens / cm

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1.5 Vibration & Shock:

The equipment & mounting arrangement shall be of robust design suitable for traction duty and shall withstand satisfactorily the vibration and shocks normally encountered in service as per IEC 61373 (latest) under the category 1 class A. The vibration test shall be done as mounted in the actual operating condition.

2.0 SCOPE OF SUPPLY:



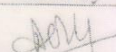
The scope of supply will include complete air conditioning system with all the associated control, protection & indication equipment and control panel, switching panel & a single unit air conditioning module along with trough arrangement for collection of condensate water, mounting and supporting bracket/structures, etc.

Details are listed as below:-

SN	Item
1	Compressor scroll type
2	Condenser fan Motor
3	Condenser fan
4	Condenser coil
5	Blower housing assembly
6	Cooling/Evaporator coil
7	Heater
8	Electronic Thermostat/Solid state temp control
9	OHP
10	Thermostatic expansion valve
11	High pressure cut - out
12	Low pressure cut - out
13	Return Air Filter
14	Copper Piping
15	Control Cubicle comprises of transformer for control wiring, MCBs/MPCBs, Connectors & Contactors etc.
16	Switching Panel
17	Trough arrangement (optional) *
18	E- Beam cable for power circuit and PTFE cable for control circuit.
19	Connectors with fire retardant halogen free inserts
20	Change Over Switch, 16A/ 3 Pole
21	Hardware for fitment of AC unit in locomotives shall be AISI 304 or A4 (316).

Note: - * The trough arrangement is an optional item and shall be supplied as per the requirements of the purchaser.

- Grill arrangement for AC system shall be supplied separately

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3.0 GENERAL DESIGN REQUIREMENTS:

3.1 The compact unit shall have following performance parameters --

- a) **Cooling capacity:** 2 ton (6045 K.cal/hr) at 35°C ambient.
1.5 ton (4534 K.cal/hr) at 50°C ambient.

However, the AC unit shall be able to operate up to 60°C ambient / 90% (max.) relative humidity ambient without tripping, damage and any other faults. It should be able to restrict 60% max relative humidity inside the cab under any circumstances.

- b) **Heating capacity:** The unit shall have overall heating capacity of 2 KW \pm 5% comprising of three numbers element in star connected suitable for 3-phase supply. Working of heating elements will be automatically.
- c) During the operation of locomotives doors and windows are likely to be opened frequently. Hence, there will be automatic intake of fresh air due to opening and other small leakages in the cab. Therefore, fresh air provision is not necessary.
- d) The temperature inside the cab shall generally be maintained between 23 to 25°C in cooling mode and 19 to 21 °C in heating mode. The suppliers shall provide a mechanism for cut in and cut out of the compressor and condenser fan motor in cooling mode and also cutting and cut out of the heater in heating mode by same mechanism.
- e) The condensate water collection system shall be foolproof and should not allow leakage of water in the cab. Drain arrangement should be designed such that it should be not get choked.
- f) Montreal protocol approved R407c should be used as refrigerant.



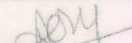
3.2 Power supply system:

- a) 415 V 3-phase 50 Hz power supply is available in locomotive. The supply voltage may vary within from 394V to 436V and frequency may vary \pm 3%. Suppliers shall design their motors i.e. the compressor, condenser fan, blower fan etc. to work on three phase ac power supply.
- b) Manufacturer shall provide delay start feature for 180 sec in their control system to protect the compressor.

3.3 Control Cubicle:

The Control Cubicle of the system shall have the following minimum features -

- a) The control cubicle will be as per latest alteration of CLW drawing no. CLW/ES/SK-3A-15. The control cubicle will be fitted inside the box section near assistant loco pilot. The control cubicle should be sealed so that dirt and water may not enter.

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
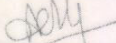
- b) The control Cubicle should be made using independent MPCB of adequate capacity for all the motors, timers & terminal blocks etc. Control cubicle should be made of MS with powder coating. All the equipment fitted in the control cubicle should be easily accessible for maintenance. The contactors, MCBs and MPCBs in the control cubicle should be connected by using lug to prevent looseness.

3.4 Switching Panel:

- a) The switching panel will be as per latest alteration of CLW drawing no. CLW/ES/SK-3A-15. Switching panel will be fitted with rotary switch type controller at the RHS corner of the loco cab below the crew fan.
- b) The rotary switch type controller will have three positions i.e. OFF, Auto & Manual Cooling.
- c) The switching panel should have the following indications:
Status LED's (Green) – Main-On, BLR-ON, COMP-ON, HTR-ON, Cool-ON
Trip/Alarm LED's (Red) – HP, LP, OHP, COMP

4.0 SPECIAL FEATURES:

- 4.1 The complete unit shall be housed in a compact housing on the roof of cab as per the dimension given in latest CLW drawings. The maximum vertical projection shall not be more than 300 mm over the roof.
- 4.2 The trough and 4 lifting hooks of AC unit shall be made of SS-304. The trough for mounting of AC unit shall be welded on the roof of the cab. The trough shall have necessary drain pipe for roof water as well as condensate water.
- 4.3 In cooling mode, the heating element shall remain off while compressor motor, condenser motor and evaporator fan motor shall be on. The evaporator fan motor shall work continuously whereas compressor motor and condenser motor will work till the temperature requirement as specified is achieved. The total connected load in cooling mode will be $2.5 \text{ KW} \pm 5\%$ at 35°C ambient.
- 4.4 In the heating mode, the heating element and evaporator fan motor will be switched on to circulate hot air inside the cab during winter season. The heating element will work depending upon the duty cycle set for temperature requirement in the cab whereas the evaporator fan motor will be continuously on. The total connected load during heating mode will be $2 \text{ KW} \pm 5\%$.
- 4.5 Actual weight of air conditioning unit should not exceed 150 kg without trough.
- 4.6 Cables shall be crimped at both ends with suitable terminal lugs. Interlocked type cable markers shall be provided to identify a particular cable.

