



Sumitomo Heavy Industries, Ltd.

MANUAL NUMBER: CD32ZZ-181A

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# **TECHNICAL INSTRUCTION**

## **CNA-61D OUTDOOR USED COMPRESSOR UNIT**

*Revision 0*

***For Service Personnel Only***

### **PART NUMBERS**

MODEL	SHI PART No.	GE PART No.
CNA-61D COMPRESSOR UNIT	RE40ZN0988	N/A
> CNA-61D-C OUTDOOR UNIT	RE40ZH0378	2384329
> CNA-61D-E INDOOR UNIT	RE40ZH0379	2384329-2

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**CROSS REFERENCE**

Thoroughly read this manual and following manuals before using this equipment.

MANUAL NAME	MANUAL No.
OPERATION MANUAL SRDK Series CRYOCOOLER (for Outdoor used Compressor Unit)	CD32ZZ-179
TECHNICAL INSTRUCTION RDK-408A2 4K COLD HEAD*	CD32ZZ-098
TECHNICAL INSTRUCTION RDK-408 4K COLD HEAD*	CD32ZZ-057
TECHNICAL INSTRUCTION RDK-408T 10K COLD HEAD*	CD32ZZ-058
TECHNICAL INSTRUCTION RDK-400 SINGLE STAGE COLD HEAD*	CD32ZZ-059

\* See TECHNICAL INSTRUCTION of Cold Head used.

## 1 GENERAL INFORMATION

### 1-1 SPECIFICATIONS

The CNA-61D, Outdoor Compressor Unit is composed of Outdoor Unit, Indoor Unit and three (3) interconnecting electric cables.

The specification of CNA-61D is summarized in Table 1.1 and outline view of each unit is shown in Figure 1.1 and Figure 1.2. Inter connecting diagram is shown in Figure 1.3.

**Table 1.1 CNA-61D COMPRESSOR UNIT SPECIFICATION**

COMPRESSOR UNIT (Model: CNA-61D)		For RDK-408A2 / RDK-408	For RDK-408T / RDK-400
Helium Gas Pressure	Static	1.60 - 1.70 MPa at 20 deg.C (16.3 - 17.3 kgf/cm <sup>2</sup> G) (232 - 246 psig)	1.45 - 1.55 MPa at 20 deg.C (14.8 - 15.8 kgf/cm <sup>2</sup> G) (210 - 225 psig)
	Operating (High Side)* (for Reference)	1.90 ~ 2.10MPa ---approx. (19.4 ~ 21.4kgf/cm <sup>2</sup> G) (275 - 304 psig)	1.90 ~ 2.10MPa ---approx. (19.4 ~ 21.4kgf/cm <sup>2</sup> G) (275 - 304 psig)
Electrical Requirement		AC 380, 400, 415 V / 50 Hz, 3 phase (3W+PE, Commercial Power Source) AC 460, 480 V / 60Hz, 3 phase (3W+PE, Commercial Power Source) ( To be selected by "dial switch" in the side panel of Indoor Unit. ) <b>"WARNING"</b> <b>Do not use inverter for the main power source.</b> <b>"WARNING"</b> <b>Factory setting of voltage and frequency is 480V/60Hz.</b>	
Power Line Voltage (+/- 10%)			
Operating Current		Max. 13 A	
Min. Circuit Ampacity		30 A	
Max. Fuse or Circuit Breaker Size		30 A	
Power Requirement		Minimum 11 kVA Recommended 14 kVA	
Power Consumption		Maximum 9.2 kW / Steady State 8.5 kW at 60 Hz Maximum 8.0 kW / Steady State 7.5 kW at 50 Hz	
Control Voltage		<b>See the ELECTRICAL SCHEMATIC of "APPENDIX" for detail.</b>	
		OUTDOOR UNIT (model: CNA-61D-C)	INDOOR UNIT (Model: CNA-61D-E )
Location		Outdoor / Indoor	Indoor
Dimension			
Width		< 910 mm**	< 270 mm
Depth		< 400 mm	< 610 mm***
Height		< 1050 mm	< 705 mm
Weight		< 115kg (254LBS)	< 55kg (121LBS)
Ambient Temperature Range		-30 - 45 deg.C	5 - 28 deg.C 28 - 35 deg.C (with 5% Cooling Capacity Loss)
Humidity Range		20 - 95 %RH (Rain condition is acceptable)	20 - 85 %RH

\* The operating pressure varies according to the heat load of cold head and temperature around the equipment.

\*\* Without the Flex Line Cover.

\*\*\* Without the Switches and Connectors.

	CABLE 1-1D (for Main Power)	CABLE 1-2 (for Heater Power)	CABLE 1-3 (for Control)
Location	Outdoor / Indoor	Outdoor / Indoor	Outdoor / Indoor
Wire Diameter (marking)	AWG 12 x 4 (R, S, T, G/PE)	AWG 16 x 9 (1 ~ 9)	AWG 16 x 10 (10 ~ 19)
Ambient Temperature Range	-30 - 45 deg.C	-30 - 45 deg.C	-30 - 45 deg.C
Humidity Range	20 - 95 %RH (Rain condition is acceptable)	20 - 95 %RH (Rain condition is acceptable)	20 - 95 %RH (Rain condition is acceptable)

