Technical specification

For Roof Mounted Air Conditioning System in the cabs of Electric Locomotives

This Specification supersedes

Specification No: RDSO/2007/EL/SPEC/0055, Rev-2

Enclosure :

Drawing No: (i) CLW/ES/3/SK-1/0678
(ii) CLW/ES/3/SK-2/0678
(iii) CLW/ES/3/SK-3/0678
(iv) CLW/ES/3/SK-4/0678
(v) CLW/ES/3/SK-5/0678
(vi) CLW/ES/3/SK-6/0678

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ISSUED BY:

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ALTERATION SHEET

SL. NO.	DATE	PAGE No.	Rev-	DESCRIPTION	REMARKS (SIGN.)
1.					
2.					
3					
4					

NOTE: THIS SPECIFICATION HAS BEEN PREPARED ON THE BASIS OF RDSO SPECIFICATION NO: RDSO/2007/EL/SPEC/0055, Rev-2 and **SUPERSEDES THE EARLIER RDSO SPECIFICATION NO:** RDSO/2007/EL/SPEC/0055, Rev-2.

"Specifications have been digitized and all existing alterations modifications have been incorporated"

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SPECIFICATION FOR ROOF MOUNTED AIR CONDITIONING SYSTEM

1.0 INTRODUCTION:

Presently, the cabs of electric locomotives are equipped with 2 numbers cab fan and 2 numbers cab heater 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.

2.0 DESCRIPTION OF THE SYSTEM:

2.1 Fabrication: The AC unit shall be fabricated out of stainless-steel SS-304.

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 Aluminum of suitable design in 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.

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 aluminum 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.

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.

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 conditioning circuit.

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~~.

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.~~

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 to the return air. Grill should be made of fire-retardant fiber glass material. The Grill arrangement should be fixed from the bottom of the unit as per fixing arrangement given in CLW drawing No. CLW/ES/3/SK-4/0678 (Latest Alteration), by which the filter assembly can be easily taken out from the cab for routine filter cleaning.

2.9 Air filter should be Non-Woven G3 type air Filter or filter approved by CLW/BLW.

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2.10 Air Deflectors – Rotary type vent port of ABS or alike material. Air deflector opening should be not less than blower supply duct size and capable to deflect conditioned Air around the cab.

2.11 An insulation of layer of 06mm thick class -O Nitrile Foam insulation to be pasted inside the grill for improving thermal insulation and minimize the condensation.

2.12 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/3/SK-1/0678 (Air conditioning M/c), CLW/ES/3/SK-2/0678 (Trough for AC unit), CLW/ES/3/SK-3/0678 (control cubical and switch panel) and CLW/ES/3/SK-4/0678 (Grill Arrangement).

3.0 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	Upto 100% during rainy season
Altitude	Upto 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 thunderstorm 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:	1. Maximum PH Value : 8.5 2. Sulphate Concentration: 7 mg/liter 3. Max. concentration of Chlorine: 6 mg/liter 4. Max. Conductivity: 130 micro siemens/cm

4.0 Vibration & Shock:

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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.

5.0 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 :-

SL No.	Item Description
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 cult
12	Low pressure cut
13	Return Air Filter
14	Copper Piping
15	Control Cubicle comprise 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)
22	Grill arrangement for AC system shall be supplied separately as per Drawing no- CLW/ES/3/SK-4/0678

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

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6.0 GENERAL DESIGN REQUIREMENTS:

6.1 The compact unit shall have following performance parameters: -

(a) Cooling Capacity: Not less than 2 TR (~~6045K.cal/hr~~) at 35 °C ambient.

Not less than 1.5 TR (~~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 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 the 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 chocked.

(f) Montreal protocol approved R-407c should be used as refrigerant.

g) Brazing joints should be secured to prevent probable refrigerant leakage and brazing joint covered with black paint coating to reduce copper oxidation. As well as proper clamping of copper tube and components shall be done.

h) Blower & motor mounting should be secured to prevent abnormal sound. Also, compressor should be secured with suitable clamping to reduce vibration.

6.2 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 ±3%. Suppliers shall design their motors i.e compressor, condenser fan, blower fan etc. to work on 3-Phase AC power supply.

(b) Manufacturer shall provide delay start feature for 180 Sec in their control system to protect the compressor.

6.3 Control Cubicle:

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

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

(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 SS-304. 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.

6.4 Switching Panel:

(a) The switching panel will be as per latest alteration of CLW drawing no. CLW/ES/SK-3/0678. 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 four positions i.e. OFF, Auto Mode, Manual cooling, Manual Heating.