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- 4.7 Silver brazed joints/fused for connecting terminal leads and winding wires shall be used for motors. Soldered joints are not acceptable.
- 4.8 Connectors with fire retardant halogen free inserts shall be used for power and control wiring. All the connecting terminals including fixing of pins with connectors should be properly crimped by appropriate tools.
- 4.9 The compressors shall be provided with high /low pressure switch to avoid working of compressor beyond permissible pressure. High pressure cut-out and low pressure cut-out shall be auto reset type. HP cut-out will be set at 450 ± 15 psi and low pressure cut-out at 30 ± 5 psi.
- 4.10 Manufacturer should use E- beam cable (as per RDSO specification no. RDSO/SPEC/ELC/0019 (Rev. '0') of 2002 or latest) of minimum size 1.5 sq. mm for power circuit and PTFE cable (as per JSS 50134) of minimum size of 1.0 sq. mm for control circuit.
- 4.11 All the hardware used, shall be AISI 304 or A4 (316) standard having metric threads only.
- 4.12 Three terminals for supply connections shall be brought out in a terminal box on the side of motor. The terminals shall be clearly marked/colour coded with RYB on the terminal box to obtain the correct direction of rotation with the supply phase sequence RYB, the terminal box should have a degree of protection IP-56. Terminal block shall be made of epoxy reinforced glass having anti- moisture absorbent and free from porosity.
- 4.13 The procurement of components/spares should be done from the OEM or sources given below. In case of any deviation prior approval of RDSO will have to be taken.

SN	Description	Make
1	Hermetically sealed scroll Compressor	Emerson Climate ZR28K3E-TFD-522
2	Condenser fan motor, as per RDSO specification No. RDSO/PE/SPEC/ AC/0089 (Rev.0) with amendment No.1 or latest	As per RDSO approved sources

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SN	Description	Make
3	Blower fan motor with double extended shaft, as per RDSO specification No. RDSO/PE/SPEC/ AC/0089 (Rev.0) with amendment No.1 or latest	As per RDSO approved sources
4	High pressure cut out IP55	Danfoss/ Sporlan/ Alco/ Emerson
5	Low pressure cut out IP55	Danfoss/ Sporlan/ Alco/ Emerson
6	SS Body Thermostatic Expansion Valve with External Equalizer Solder connection	Danfoss/ Sporlan/ Emerson
7	Filter Drier – Solder connection	Danfoss/ Sporlan/ Emerson
8	Sight Glass with Moisture indicator Solder connection	Danfoss/ Sporlan/ Emerson
9	Service Valve/Pump Down Valve	Danfoss/ Sporlan/ Emerson
10	Charging Valve 1/4" (Solder x Flare connection)	Danfoss/ Sporlan/ Emerson
11	OHP	Danfoss/ Sporlan/ Emerson
12	MCBs	L&T/ Siemens/ Schneider/ ABB/ Legrand
13	MPCBs	L&T/ Siemens/ Schneider/ ABB
14	Contactors	L&T/ Siemens/ Schneider/ ABB/ BCH
15	Time Delay Relay	Schneider/ BCH/ WQ
16	Change over switch	Of Reputed make
17	Connectors with fire retardant halogen free inserts	As per CLW approved list
18	Electronic Thermostat/Solid state temp control to RDSO/PE/SPEC/AC/0020, (Latest Alt.)	A. Paul Instruments/Analog Electronics

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

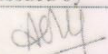
5.0 SAFETY FEATURES:

The safety requirements are of highest standards being an item of driving cab. Therefore, tenderers shall take all the possible protection against -

- 5.1 Malfunctioning/mal-operation by the untrained person or tampering. Proper warning levels shall be provided.
- 5.2 Adequate cross covers shall be applied so that it is impossible for human to contact any electrical connection, rotating parts of the motors etc even on the roof of the locomotive.
- 5.3 The roof-exposed part of the AC unit for the condenser air flow shall be protected with flat grill of sufficient size and thickness from which no foreign materials shall enter in the system from the roof of the cab.
- 5.4 There shall not be any sharp edges, corners, projected parts which may cause injury to the crew as well as maintenance staff on the roof.

6.0 MAINTAINABILITY:

- 6.1 The system shall be designed so that it will be in one unit which can be easily taken out from the top of the locomotive by opening of fixation bolts, electric power supply connection and drainage pipeline system.
- 6.2 The supplier shall give troubleshooting and maintenance booklet giving the system description, Bill of material, and the detailed instruction for periodic checking and maintenance of AC unit. No. of copies to be supplied shall be 10% of the no. of equipment ordered, subject to minimum of 2 copies per order. The periodicity of replacement of filters, filling up of refrigerants, replacement of certain items shall also be given by the supplier
- 6.3 The checking and replacement of assemblies/sub-assemblies of AC unit should be easily performed by removal of covers and without removal/opening of main components.