#### **"IMPOTANT"**

**The noise level of the whole equipment may exceed 70 dBA depending on the environment it is used in.**

#### **"IMPORTANT"**

**Before install the electrical cables, see the "Installation Notice" of the "APPENDIX".**

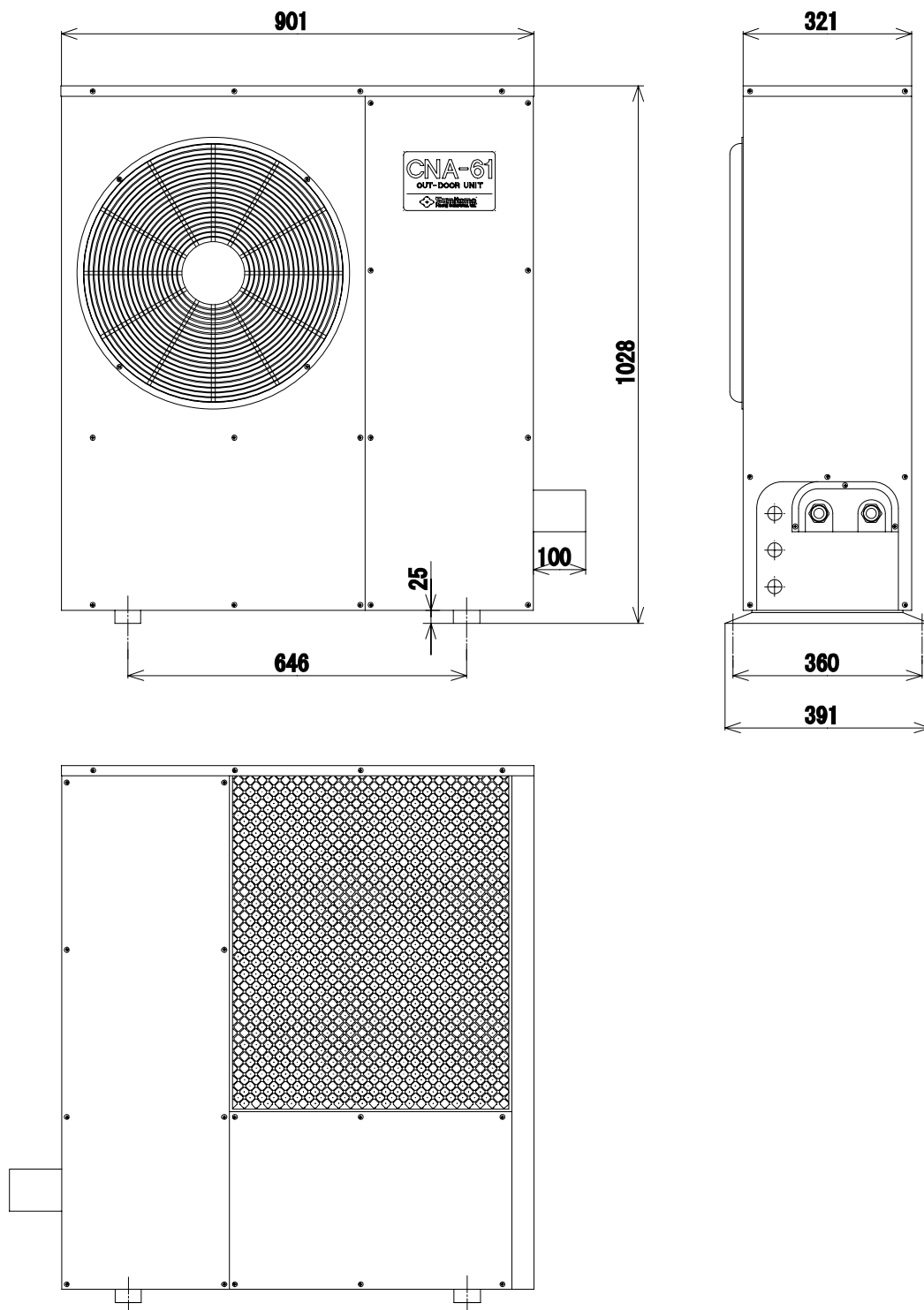
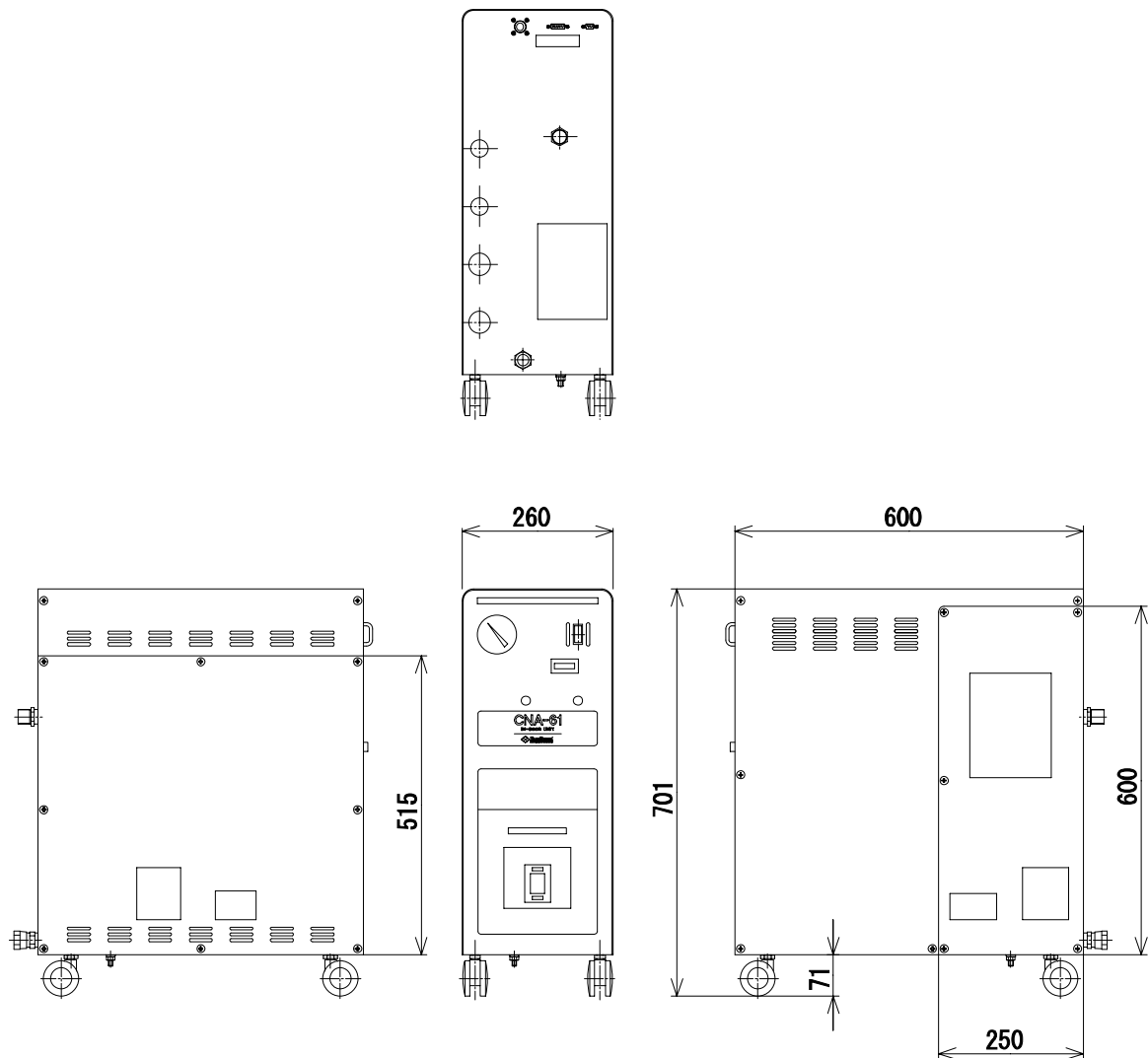


Figure 1.1 OUTLINE VIEW OF OUTDOOR UNIT (CNA-61D-C)



**Figure 1.2 OUTLINE VIEW OF INDOOR UNIT (CNA-61D-E)**

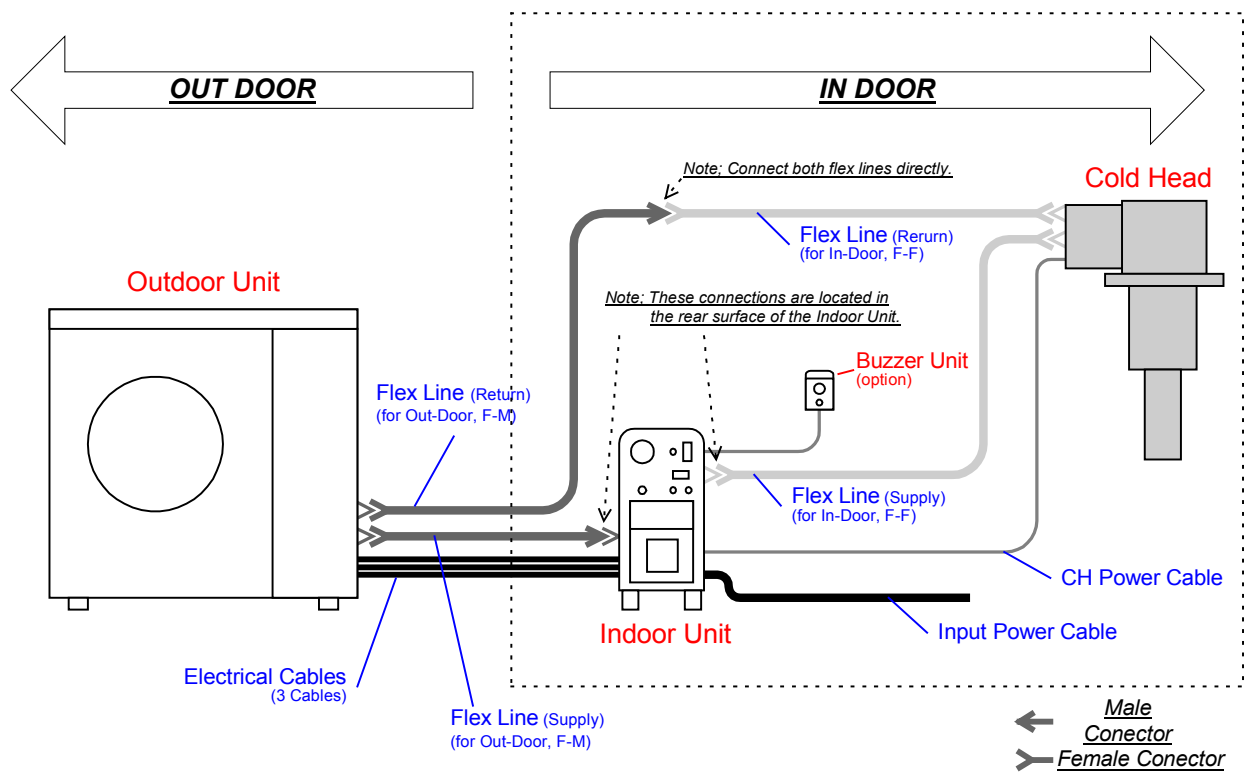


Figure 1.3 INTERCONNECTING DIAGRAM

## 1-2 CONSTRUCTION

The function of the Compressor Unit is to supply high pressure He gas to the Cold Head and re-compress the returned He gas from the Cold Head. The Compressor Unit consists of the following major components: a Compressor Capsule, a Cooling system, Oil separation and injection system, and Adsorber.