(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.

7.0 **SPECIAL FEATURES**:

7.1 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.

7.2 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. Scope of supply of Trough is optional as it is a part of CAB.

7.3 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 KW± 5% at 35 ºC ambient.

7.4 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 KW ± 5%.

7.5 Actual weight of air conditioning unit should not exceed ~~150 kg~~ 170 Kg without trough.

7.6 Cables shall be crimped at both ends with suitable terminal lugs; interlocked type cable markers shall be provided to identify a particular cable.

7.7 Silver brazed joints/fused for connecting terminal leads and winding wires shall be used for motors. Soldered joints are not acceptable.

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7.8 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.

7.9 The compressors shall be provided with high flow 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.

7.10 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 of control circuit.

7.11 All the hardware used, shall be AISI 304 or A4 (316) standard having metric threads only.

7.12 Three terminals for supply connections shall be brought out in a terminal box on the side of motor. The terminals shall be clearly marked/color 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. Condenser Fan motor and its cable connection terminal box/ Junction Box should be IP 67 or more.

7.13 Terminal connections should be ensured by wago connectors/suitable arrangement.

7.14 The procurement of components should be done from OEM or sources given below. In case of deviation prior approval of CLW/BLW will have to be taken

SN	Description	Make
1	Hermetically sealed scroll Compressor	~~Emerson Climate ZR28K3E-TFD-522~~ Should be of reputed make with warranty should be 10 years (BLW & Hind Rectifier)
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.~~ Should be of reputed make with warranty should be 05 years
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.~~ Should be of reputed make with warranty should be 05 years
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	~~Slight Glass with moisture indicator Solder connection.~~	~~Danfoss/ Sporlan /Emerson~~ As the item fitted top of the AC unit and not used practically
9	Service Valve/Pump Down Valve	Danfoss/ Sporlan /Emerson
10	Charging Valve ¼ (Solder * Flare connection)	Danfoss/ Sporlan /Emerson

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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	Connector 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

7.15 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.

8.0 **SAFETY FEATURES**:

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

8.1 Malfunctioning/mal-operation by the untrained person or tempering. Proper warning levels shall be provided.

8.2 Adequate cross covers shall apply, so that it is impossible for human to contact any electrical connections, rotating parts of the motor etc. even on the roof of the locomotives.

8.3 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.

8.4 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.

9.0 **MAINTAINABILITY**:

9.1 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 or fixation bolts, electric power supply connection and drainage pipeline system.

9.2 The supplier shall give troubleshooting and maintenance booklet giving the system description, Bill of the 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.

9.3 The checking and replacement of assemblies/sub-assemblies of AC unit should be easily performed by removal of covers and without/opening of main components.

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10.0 **INSPECTION AND TESTING:**

10.1 **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	10.1.1	√	√	√
2	Test for water tightness (Clause 10.1.2)				
2.1	Rain test	10.1.2.1	√	√	√
2.2	Test for drainage of condensate water	10.1.2.2	√	√	√
3	Electrical test (Clause 10.1.3)				
3.1	Insulation resistance	10.1.3.1	√	√	√
3.2	High voltage test	10.1.3.2	√	√	√
3.3	Voltage change test	10.1.3.3	√	√	√*
3.4	Frequency change test	10.1.3.4	√	√	√*
3.5	High temperature startup test	10.1.3.5	√	√**	√**
4	Cooling capacity test	10.1.4	√	√	√*
5	Measurement of power	10.1.5	√	√	√*
6	Heating capacity test	10.1.6	√	√	√*
7	8 hrs Running test	10.1.7	√	√**	√**
8	Noise test	10.1.8	√	-	-
9	Shock & Vibration test	10.1.9	√	-	-

Note:(*) Test shall be conducted on 20% unit of the lot offered selected at random, subject to minimum two (02) nos.

(**) High temp start up test in cl no. 10.1.3.5 and 8 hrs. running test in cl.no. 10.1.7 shall be conducted on single unit of the lot offered. (selected at random) during every routine test and Acceptance Test.

10.1.1 **Dimensional and Visual Inspection**

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

10.1.**2 Test for water tightness**

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

10.1.2.1 **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.

10.1.2.2 **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.

10.1.3 **Electrical test**

10.1.3.1 Insulation Resistance:

Insulation resistance of compressors motors shall not be less than 100 megaohms with DC 1000 V megger in all the weather conditions.