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7.0 INSPECTION AND TESTING:

7.1 Type test:

The following test shall be carried out on the A/C unit in presence of Indian Railway's representative as per relevant governing specifications as under:-

SN	Test description	Clause No.	Type test	Routine test	Acceptance test
1	Dimensional & Visual inspection	7.1.1	✓	✓	✓
2	Test for water tightness (Clause 7.1.2)				
	Rain test	7.1.2.1	✓	✓	✓
	Test for drainage of condensate water	7.1.2.2	✓	✓	✓
3	Electrical test (Clause 7.1.3)				
	Insulation resistance	7.1.3.1	✓	✓	✓
	High voltage test	7.1.3.2	✓	✓	✓
	Voltage change test	7.1.3.3	✓	✓	✓*
	Frequency change test	7.1.3.4	✓	✓	✓*
	High temp. startup test	7.1.3.5	✓	Ⓐ ✓	✓*
4	Cooling capacity test	7.1.4	✓	✓	✓*
5	Measurement of power	7.1.5	✓	✓	✓*
6	Heating capacity test	7.1.6	✓	✓	✓*
7	8 hrs running test	7.1.7	✓	Ⓐ ✓**	✓**
8	Noise Test	7.1.8	✓	-	-
9	Shock & Vibration Test	7.1.9	✓	-	-

Ⓐ Rev 2: High temp. startup test in cl.no. 7.1.3.5 and 8 hrs running test in cl.no. 7.1.7 shall be conducted on single unit of the lot offered (selected at random) during every routine tests.

Note: *Test shall be conducted on 20% unit of the lot offered selected at random, subject to minimum two nos.

** Tests shall be conducted on 10% unit of the lot offered selected at random, subject to minimum two nos.

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7.1.1 Dimensional & Visual Inspection

It shall be done for checking the overall dimensions, location of lifting hooks, material of filters, accessibility of blower motors, filters, thermostats & protective devices, quality of welding in AC unit. A measuring instrument/gauge to measure centre to centre distance of mounting bracket of the unit along the length & width to the unit shall be made available with the firm.

7.1.2 Test for water tightness

The AC Unit shall be tested for water tightness as per test arrangement and test programme described below:

7.1.2.1 Rain Test:



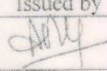
The water tightness of the body and electrical equipment boxes mounted outside the body shall be inspected at all opening, doors, covers, cover strips or crevices which might allow penetration of water or snow.

A distinction shall be made between the water tightness of openings (air inlet etc.), which depends primarily on erection and the condition of joints.

- i) A check on the water tightness of openings shall form type test. It shall be carried out for a period of 30 minutes with all fans running under artificial rain of intensity not less than 60 mm per minute. The angle of rain will be 45 degree towards evaporator compartment from condenser side.
- ii) A check on the water tightness of covers shall be conducted. It shall be carried out by means of a jet of 6 to 10 mm internal diameter, at a distance of 2 meters and a pressure of 1 bar with all fans running and then at a pressure of 3 bars with the fans stopped. The water shall be sprayed on each cover/side minimum for 15 minutes.
- iii) In each case, the penetration of water shall be slight, and shall not be of such nature as to have an adverse effect on cabling and electrical equipment, or any other equipment necessary for maintaining the vehicle in proper working order.

7.1.2.2 Test for drainage of condensate water:

The test will be conducted to see the efficiency of condensate water drain out system from the AC unit with blower motor in working condition.

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7.1.3 Electrical test**7.1.3.1 Insulation Resistance:**

Insulation resistance of compressor/motors shall not be less than 100 mega-ohms with DC 1000 V megger in all the weather conditions.

7.1.3.2 High Voltage test:

Test certificate from original equipment manufacturer (OEM) certifying the equipment to withstand a voltage of 1000 V AC for one minute shall be furnished.

7.1.3.3 Voltage Change test:

During the normal operation of the AC unit under cooling capacity test (Clause 7.1.4) condition, the power source voltage will be changed from 375 V AC to 460 V AC. The unit should be allowed to work for at least 10 min. at both the extreme voltages.

The AC unit shall operate without significant change of discharge & suction pressure and tripping of any protective device.

7.1.3.4 Frequency change test:



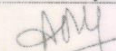
During the normal operation of the AC unit at standard condition, the power source frequency shall be changed to 47.5 to 52.5 Hz.

The AC unit shall operate without significant change of discharge & suction pressure and tripping of any protective device.

7.1.3.5 High temperature startup test:

The condenser side temperature shall be maintained at 60 deg. C. The AC unit shall be made to run for one hour as per condition specified below. The unit should work satisfactorily without tripping of any of the protective devices.

Test condition	Condition Created in Hot Chamber	Condition Created in Cold Chamber
Dry summer condition	60 deg. C (DB)	25 deg. C (DB) 16 deg. C (WB)

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7.1.4 Cooling Capacity test:

A) This test shall be made in following conditions :-

i) 50 deg. C temperature condition:

Test condition	Condition Created in Hot Chamber	Condition Created in Cold Chamber
Dry summer condition	50 deg. C (DB)	25 deg. C (DB)
	25 deg. C (WB)	16 deg. C (WB)

ii) 35 deg. C temperature condition:

Test condition	Condition Created in Hot Chamber	Condition Created in Cold Chamber
Dry summer condition	35 deg. C (DB)	25 deg. C (DB)
	25 deg. C (WB)	16 deg. C (WB)

B) Cooling capacity from evaporator side shall be calculated as under: -

$$C = \frac{60 \times Q \times (E2 - E1)}{S}$$

Where



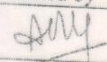
- C = Cooling capacity (K.cal/h) evaporator side.
 Q = Conditioned air quantity (m³/min) of evaporator blower fan.
 E1 = Enthalpy of supply air (Kcal/kg)
 E2 = Enthalpy of return air (Kcal/Kg)
 S = Specific volume of supply air m³/Kg.