### 1-2-1 CONSTRUCTION OF OUTDOOR UNIT

The exterior parts for CNA-61D-C Outdoor Unit are summarized in Table.1.2. Internal components are summarized in Table1.3 and Figure 1.5 for outline view.

**Table 1.2 LIST OF EXTERIOR PARTS FOR CNA-61D-C**

No.	ITEM	FUNCTIONS
1	FRONT PANEL	
2	INSTALLATION PANEL	To be opened for wiring of interconnecting electric cable.
3	SIDE PANEL	
4	UPPER PANEL	
5	FAN GUARD	To protect the Cooling Fan and Fan Motor and to prevent human access.
6	PROTECTION NET	To protect heat exchanger.
7	HE-GAS SUPPLY CONNECTOR	Connector for the supply Outdoor Flex Line.
8	HE-GAS RETURN CONNECTOR	Connector for the return Outdoor Flex Line.
9	Electric cable inlet (for CABLE 1-3)	Inlet of interconnecting electric cable. (for CABLE 1-3)
10	Electric cable inlet (for CABLE 1-2)	Inlet of interconnecting electric cable. (for CABLE 1-2)
11	Electric cable inlet (for CABLE 1-1D)	Inlet of interconnecting electric cable. (for CABLE 1-1D)

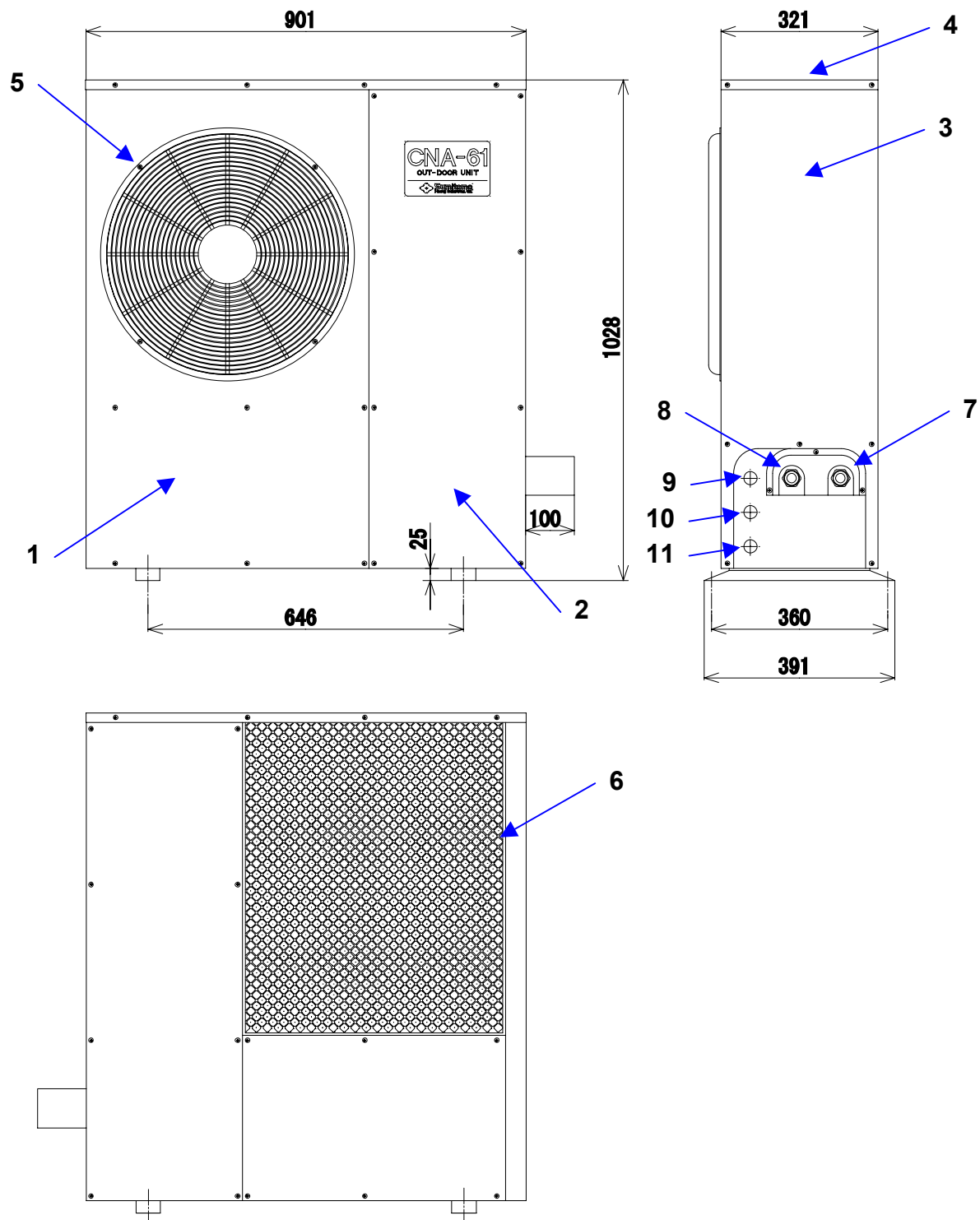
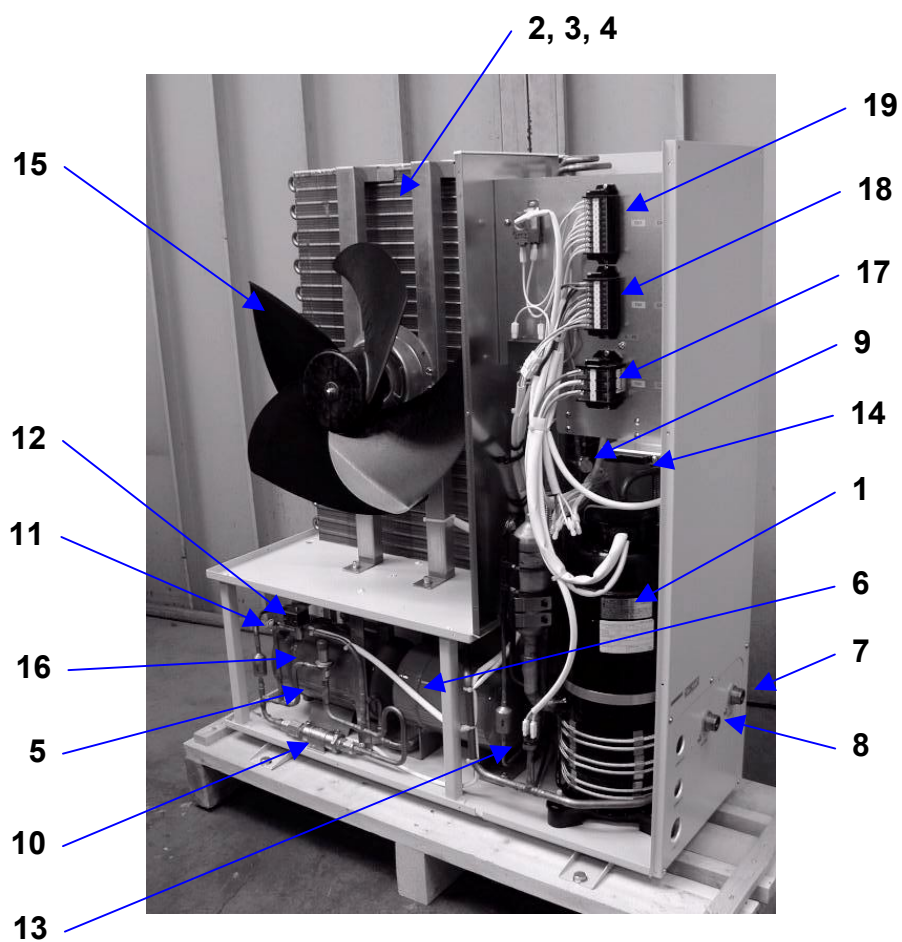