10.1.3.2 High Voltage test:

Test certificate from original equipment manufacturer (OEM) certifying the equipment to withstand a voltage of 1000 V AC for 1 minute shall be furnished.

10.1.3.3 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.

10.1.3.4 Frequency change test:

During the normal operation of the AC unit at standard condition, the power sources 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.

10.1.3.5 High temperature startup test:

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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 satisfactory without tapping 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)

10.1.4 **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 (WB)	25 deg C (DB) 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 (WB)	25 deg C (DB) 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 (m^3/min) of evaporator blower fan

E1 = Enthalpy of supply air (K.Cal/kg)

E2 = Enthalpy of return air (K.Cal/kg)

S = Specific volume of supply air

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

$$Qtc = \frac{1.02 \times 10^3 \times Qv\ (te2-te1)}{Vn} - Et$$

where

Qtc = Condenser side total cooling capacity (watt)

Te2 = Dry bulb temperature of air leaving equipment in ºC

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Te1 = Dry bulb temperature of air entering equipment in ºC

Qv = Measured condenser air flow in meter/sec

Vn = Specific Volume of air at place of air flow measurement in m^3/kg dry air

Et = Total power input in watt

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	± 0.3ºC (DB) ± 0.2ºC (WB)	± 1.0ºC (DB) ± 0.5ºC (WB)
Temp. of air entering outdoor side	± 0.3ºC (DB) ± 0.2ºC (WB)	± 1.0ºC (DB) ± 0.5ºC (WB)

10.1.5 **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.

10.1.6 **Heating capacity test**

Heating capacity of the AC unit should be 2.0 KW ± 5%

10.1.7 8 **Hrs Running Test**

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

10.1.8 **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.

10.1.9 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:-

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

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		Longitudinal	10 min	0.1073	0.50
Stimulated 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 negatives
		Transverse	30 ms	30	3 positive & 3 negatives
		Longitudinal	30 ms	50	3 positive & 3 negatives

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

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

10.2 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.

10.3 The test sample plan would be finalized as agreed between suppliers and purchasers.

10.4 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.

10.5 The suppliers shall indicate their compliance against each clause and sub clause of the technical specifications and submit with the other.

11.0 **MARKING AND PACKAGING**:

11.1 The air conditioning system shall be constructed in workman like manner.

11.2 Marking of AC supplier with proper identification on each components of cab AC and peripherals including Harnessed Cable.

11.3 Each air conditioning system shall be provided with plate displaying the following information:

a) Manufacturer's name

b) Type and serial number

c) Important Rating

d) Month and year of manufacturing

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e) Refrigerant used

f) Refrigerant quantity

g) Weight

11.4 All units shall be packed with waterproof packing in boxes/crate to prevent any damage during transit and handling.

12.0 **APPROVAL OF DESIGN/ DRAWING:**

12.1 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 offerings 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.

12.2 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.

13.**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.

14.0 **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 shouting of the system.

15.0 **INFRINGEMENT OF PETENT 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 and development and any other factors, which may cause such disputes. The responsibility to settle any such issue lies with the manufacturer.

16.**0 MAINTENANCE OF CAB AC UNIT:**

16.1 The details of failures, actions taken to arrest re-occurrence of similar failure in future, failure analysis report etc. shall be submitted to CLW and purchaser Railways.

16.2 In case of repeated failures, necessary changes in design on the units put in service or in production line shall be made by manufacturer in consultation with RDSO. Investigation tests, if considered necessary, shall be arranged/conducted by the manufacturer.

16.3 Warranty: Warranty of complete AC shall be 05 years.

17.0 **OTHERS**:

17.1 **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.

DRAFT

ANNEXURE

1. PIN Allocation details of **control harness** for connection between **A.C. Machine** and **Control Unit** (Female coupler towards Control Unit and Male coupler toward machine side, will be fixed at harnessed cables), 16 Pin Fire retardant halogen free connector, shell size 24 shell (OD:43.4 mm). Make: CLW approved sources.