C) Cooling capacity from condenser side shall also be determined as under:

$$Q_{tc} = \frac{1.02 \times 10^3 \times Q_v (te2 - te1)}{V_n} - E_t$$

Where

- Q_{tc} = Condenser side total cooling capacity (Watt)
 Te2 = Dry bulb temperature of air leaving equipment in °C
 Te1 = Dry bulb temperature of air entering equipment in °C
 Q_v = Measured condenser air flow in meter /sec.
 V_n = Specific volume of air at place of air flow measurement in m³ /kg dry air
 E_t = Total power input in watt.

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Note - The temperature reading shall be taken when the steady state condition is achieved. However, following variations in temperature measurement during capacity test under cooling as well as in heating mode shall be allowed.

Reading	Variation of arithmetical mean values from specified test conditions	Max. variation of individual reading from rating condition
Temp. of air entering indoor side	$\pm 0.3^{\circ}\text{C}(\text{DB})$	$\pm 1.0^{\circ}\text{C}(\text{DB})$
	$\pm 0.2^{\circ}\text{C}(\text{WB})$	$\pm 0.5^{\circ}\text{C}(\text{WB})$
Temp. of air entering outdoor side	$\pm 0.3^{\circ}\text{C}(\text{DB})$	$\pm 1.0^{\circ}\text{C}(\text{DB})$
	$\pm 0.2^{\circ}\text{C}(\text{WB})$	$\pm 0.5^{\circ}\text{C}(\text{WB})$

7.1.5 Measurement of power

In type test, total power input of the AC unit as well as to each of the motors shall be recorded during the normal operation of the AC unit under cooling capacity test.

7.1.6 Heating capacity test

Heating capacity of the AC unit should be $2.0 \text{ KW} \pm 5\%$.

7.1.7 8 Hrs Running Test



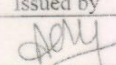
The AC unit should be made to run for 8 hrs continuously as per dry summer condition at 50°C temperature. The unit should work satisfactorily without any problem.

7.1.8 Noise Test

Maximum permissible noise level of the air conditioning unit shall be 78 dB A approx. under normal operating condition, when measured 24 inches to each side of the air conditioning unit and 30 inches below the center point of each evaporator air discharge grill.

7.1.9 Shock and vibration tests

Shock and vibration tests shall be got carried out by the manufacturer from NABL approved/recognized laboratory as per IEC 61373 (latest) under the category 1 class A, location M as given in annexure C to above mentioned IEC. Details are given as below:-

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Vibration Test: (As per fig no. 1 of IEC 61373)

Test	Frequencies	Orthogonal Plane	Duration (not less than 10 Min)	ASD level (m/s ² /Hz)	RMS Value m/s ²
Functional Random Test	5-150 Hz	Vertical	10 Min	0.0164	0.75
		Transverse	10 Min	0.0041	0.37
		Longitudinal	10 Min	0.1073	0.50
Simulated Long Life Test	5-150 Hz	Vertical	5 h	1.034	5.9
		Transverse	5 h	0.250	2.9
		Longitudinal	5 h	0.452	3.9



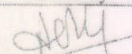
Shock Test: (As per fig no. 6 of IEC 61373)

Test	No. of shock	Orthogonal Plane	Duration	Peak Value m/s ²	Type of shocks
Shock Test	18	Vertical	30 ms	30	3 positive & 3 negative
		Transverse	30 ms	30	3 positive & 3 negative
		Longitudinal	30 ms	50	3 positive & 3 negative

After the test there shall be no resulting damage, abnormality in the operation of equipment.

The AC unit is subjected to pass shock and vibration test as per IEC from any NABL accredited approved reorganized laboratory. The manufacturer shall submit complete detailed report to RDSO. The test shall be conducted in energized conditioned.

- 7.2 The degree of protection for enclosure for condenser fan motor and blower fan motor shall be IP56 (TEFC) as per IEC-60529 and the test certificate shall be furnished by motor manufacturers in this regard.
- 7.3 The test sample plan would be finalized as mutually agreed upon between suppliers and purchasers.

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

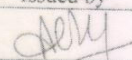
- 7.4 Suppliers shall allow all the testing at their premises and shall arrange type test from outside agencies for which inside facilities with the suppliers are not available. Type test and routine test shall be done at the manufacturer's cost.
- 7.5 The suppliers shall indicate their compliance against each clause and sub clause of the technical specification and submit with the offer.

8.0 MARKING AND PACKAGING:

- 8.1 The air conditioning system shall be constructed in workman like manner.
- 8.2 Each air conditioning system shall be provided with a plate displaying the following information:
- a) Manufacturer's name
 - b) Type and serial number
 - c) Important rating
 - d) Month and year of manufacturing
 - e) Refrigerant used
 - f) Refrigerant quantity
 - g) Weight
- 8.3 All units shall be packed with waterproof packing in boxes/Crate to prevent any damage during transit and handling.