Figure 1.4 EXTERIOR PARTS FOR CNA-61D-C

Table 1.3 LIST OF INTERIOR PARTS FOR CNA-61D-C

No.	ITEM	FUNCTIONS
1	COMPRESSOR CAPSULE	To compress the helium gas. Thermostat is equipped in the compressor capsule to prevent it from over temperature.
2	NO.1 HELIUM GAS COOLER	An air cooled type heat exchanger for compressed He-gas.
3	NO.2 HELIUM GAS COOLER	An air cooled type heat exchanger for compressed He-gas.
4	OIL COOLER	An air cooled type heat exchanger for recirculating lub oil.
5	OIL SEPARATOR	To eliminate oil contamination from the compressed He-gas.
6	STORAGE TANK	A He-gas reservoir for piping to Compressor Capsule.
7	HE-GAS SUPPLY CONNECTOR	Connect the supply Flex Line to the coldhead.
8	HE-GAS RETURN CONNECTOR	Connect the return Flex Line from the coldhead.
9	OIL CHARGE PORT	To use for charging and filling a OIL. (for SHI facility use only).
10	INLINE RELIEF VALVE	To release the high-pressure supply gas to the return line to keep the pressure difference between supply and return within specified value.
11	RELIEF VALVE	To adjust a Supply He-gas pressure smoothly by a function of the Relief Valve for blowing off the He-gas to the atmosphere, in case of higher pressure of Supply He-gas than the setting pressure.
12	SOLENOID VALVE	To stabilize a pressure for even of the He-gas between the Supply and Return piping, at a shut off the Compressor Unit.
13	LOW PRESSURE SWITCH	To shut down the Compressor Unit and signal a Low pressure alarm to the External Connector, in case of lower pressure of a compressed He-gas caused by a smaller quantity of He-gas than original filling in the compressor unit.
14	THERMOSTAT	To shut down the Compressor Unit and signal a high temperature alarm to the External Connector, in case of higher temperature of a compressed He-gas at a compressor outlet than the setting temperature.
15	COOLING FAN	To cool the heat exchanger.
16	LOW PRESSURE CONTROLLER	To keep the return pressure more than specified value.
17	TERMINAL FOR CABLE1-1D (TB5)	Terminal to connect the CABLE1-1D.
18	TERMINAL FOR CABLE1-2 (TB6)	Terminal to connect the CABLE1-2.
19	TERMINAL FOR CABLE1-3 (TB7)	Terminal to connect the CABLE1-3.



**Figure 1.5 INTERIOR PARTS FOR CNA-61D-C**

## 1-2-2 CONSTRUCTION OF INDOOR UNIT

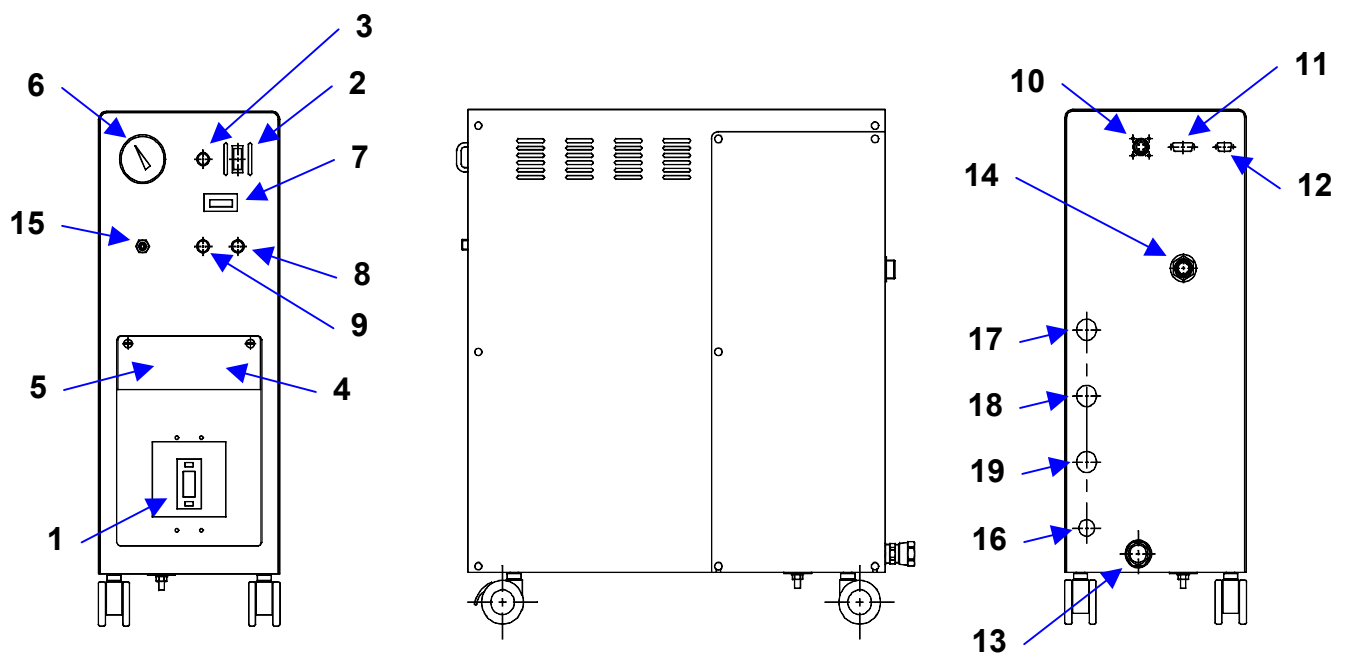
The exterior parts for CNA-61D-E Indoor Unit is summarized in Table.1.4. Internal components are summarized in Table1.5 and Figure 1.7 for outline view.

Table 1.4 LIST OF EXTERIOR PARTS FOR CNA-61D-E

No.	ITEM	FUNCTIONS
1	MAIN POWER SWITCH	A twist handle for main electric power supply and for protection from over-current and short-circuit.
2	DRIVE SWITCH	A seesaw switch for start-up and shut-down operation for the compressor unit. The refrigerating system can be in a operating condition by the DRIVE SWITCH "ON" after switching the MAIN POWER SWITCH "ON" condition.
3	DRIVE INDICATING LAMP " OPERATION " (GREEN)	This lamp indicates the operation of cryocooler. Lamp "ON" ----- Operates Lamp "OFF" ----- Stops
4	COLD HEAD DRIVE SWITCH	A switch for operating the COLD HEAD maintenance only. Under the MAIN POWER SWITCH "ON" and the DRIVE SWITCH "OFF". <b>Caution;</b> <i>Be sure to turn it OFF in normal operation.</i> <i>Using the compressor unit with the cold head drive switch turned ON may result in misoperation or malfunction.</i>
5	REMOTE DRIVE SWITCH	The compressor unit can be operated remotely with the external control by switching "EXT", and cannot be started up in condition of switching "EXT" after the Drive Switch operated. <b>Caution;</b> <i>Set to "INT" position for normal operation.</i> <i>The Compressor Unit will not start by drive switch in "EXT" position.</i>
6	SUPPLY PRESSURE GAUGE	To indicate a filled He-gas pressure in the compressor unit, during not in operation of the compressor unit, and a compressed He-gas pressure (Supply Pressure) can be indicated under the operating condition.
7	HOUR METER	To indicate a total operating hour of the compressor unit, and the hour counting will be referred for maintenance interval.
8	HE-GAS TEMPERATURE ALARM INDICATING LAMP " OVER TEMPERATURE " (ORANGE)	This lamp indicates the abnormal helium gas temperature. Lamp "ON" ----- Over temperature of gas outlet of compressor capsule. (Cryocooler stops) Lamp "OFF" ----- Normal
9	HE-GAS PRESSURE ALARM INDICATING LAMP " PRESSURE DROP " (ORANGE)	This lamp indicates the abnormal pressure. Lamp "ON" ----- Low suction pressure. (Cryocooler stops) Lamp "OFF" ----- Normal
10	COLD HEAD CONNECTOR	To use for connecting the Cold Head Cable to supply a Cold Head driving power.
11	EXTERNAL CONNECTOR	To use for the external signal output of condition monitoring for the compressor unit. The connector to be "D-Sub 15 Pins (Female type)" in use. <b>Warning;</b> <i>Pay special attention to its wiring when using the external connector on the Compressor Unit.</i> <i>Connecting a jumper wire between Pins No.6 - No.8, No.6 - No.13 and No.6 - No.15 may result in misoperation in some of safety devices in the equipment, causing electric shock, burn or malfunction.</i>
12	BUZZER UNIT CONNECTOR	Coupling to connect the cable from Buzzer Unit.
13	HE-GAS SUPPLY CONNECTOR " FROM OUTDOOR UNIT "	Coupling to connect the supply Outdoor Flex Line from Outdoor Unit.
14	HE-GAS SUPPLY CONNECTOR " FOR COLD HEAD "	Coupling to connect the supply Indoor Flex Line to the coldhead.
15	HELIUM GAS CHARGE PORT	To use for charging and refilling a He-gas.