Pin Numbers	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	-
P	46	-
R	47	-
S	-	-

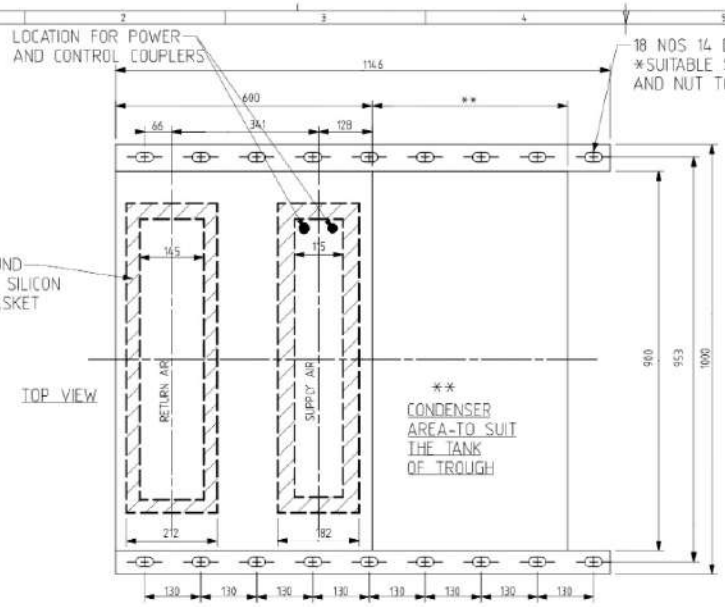
2. Pin allocation details of **power harness** for connection between **A.C. Machine** and **Control Unit** (Female coupler towards control unit and male coupler toward machine side, will be fixed at harnessed cables), 14 Pin Fire retardant halogen free connector, shell size 20 shell (OD:37.3 mm) . Make: CLW approved sources

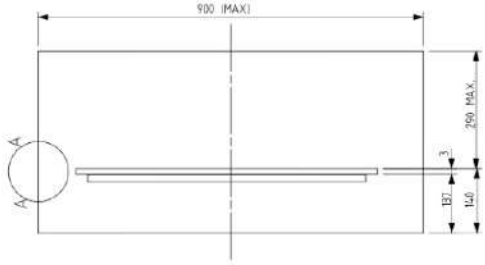
Pin Numbers	Wire Number	Particulars
A	101	BLOWER
B	102	
C	103	
D	104	COMPRESSOR
E	105	
F	106	
G	107	CONDENSER
H	108	
I	109	
J	110	HEATER
K	111	
L	112	

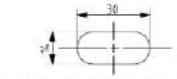
3. PIN allocation details of control harness for connection between **Control Unit and Switch panel** (Female coupler towards Control Unit and Male coupler toward switch panel, will be fixed at harnessed cables), 16 Pin Fire retardant halogen free connector with 'X' orientation, shell size 24 shell (OD:43.4 mm). Make: CLW approved sources.

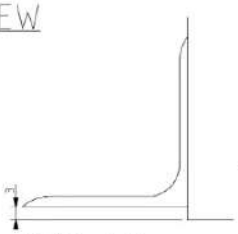
Pin Numbers	Wire Number	Particulars
A	10	INPUT
B	11	To BLR Aux. Contractor
C	13	From BLR Aux. Contractor
D	25	To Thermostat
E	21	From thermostat heating point
F	14	From thermostat Cooling point
G	15	Neutral for indicating light
H	38	Comp. Trip
J	39	LP Trip
K	40	HP Trip
L	48	BLR ON
M	41	Comp. ON
N	34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

DRAFT

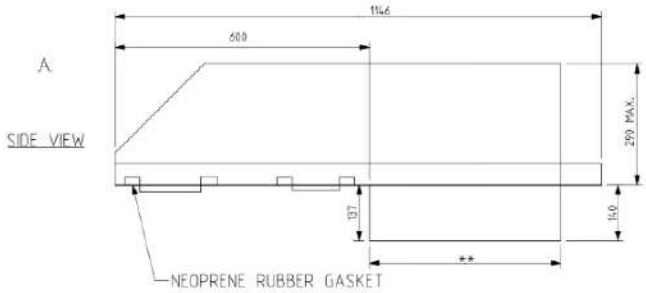








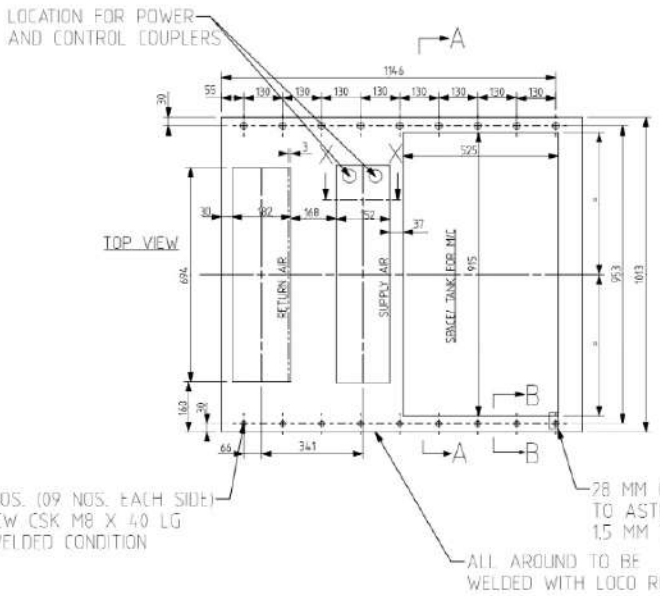
DETAIL OF ALINMENT MACHINE AND MOUNTING A