9.0 APPROVAL OF DESIGN/DRAWING:

- 9.1 The supplier shall submit design details of equipment, electrical circuit diagrams, and layout drawings showing important dimensions and location of equipment of A/C system for approval before offering unit for prototype inspection. Approval of the drawings would mean approval of general adaptability of design features to the specified condition of service. RDSO will not be responsible for the correctness of the dimensions in the drawings the adequacy of the designs for the satisfactory performance of the equipment etc. for which the supplier shall be wholly and completely responsible. The supplier shall submit relevant performance data and ratings, calculations, technical specifications, test results and relevant equipment drawings and descriptive write up etc. necessary for correct appreciation. The supplier shall also submit Heat loss calculations along with their offer for evaluation.

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- 9.2 Based on provisional approval of design/drawings, prototype unit shall be manufactured after incorporating all the modifications found necessary during inspection / testing without any additional charges.

10.0 COMMISSIONING OF AC IN LOCOMOTIVES:

Suppliers shall commission all or few AC units in the locomotives as mutually agreed upon between purchasers and suppliers. Suppliers shall provide necessary manpower for commissioning in locomotives. However, assistance for handling, mounting, welding of structure etc. will be provided by purchasers.

11.0 TRAINING OF INDIAN RAILWAY PERSONAL:

The supplier shall arrange for free of cost training to Indian Railway's personal in operation, maintenance covering installation, commissioning, maintenance and trouble shooting of the system.

12.0 INFRINGEMENT OF PATENT RIGHTS:

Indian Railways shall not be responsible for infringement of Patent rights arising due to similar design, manufacturing process, use of components, used in design & development and any other factors, which may cause such dispute. The responsibility to settle any such issue lies with the manufacturer.

13.0 FIELD TRIAL:

One prototype cab AC unit shall be subjected to field trials on IR for at least three months. The manufacturer shall depute a team of engineers for commissioning testing and field trials of the cab AC unit in service. The manufacturer shall associate in the field trials jointly with IR. The manufacturer shall ensure availability of typical tools & spare parts in adequate quantity for field trials to be done as part of commissioning.

14.0 MAINTENANCE OF THE CAB AC UNIT:



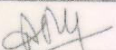
- 14.1 The details of failures, action taken to arrest re-occurrence of similar failure in future, failure analysis report etc. shall be submitted to CLW and purchaser Railways.
- 14.2 In case of repeated failures, necessary changes in design on the units put in service or in production line shall be made by the manufacturer in consultation with RDSO. Investigation tests, if considered necessary, shall be arranged / conducted by the manufacturer.

Prepared by	Checked by	Issued by
<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>

15.0 OTHERS:

- 15.1 **Development:** This specification has been prepared keeping in view the development of air conditioning system to increase the level of comfort for crew. The development of such a system over IR in electric locomotives shall need more rugged, reliable and latest technology being used worldwide. Tenderers may quote some alternative design also for future application. The offer of the tenderers should have all the details documentation pertaining to design, manufacturing, commissioning and maintainability of the air conditioning system they are proposing for installation in electric locomotives.

.....X.....

Prepared by	Checked by	Issued by
		

P.K. RUIDAS	DRAWN	CHECKED	SSE/D	AEE/D-1
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REF: RDSO'S SPEC. NO
RDSO/2007/EL/SPEC/0055
(REV-1)

Rev-1
15/15
Dy.C.E.E.(D.F)

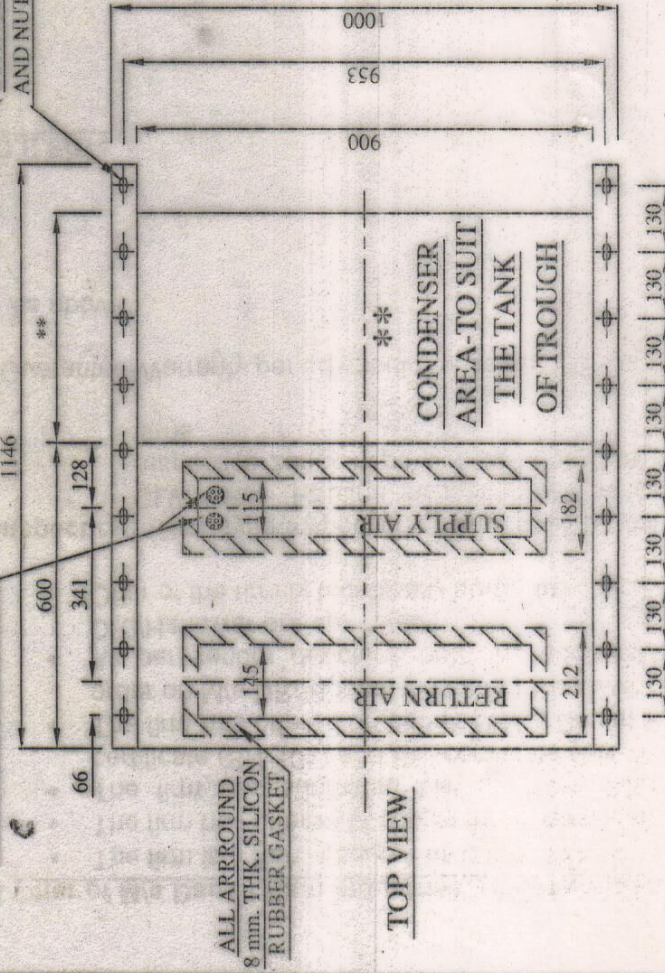
CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA.
DRG.No. CLW/ES/SK-1/A-15/X B
DT:- 06 / 05/2015