**Table 1.4 LIST OF EXTERIOR PARTS FOR CNA-61C-E  
(Continued)**

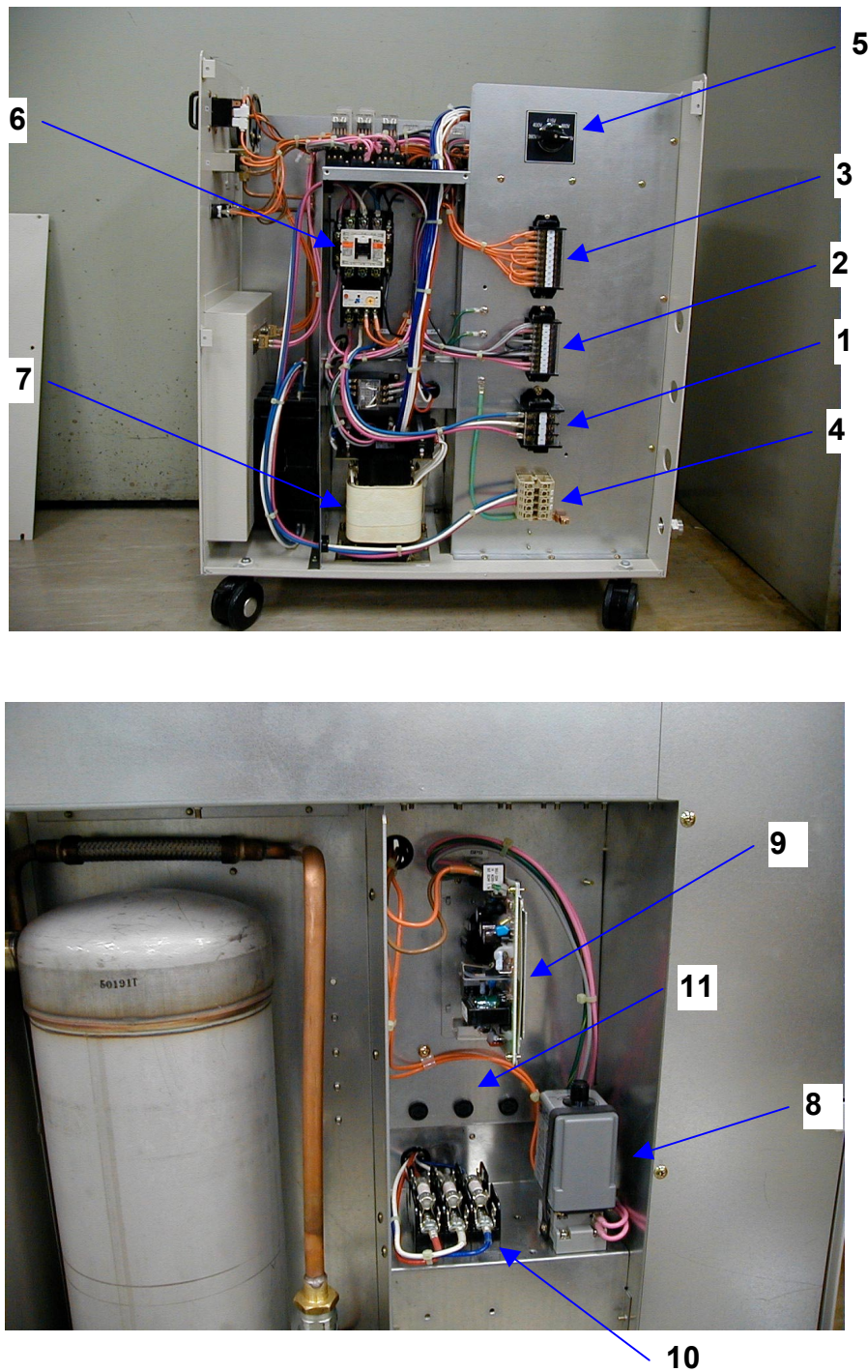
No.	ITEM	FUNCTIONS
16	<b>Input power cabling inlet</b>	Inlet of Input Power Cabling.
17	<b>Electric cable inlet (for CABLE 1-3)</b>	Inlet of interconnecting electric cable. (for CABLE 1-3)
18	<b>Electric cable inlet (for CABLE 1-2)</b>	Inlet of interconnecting electric cable. (for CABLE 1-2)
19	<b>Electric cable inlet (for CABLE 1-1D)</b>	Inlet of interconnecting electric cable. (for CABLE 1-1D)



**Figure 1.6 EXTERIOR PARTS FOR CNA-61D-E**

Table 1.5 LIST OF INTERIOR PARTS FOR CNA-61D-E

No.	ITEM	FUNCTIONS
1	TERMINAL FOR CABLE1-3 (TB4)	Terminal to connect the CABLE1-3.
2	TERMINAL FOR CABLE1-2 (TB3)	Terminal to connect the CABLE1-2.
3	TERMINAL FOR CABLE1-1D (TB2)	Terminal to connect the CABLE1-1D.
4	FIELD TERMINAL	To use for connecting of input power supply cable. At a connecting power cable, verify the phase label markings L1, L2 and L3. The compressor unit cannot be operated in case of miss-connecting the power cable.
5	INPUT POWER VOLTAGE SELECTOR	Dial switch to select the voltage and frequency. Factory setting of voltage and frequency is 480V/60Hz.
6	MAGNETIC CONTACTOR	
7	TRANSFORMER	
8	PHASE FAILURE RELAY	To avoid starting-up of the Compressor Unit in case of an abnormal operation caused by irregular connecting of Input Power Cable such as failure connecting.
9	DC POWER SUPPLY	
10	FUSE (F4, F5, F6) FUSE HOLDER	To protect the Compressor Unit from the over-load caused by short-circuit and/or any other electrical failure.
11	FUSE (F1, F2, F3) FUSE HOLDER	To protect the Compressor Unit from the over-load caused by short-circuit and/or any other electrical failure.