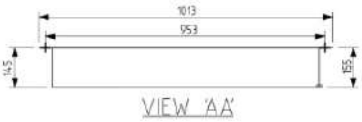


NOTE :-
1. ALL DIMENSIONS ARE IN MM.
2. TOLERANCE: FIXING HOLE CENTRES +0.5 MM
OTHER DIMENSIONS ± 1 MM.
3. DIMENSION OF AC UNIT SHOULD BE MAINTAIN TO SUIT THE TROUGH DESIGN AS SHOWN IN DRG. NO-CLW/ES/3/SK-2/0678.
4. THE DIMENSION OF CONDENCER AREA WILL BE TO SUIT THE TANK OF TROUGH.
5. UPPER HEIGHT OF THE MACHINE (290 MAX.) LOWER THAN 290 WILL BE APPRICIABLE.

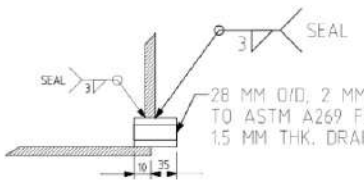
	चित्तरंजन रेलइंजन कारखाना CHITTARANJAN LOCOMOTIVE WORKS, INDIA
DESCRIPTION	AIR CONDITIONING M/C
DRAWING NO.	CLW/ES/3/SK-1/0678
ALTERATION NO.	SHEET 1 OF 1 — A2

INDICATIVE PURPOSE ONLY

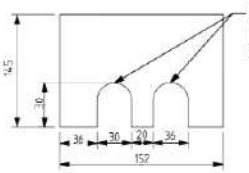




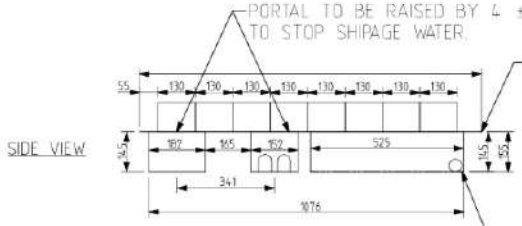
VIEW 'AA'



VIEW 'BB'



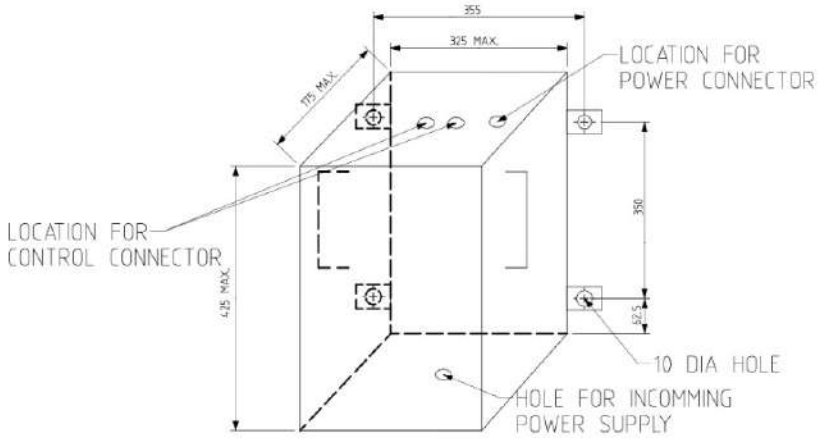
VIEW 'XX'



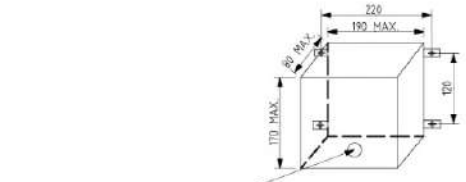
NOTE :-

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

	चित्तरंजन रेलइंजन कारखाना CHITTARANJAN LOCOMOTIVE WORKS, INDIA		
	DESCRIPTION	TROUGH FOR A.C. UNIT (OPTIONAL)	
	DRAWING NO.	CLWES/3/SK-2/0678	
	ALTERATION NO.	SHEET 1 OF 1	A2