AIR CONDITIONING M/C

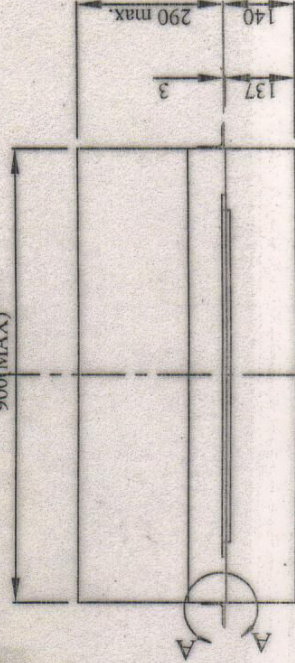
CLW

LOCATION FOR POWER
AND CONTROL COUPLERS

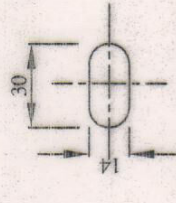
18 NOS 14 DIA OBLONG HOLES FOR FIXING AC UNIT WITH TROUGH
(SUITABLE SIZE OF PLAIN WASHER, SPRING WASHER
AND NUT TO BE SUPPLIED BY THE FIRM)



TOP VIEW



FRONT VIEW



DETAIL OF MOUNTING HOLES

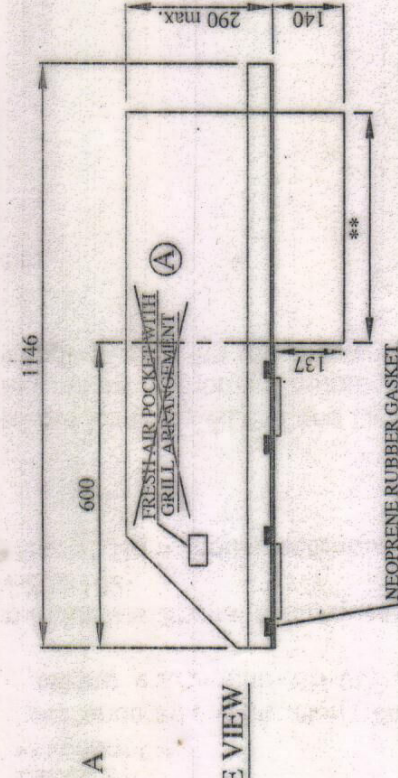


DETAIL A-A

DETAIL OF ALIGNMENT MACHINE AND MOUNTING ANGLE

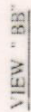
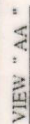
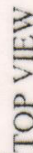
NOTE:-

1. ALL DIMENSIONS ARE IN mm.
2. TOLERANCE : FIXING HOLE CENTRES + 0.5 mm
OTHER DIMENSIONS ± 1 mm
3. DIMENSIONS OF AC UNIT SHOULD BE MAINTAIN TO SUIT THE
TROUGH DESIGN AS SHOWN IN DRG. NO-CLW/ES/SK-2/A-15
4. THE DIMENTION OF CONDENSER AREA WILL BE TO SUIT THE TANK OF TROUGH
5. UPPER HEIGHT OF THE MACHINE (290 max.) LOWER THAN 290 WILL BE APPRICIATED



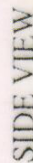
SIDE VIEW

Ⓐ

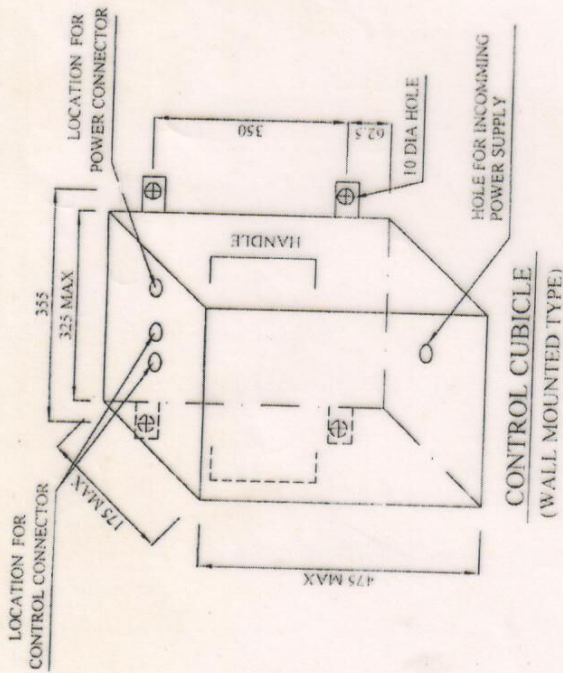


NOTE:-

1. ALL DIMENSIONS ARE IN mm. EXCEPT SEPARATELY INDICATED
2. TOLERANCE : FIXING HOLE CENTRES ± 0.5 mm.
3. OTHER DIMENSIONS ± 1 mm.
3. 18 NOS. M8 X 40 LG CSK SCREW TO BE USED FOR FIXING
AC UNIT WITH TROUGH
4. TROUGH WILL BE MADE OF 3 MM THICK
SS SHEET TO AISI 304