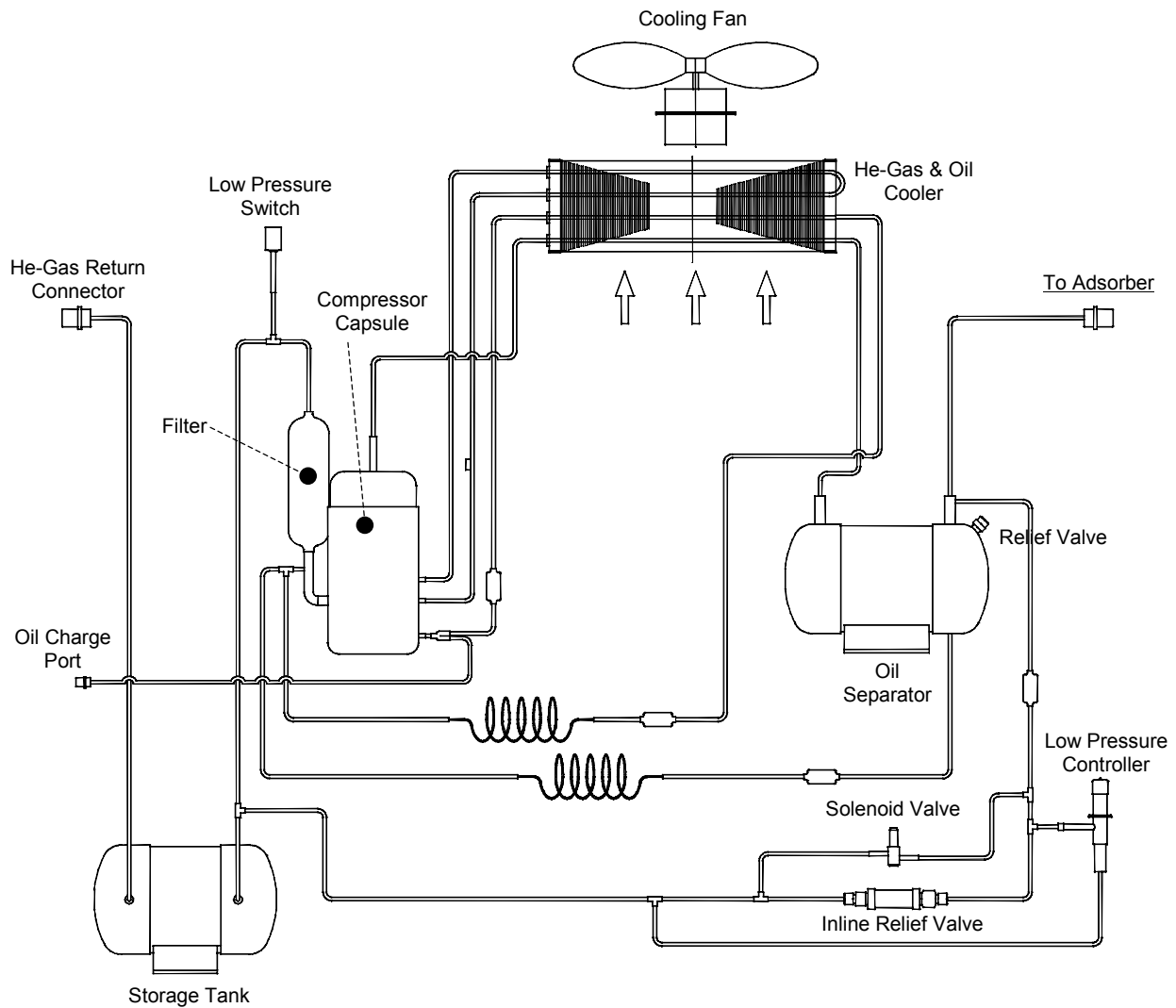
**Figure 1.7 INTERIOR PARTS FOR CNA-61D-E**

### 1-2-3 GAS AND OIL FLOW IN THE COMPRESSOR UNIT

The flow diagram for the CNA-61D Compressor Unit is shown in **Figure 1.8**.

The Compressor Unit works as follows;

- 1 ) Low pressure He gas discharged from a Cold Head can be led through a **HE-GAS RETURN CONNECTOR** to the Compressor Unit.
- 2 ) The low pressure (Return) He gas can pass through a **STORAGE TANK** and a **FILTER**, and flow into a **COMPRESSOR CAPSULE**.
- 3 ) The low pressure He gas will be compressed and pressurized in the **COMPRESSOR CAPSULE**, and the high pressure with high temperature He gas after the compression will be discharged from the **COMPRESSOR CAPSULE** outlet.
- 4 ) The high pressure with high temperature He gas will be led to an air cooled **HE-GAS COOLER** and cooled down in the cooler.
- 5 ) The high pressure He gas after cooling will flow into an **OIL SEPARATOR** to separate an almost all of lubricating oil mist from the high pressure He gas.
- 6 ) The separated lubricating oil can be returned to the **COMPRESSOR CAPSULE** through a lub oil return pipings.
- 7 ) The high pressure He gas discharged from the **OIL SEPARATOR** will be led to an **ADSORBER**.
- 8 ) A remained lub oil contents in the high pressure He gas can be adsorbed through an active charcoal layer to make the high pressure He gas being pure.
- 9 ) The pure high pressure He gas can be supplied to the Cold Head through a **HE-GAS SUPPLY CONNECTOR**.



**Figure 1.8 HELIUM GAS FLOW DIAGRAM  
FOR CNA-61D COMPRESSOR**

## 1-3 ELECTRICAL DESCRIPTION

### 1-3-1 EXTERNAL CONNECTOR

#### **"IMPORTANT"**

**See the "ELECTRICAL SCHEMATIC" of CNA-61D Compressor Unit, for detail.**

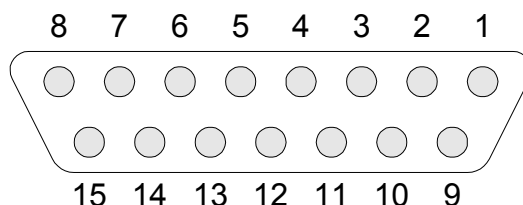
External Connector can be used monitoring the status of the Compressor Unit and the remote control sequence of the Compressor Unit are described in **Table 1.6**.

The "D-sub" pins indicated in **Figure 1.9** on the control panel for the Compressor Unit can be applied to an initial condition monitoring for a first-aid diagnostics of the Compressor Unit by means of measuring the each item with a digital Volt/Ohm Meter. The Fault Condition classified the digital meter reading as referred to the **Table 1.6** can be identified simply an actual operation condition of the Compressor Unit in the field.

**Table 1.6 EXTERNAL CONTROL / ALARM**

No.	ITEM	OPERATION			PIN No.	FAULT CONDITION*
1	Pressure Alarm Signal	Contact	Normal	Close	1, 2	> 10 <sup>6</sup> ohm
			Alarm	Open		
2	Temp. Alarm Signal	Contact	Normal	Close	3, 4	> 10 <sup>6</sup> ohm
			Alarm	Open		
3	Drive Indication	DC Power	Operate	24V DC(0.15A max.)	6, 7	0 V
			Stop	0V		
4	Control Voltage	DC Power	Output 24V DC(0.15A max.), when Main Power SW is “ON”		7, 13	
5	Remote Reset	Relay	Pulsed 24VDC for 1 second to be furnished by user.		12, 14	
6	Remote Drive	Contact	Drive	Close	8, 15	
			Stop	Open		

\* Digital Volt./Ohm Meter Reading



**Figure 1.9 EXTERNAL CONNECTOR WIRING ON THE COMPRESSOR UNIT**

## 1-3 ELECTRICAL DESCRIPTION

## 1-3-2 SAFETY DEVICES

The safety devices list for Compressor Unit are shown in **Table 1.7**.