CONTROL CUBICLE
(WALL MOUNTED TYPE)



SWITCH PANEL
(WALL MOUNTED TYPE)

NOTE -

1. ALL DIMENSIONS ARE IN MM.
2. TOLERANCE FIXING HOLE CENTRES +0.5 MM OTHER DIMENSIONS +1 MM.
3. CONTROL CUBICLE SHOULD BE MADE OF SS-304 AND SWITCH PANELTO BE MADE OF MS WITH POWDER COATED SIEMENS GRAY IN COLOUR/SS-304.

चित्तरंजन रेलइंजन कारखाना
CHITTARANJAN LOCOMOTIVE WORKS, INDIA

DESCRIPTION: G.A. DRAWING FOR CONTROL AND SWITCH PANEL

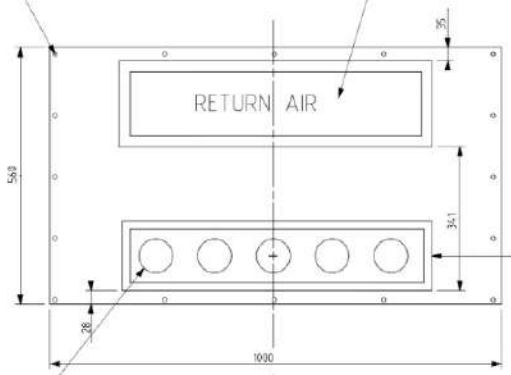
DRAWING NO. CLWES/3/SK-3/0678

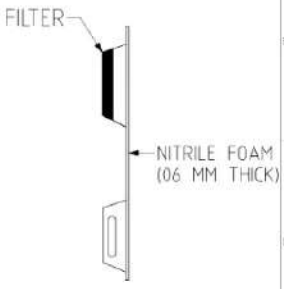
SHEET 1 OF 1 | A2

10 MM. DIA HOLE TO BE DONE BY USER SUITABLY

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

LOCATION FOR RETURN AIR. FITTED WITH FILTER





LOCATION OF SUPPLY AIR FITTED WITH MANUAL ADJUSTABLE ROTARY TYPE VENT PORT.

DIRECTIONAL POSITION OF THE TANK OF TROUGH

NOTE -

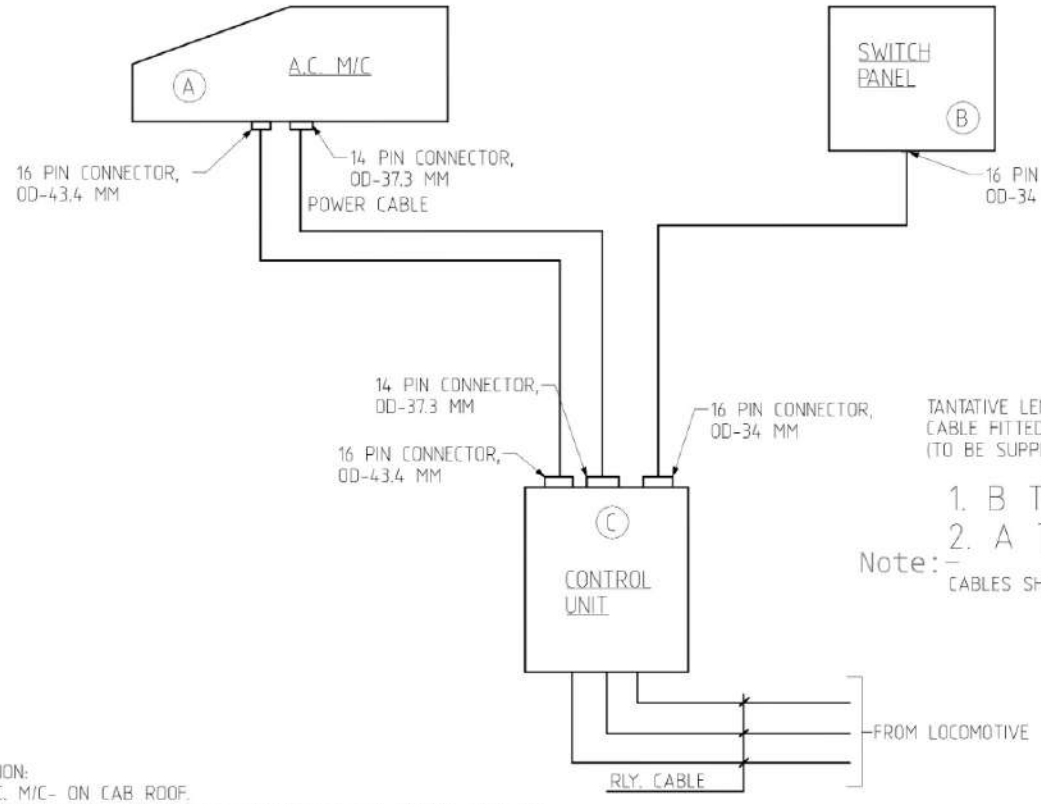
1. ALL DIMENTIONS ARE IN MM.
2. TOLERANCE : FIXING HOLE CENTRES +0.5 MM OTHER DIMENSIONS ±1 MM.
3. MATERIAL FOR GRILL ARRANGEMENT FIRE RETARDENT GLASS FIBER, COLOUR : SIEMENS GRAY.
4. ~~GRILL DIMENSION HAS BEEN REVISED.~~
5. NITRILE FOAM INSULATION, 6 MM., CLASS-O TO BE PASTED INNER SIDE OF THE GRILL ARRANGEMENT.
6. MINIMUM 05 NOS. VENT PORT TO BE PROVIDED FOR SUPPLY AIR.