○ 22
13



CONTROL CUBICLE SHOULD HAVE THE FOLLOWING INDICATION

MAIN - ON
BLR - ON
COMP. ON
TRIP- HP, LP, OHP, COMP, VR

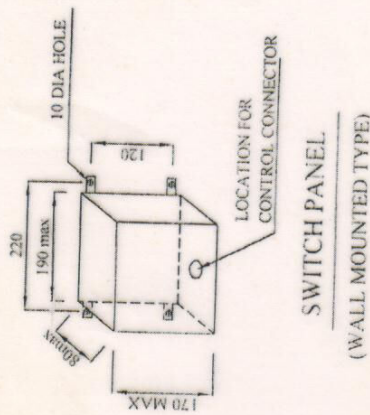
(A) SUPPLY

NOTE-

1 ALL DIMENSIONS ARE IN mm.

2 TOLERANCE - FIXING HOLE CENTRES + 0.5 mm OTHER DIMENSIONS + 1.4mm

3. CONTROL CUBICLE SHOULD BE MADE OF (SS-304) AND SWITCH PANEL (MS WITH POWDER COATED SIEMENS GRAY IN COLOUR.)



SWITCH PANEL SHOULD HAVE THE FOLLOWING INDICATION

AC UNIT - ON
COOLING - ON
HEATING - ON
AUTO - ON
MANUAL - ON
EARTH FAULT - ON

(A)

CL. NO - 3.4C
OF SPEC.

A.K.SEN
P.K.DHAR
CHECKED
SSE/D
AEE/D-III

REF. :- RDSO'S SPEC. NO.
RDSO/ 2007/EL/SPEC/ 0055 (REV. 2)

Dy C.E.E.(D-I)
3/10

CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA.
DRG.No. CLW/ES/SK-3/A-15/A Date:- 17/10/2014

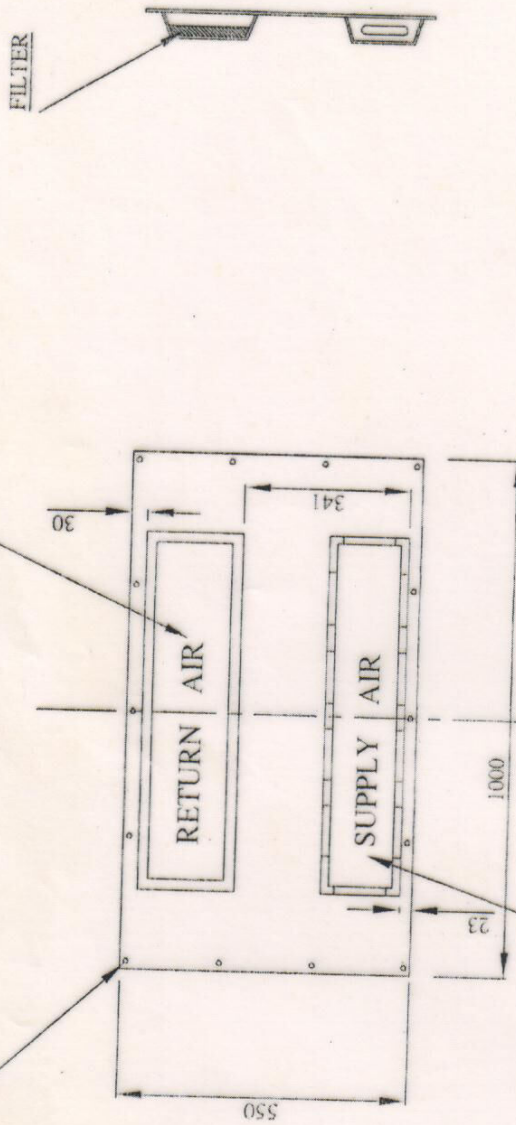
G.A. DRAWING FOR
CONTROL AND
SWITCH PANEL

CLW

10mm DIA HOLE TO BE DONE BY USER SUITABLY (A)

(TRAY FOR GRILL ARRANGEMENT TO BE FIXED WITH CAB CEILING BY WOOD SCREW)

LOCATION FOR RETURN AIR, FITTED WITH FILTER



LOCATION FOR SUPPLY AIR, FITTED WITH MANUAL ADJUSTABLE GRILL, ARRGT.

DIRECTIONAL POSITION OF THE TANK OF TROUGH

NOTE:-

1. ALL DIMENSIONS ARE IN mm.
2. TOLERANCE : FIXING HOLE CENTRES + 0.5 mm OTHER DIMENSIONS ± 1 mm.

(A) 3. MATERIAL FOR GRILL ARRANGEMENT FIRE RETARDED GLASS FIBER, COLOUR: SIEMENS GRAY

REF. :- RDSO'S SPEC. NO.
RDSO/2007/EL/SPEC/0055 (REV. 1)

Dy.C.E.E.(D-1)

CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA.