**Table 1.7 SAFETY DEVICES OF CNA-61C**

ITEM	FUNCTIONS
<b>THERMOSTAT</b>	Setting temperature; "Operate" 120 deg.C (248 deg.F) ---- approx. "Reset" 95 deg.C (203 deg.F) ---- approx. To shut down the Compressor Unit and signal a high temperature alarm to the External Connector, in case of higher temperature of a compressed He-gas at a compressor outlet than the setting temperature.
<b>THERMOSTAT (INSIDE THE COMPRESSOR CAPSULE)</b>	Setting temperature; "Operate" 130 deg.C (266 deg.F) ---- approx. "Reset" 108 deg.C (226 deg.F) ---- approx. To shut down the Compressor Unit and signal a high temperature alarm to the External Connector, in case of higher temperature of a Compressor Capsule than the setting temperature.
<b>INLINE RELIEF VALVE</b>	Setting pressure; "Operate" 1.80 MPa ---- approx. (18.4 kgf/cm <sup>2</sup> G, 261 psig) To release the high-pressure supply gas to the return line to keep the pressure difference between supply and return within specified value.
<b>SOLENOID VALVE</b>	To stabilize a pressure for even of the He-gas between the Supply and Return piping, at a shut off the Compressor Unit.
<b>LOW SIDE PRESSURE CONTROLLER</b>	Setting pressure; "Operate" 0.40 MPa ---- approx. (4.1 kgf/cm <sup>2</sup> G, 58 psig) To keep the return pressure more than specified value.
<b>LOW PRESSURE SWITCH</b>	Setting Pressure; "Operate" 0.10 MPa ---- approx. (1.0 kgf/cm <sup>2</sup> G, 14 psig) To shut down the Compressor Unit and signal a Low pressure alarm to the External Connector, in case of lower pressure of a compressed He-gas caused by a smaller quantity of He-gas than original filling in the compressor unit.
<b>RELIEF VALVE</b>	Setting pressure; "Operate" 2.61 - 2.75 MPa (26.6 - 28.0 kgf/cm <sup>2</sup> G, 378 - 398 psig) "Reset" 2.50 MPa ---- minimum (25.5 kgf/cm <sup>2</sup> G, 362 psig) To adjust a Supply He-gas pressure smoothly by a function of the Relief Valve for blowing off the He-gas to the atmosphere, in case of higher pressure of Supply He-gas than the setting pressure.
<b>MAIN POWER SWITCH</b>	Setting current; 30 A To shut down the Compressor Unit, in case of occurring over-current and/or short-circuit than the setting current.
<b>THERMAL RELAY</b>	Setting current; 15 A To shut down the Compressor Unit, in case of occurring over-current and/or short-circuit than the setting current.
<b>PHASE FAILURE RELAY</b>	To avoid starting-up of the Compressor Unit in case of an abnormal operation caused by irregular connecting of Input Power Cable such as failure connecting.
<b>FUSE (F1, F2, F3)</b>	Rating; AC250V, 4 A To protect the Compressor Unit from the over-load caused by short-circuit and/or any other electrical failure.
<b>FUSE (F4, F5, F6)</b>	Rating; AC600V, 2 A To protect the Compressor Unit from the over-load caused by short-circuit and/or any other electrical failure.

## 2 INSTALLATION

### **“IMPORTANT”**

**Do not use inverter for the main power source of the compressor unit. Operating with inverter may result in the damage or malfunction of the compressor electric circuit.**

### **“IMPORTANT”**

**Avoid using the transformer for the main power source of the compressor unit. If the transformer is installed at the upstream of the unit, lacking phase protection circuit with the cryocooler occurs in a malfunction. That may result in misoperation or malfunction. When using the transformer, install the other lacking phase protection device in upstream of the transformer.**

### **“IMPORTANT”**

**Before install the electrical cables, see the “Installation Notice” of the “APPENDIX”.**

## 2-1 SITE REQUIREMENT

Site requirement is different between Indoor Unit and Outdoor Unit.  
Confirm the site requirement by following instruction.

### 2-1-1 SITE REQUIREMENT FOR OUTDOOR UNIT

The Outdoor Unit can be installed at the field as complying with the Site Requirement;

- The Outdoor Unit must be placed on level and even and strongly-build area.
- Fix the Outdoor Unit firmly on the concrete base using anchor bolt.
- An efficient ventilated area will be required to free from an exhausted heat of the Outdoor Unit in the field.
- A clean environment without dirt and oil mist will be recommended to install the Outdoor Unit in the field, or frequent cleaning of heat exchanger will be required.
- Do not expose the Outdoor Unit to the sun.
- In case the Outdoor Unit is placed in snowfall region, install a snow guard over the Outdoor Unit.
- Any object and/or obstacle cannot be positioned near the ventilation fan and/or surroundings of the heat exchanger.
- Do not put the heat sensitive or flammable object near the Outdoor Unit and Indoor Unit.
- Place the Outdoor Unit to the area without any noise trouble to the neighbors.

### **AMBIENT TEMPERATURE CONDITION**

The ambient temperature must be between -30 deg.C (-22 deg.F) and 45 deg.C (113 deg.F).

### **FIX THE UNIT**

The Outdoor Unit employs the anchor bolt to fix on the concrete base. The height of the concrete base must be more than 5cm and well drained.

Anchor bolt pitch requirement is shown in Figure 2.1

### **INSTALLATION AREA**

The Outdoor Unit is air-cooled and should have enough space for air-flow.

Required space for Outdoor Unit installation is shown in Figure 2.2 and required space for multi setting is shown in Figure 2.3.