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CHITTARANJAN LOCOMOTIVE WORKS, INDIA

GRILL ARRANGMENT FOR A.C. UNIT

CLWES/3/SK-4/0678

A2



TANTATIVE LENGTH OF HARNESSED CABLE FITTED WITH COUPLER (TO BE SUPPLIED BY FIRM)

1. B TO C - 12 M.
2. A TO C - 5.5 M.

Note:-
CABLES SHOULD BE COVERED WITH EIT JACKET

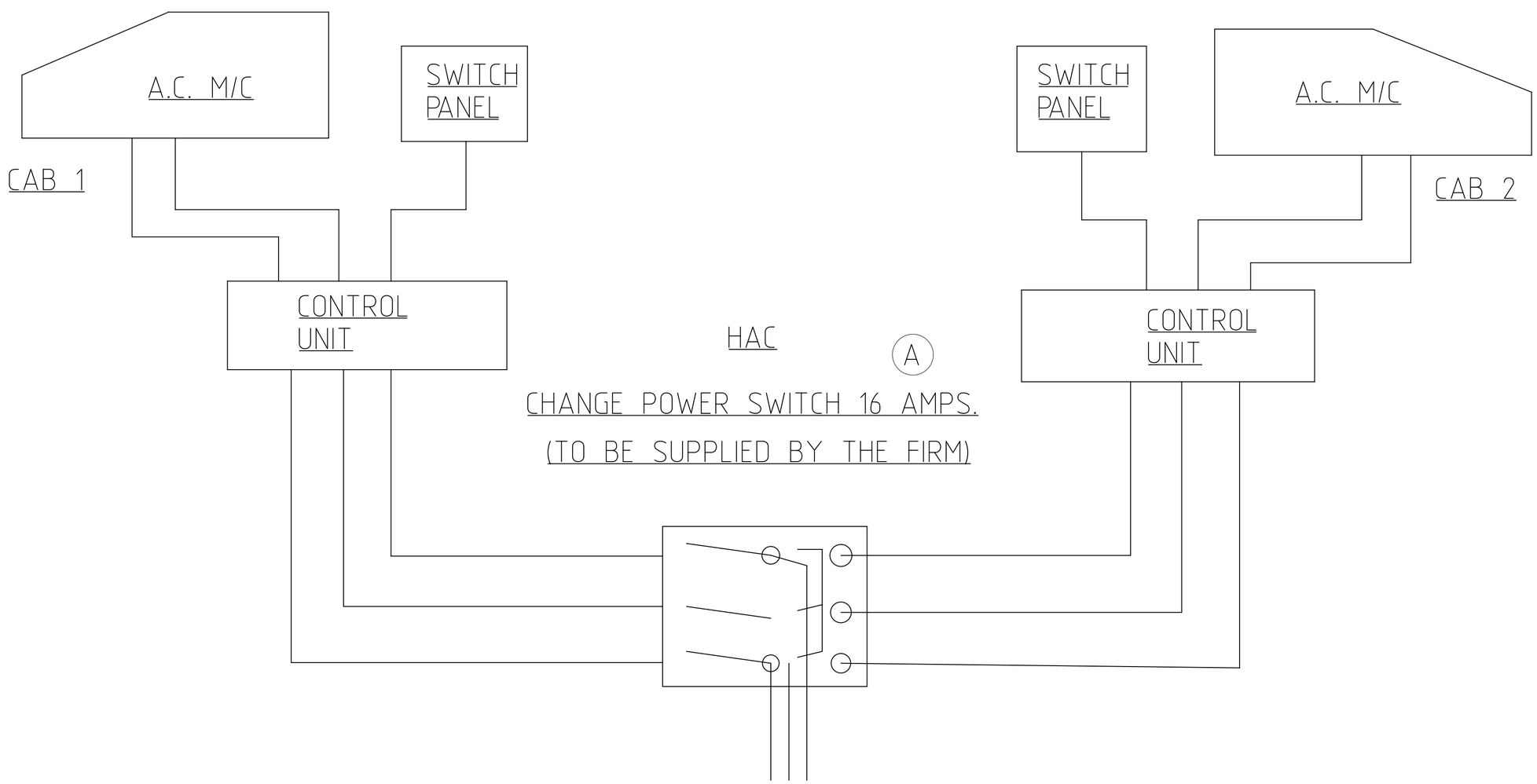
LOCATION:
A. A.C. M/C- ON CAB ROOF.
B. SWITCH PANEL - AT THE RHS CORNER OF CAB. BELOW CAB FAN.
C. CONTROL UNIT - INSIDE THE **MACHINE ROOM.**