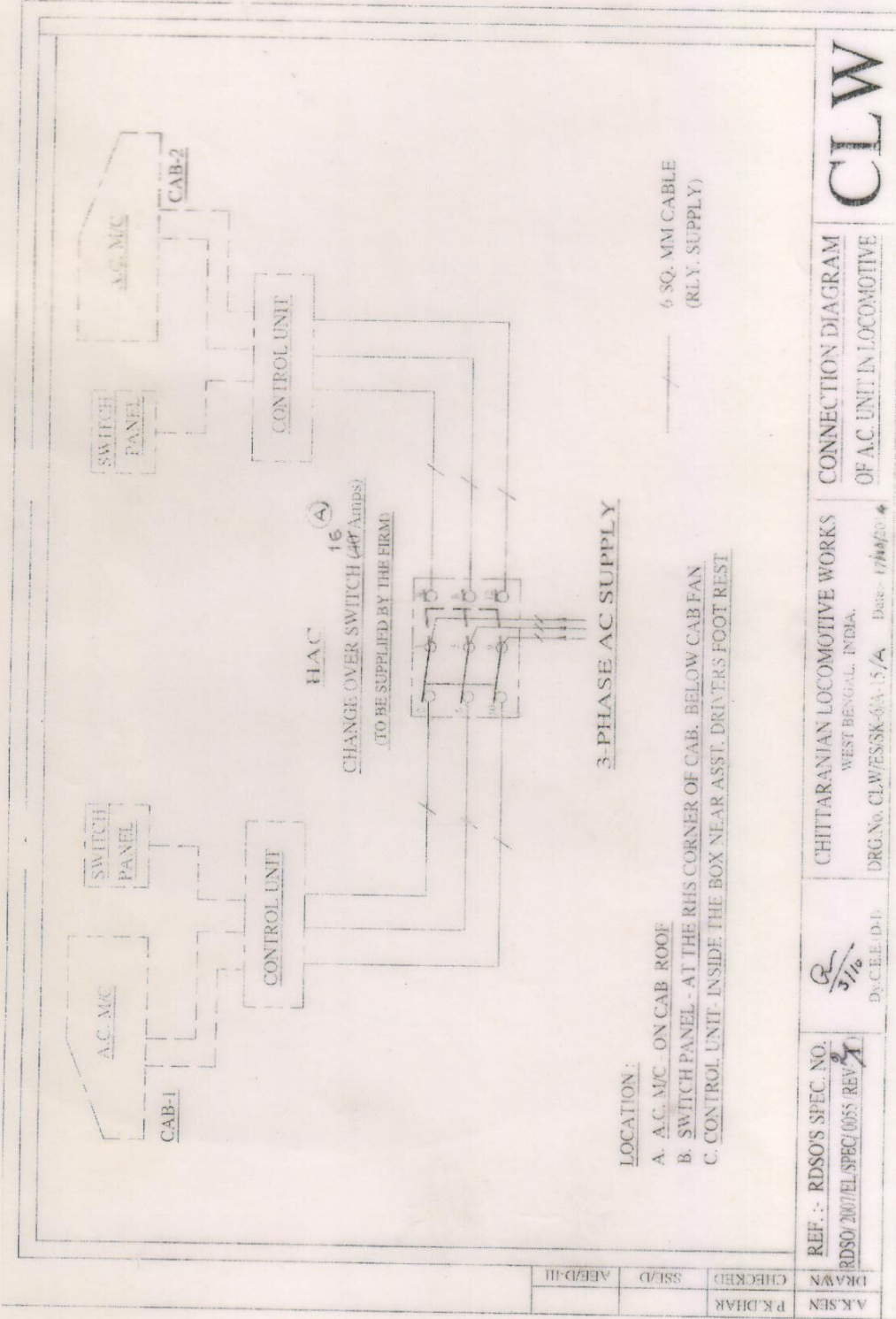
DRG.No. CLW/ES/SK-4/A-15/A Date:- 17/09/2014

GRILL ARRANGEMENT
FOR A.C. UNIT

CLW

P.K.DHAR
CHECKED
SSE/D
AEE/D-III

A.K.SEN
DRAWN



1/3

Pin allocation details of control harness for connection between A.C.M/c and Control Unit (Female coupler towards Control Unit and Male coupler toward M/c side, will be fixed at harnessed cables) 16 pin connectors, Mill Grade, shell size 24 shell (OD:43.4mm); make:CLW approve source.

Pin number	Wire number	Particulars
A	23	OHP outgoing
B	22	OHP incoming
C	19	LP outgoing
D	18	LP incoming
E	18	HP outgoing
F	17	HP incoming
G	-	-
H	30	To return air sensor
J	31	To return air sensor
K	35	OHP Trip
L	39	LP Trip
M	40	HP Trip
N	11	VR incoming
P	46	VR Trip
R	47	VR outgoing
S		

Deleted (A)

2/3

Pin allocation details of power harness for connection between A.C.M/c and Control Unit (Female coupler towards Control Unit and Male coupler towards M/c side, will be fixed at harnessed cables) 14 pin connectors, Mill Grade, shell size 20 shell (OD:37.3mm); make:CLW approve source.

Pin number	Wire number	Particulars
A	101	BLOWER
B	102	
C	103	
D	107	COMPRESSOR
E	108	
F	109	
G	104	CONDENSER
H	105	
I	106	
J	110	HEATER
K	111	
L	112	

(B) 3/3

Pin allocation details of control harness for connection between Control Unit and switch panel (Female coupler towards Control Unit and Male coupler towards switch panel, will be fixed at harnessed cables) 16 pin connectors with 'X' orientation, Mill Grade, shell size-24 shell (OD 43.4mm); make:CLW approve source.

Pin number	Wire number	Particulars
A	10	In put
B	11	To BLR Aux. Contractor
C	13	From BLR Aux. Contractor
D	25	To Thermostat
E	21	From thermostat heating point
F	14	From thermostat cooling point
G	15	Neutral for indicating light
H	38	Comp. Trip
J	39	LP Trip
K	40	HP Trip
L	48	BLR On
M	41	Comp. On
N	34	HTR On

(B)

Connectors will be Fire Retardent Halogen Free

<p>Ref.: RDSO's Spec. No. RDSO/2007/EL/SPEC./0055 (Rev.1) 2</p>	<p>CHITTARANJAN LOCOMOTIVE WORKS Date:06/05/2015 Drg.No.CLW/ES/SK-07/A15/B</p>	<p>PIN ALLOCATION DETAILS</p>
<p>SE AEE/D-I</p>	<p>11/5/15 Dy.CEE/D-I</p>	