चित्तरंजन रेलइंजन कारखाना
CHITTARANJAN LOCOMOTIVE WORKS, INDIA

DESCRIPTION: SCHEME FOR CABLE LAYOUT OF AC UNIT IN CAB

DRAWING NO. CLWES/3/SK-5/0678

ALTERATION NO. | SHEET 1 OF 1 | A2



6 SQ. MM. CABLE
(RLY. SUPPLY)

LOCATION:

A. A.C. M/C- ON CAB ROOF.

B. SWITCH PANEL - AT THE RHS CORNER OF CAB. BELOW CAB FAN.

C. CONTROL UNIT - INSIDE THE BOX NEAR ASST. DRIVERS FOOT REST.

धातु–वेल्डन चिन्ह भा. मा. : 813 / अ. मा. सं. :2553 WELDING SYMBOLS TO IS:813 / ISO:2553	अनिर्दिष्ट सह्य – सीमा भा. मा. : 2102 / अ. मा. सं. : 2768 UNSPECIFIED TOLEARANCE TO IS : 2102 / ISO : 2768										TOL. CLS.	
सतह – रुक्षता का मान भा. मा. 3073 / अ. मा. सं. 1302 SURFACE ROUGHNESS VALUE TO IS:3073 / ISO:1302	पदांक GRADE NO.	सं1 N1	सं2 N2	सं3 N3	सं4 N4	सं5 N5	सं6 N6	सं7 N7	सं8 N8	सं9 N9	सं10 N10	सं11 N11	सं12 N12
	Rz	0.16-0.3	0.5-0.7	0.9-1.1	1.5-2.0	2.5-3.8	5.0-6.3	9.0-12	16-25	30-40	50-63	75-100	160-250
	Ra µm	0.025	0.05	0.1	0.2	0.4	0.8	1.6	3.2	6.3	12.5	25	50
	चिन्ह SYMBOL												

परिवर्तन संख्या ALT. NO.	प्राधिकार AUTHY	वर्णन DESCRIPTION	दिनांकित आद्यक्षर DATED INITIAL

अभिकल्पित DGN	
जाँचा व.अ.अ. CHD SSE	
समीक्षित स.वि.अ. / व.वि.अ. REVIEWED AEE / SEE	
अनुमोदित उ.मु.वि.अ. APPROVED DYCEE	
दिनांक DATE	
रेखिक अनुपात SCALE	1:1
संदर्भ / REF.	ALT.-

चित्तरंजन रेलइंजन कारखाना
CHITTARANJAN LOCOMOTIVE WORKS, INDIA

पदार्थ MATL	प्रति चार कि. ग्रा. WT. EACH IN KG
विशिष्ट SPECN	
वर्णन DESCRIPTION	CONNECTION DIAGRAM OF A.C. UNIT IN LOCOMOTIVE
आरेखण संख्या DRAWING NO.	CLW/ES/3/SK-6/0678
परिवर्तन संख्या ALTERATION NO.	वर्ण SHEET 1 OF 1 — A2

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