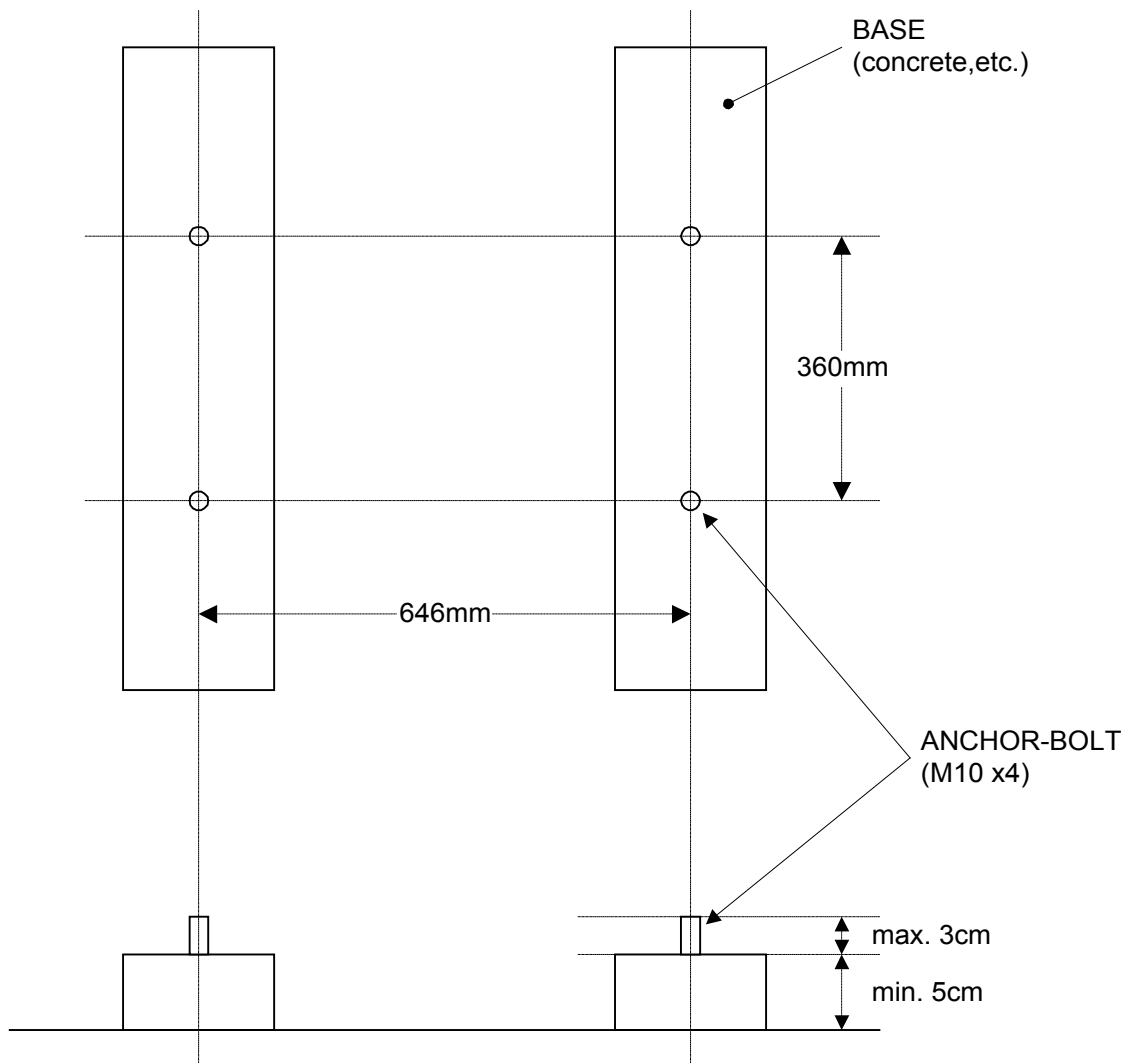
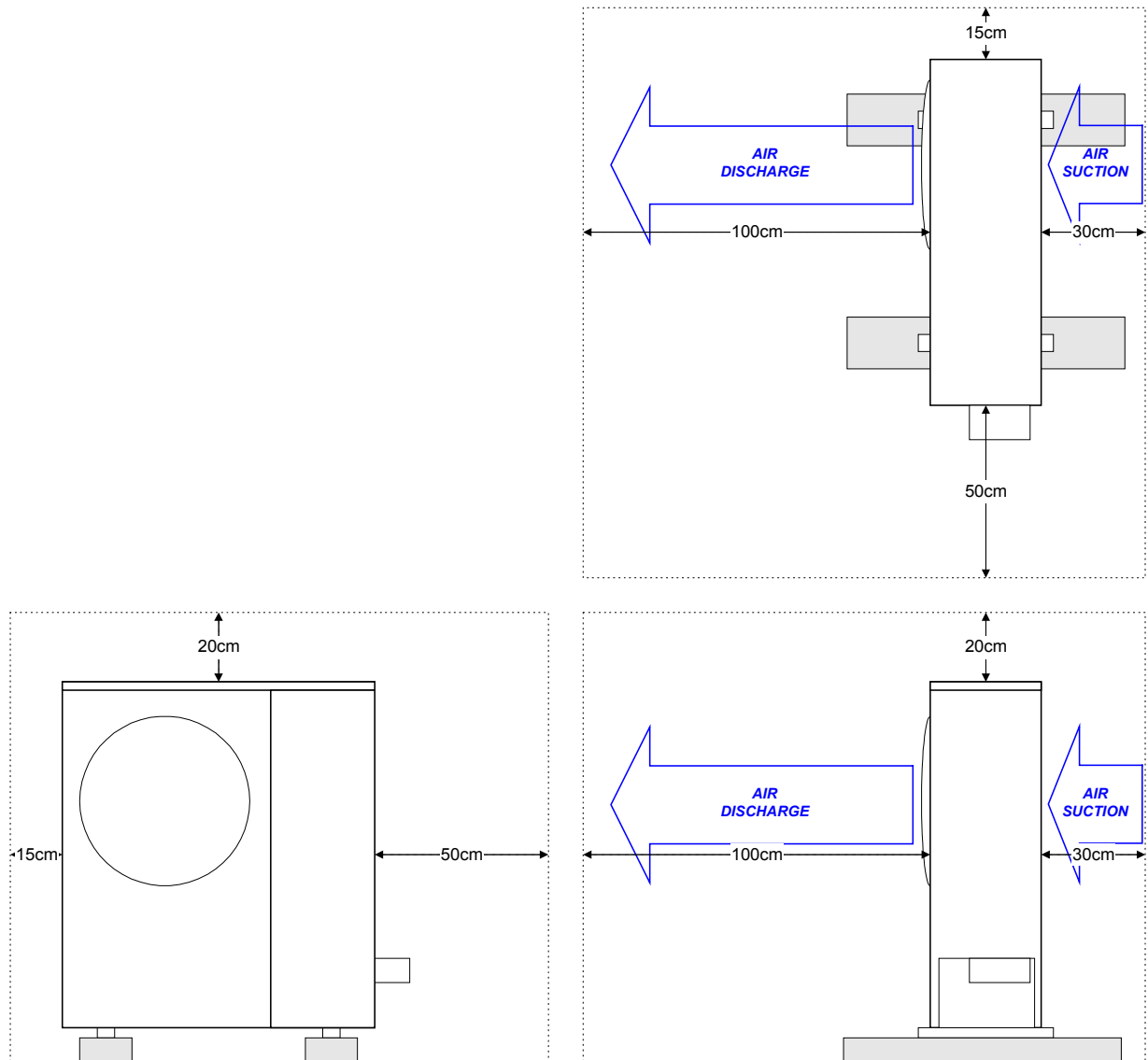
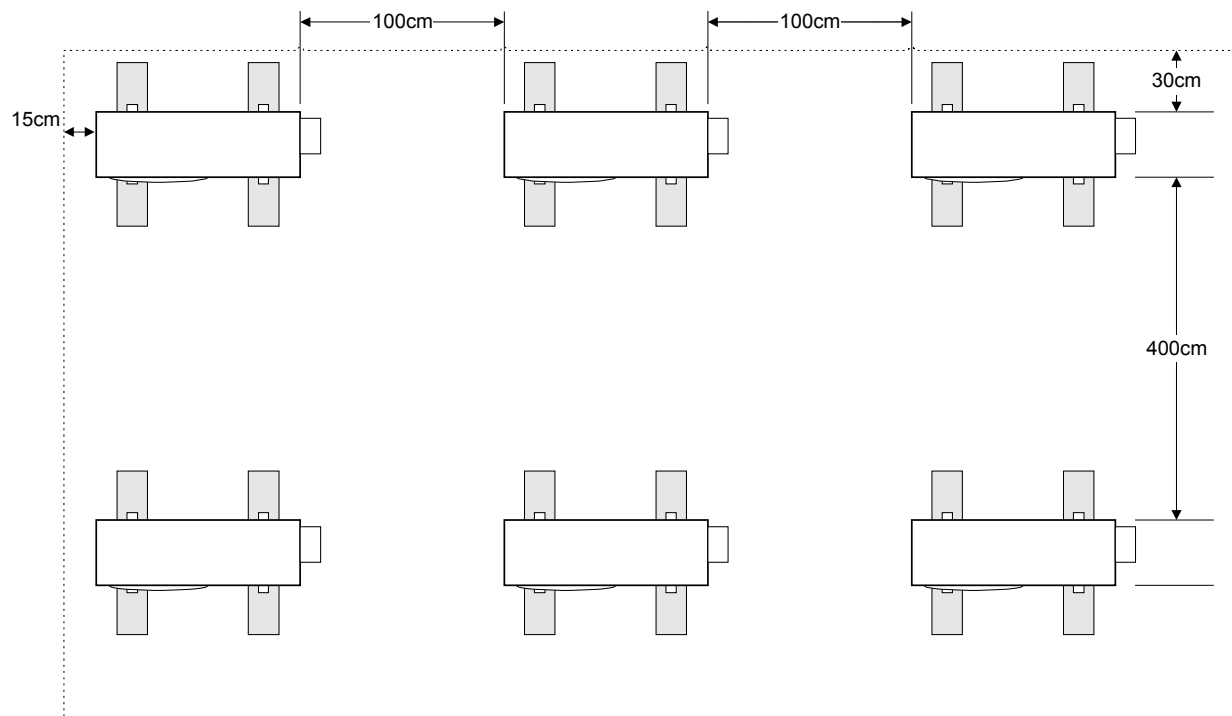


Figure 2.1 ANCHOR BOLT PITCH FOR FIXING CNA-61D-C



\* At least two surfaces will be opened to maintain the sufficient cooling airflow.

**Figure 2.2 REQUIRED SPACE FOR CNA-61D-C OUTDOOR UNIT**



**Figure 2.3 REQUIRED SPACE FOR MULTI USE  
FOR CNA-61D-C OUTDOOR UNIT**

## 2-1-2 SITE REQUIREMENT FOR INDOOR UNIT

The Indoor Unit can be installed at the field as complying with the Site Requirement;

- An almost level and even area in the field will be selected to install the Indoor Unit.
- An area to be influenced by splashing water and/or dusts will not be selected to install the Indoor Unit.
- A clean environmental condition without dirt and/or free from an exhausted heat will be selected to install the Indoor Unit in the field.
- Do not put the heat sensitive or flammable object near the Outdoor Unit and Indoor Unit.

### **AMBIENT TEMPERATURE CONDITION**

The ambient temperature must be between 5 deg.C (41 deg.F) and 28 deg.C (82.4 deg.F) to get the specified cooling capacity. The system can operate up to 35 deg.C (95 deg.F) with less than 5% cooling capacity down. The maximum relative air humidity is 85%RH.

### **HELIUM SUPPLY SYSTEM**

A helium supply system is necessary if you need to decontaminate the helium gas, or charge the helium gas that has leaked out of the system. A helium supply system includes a Grade 5 (99.999% up pure) helium gas bottle, a regulator, an outlet valve, and a charging hose or equivalent delivery line.

### **POWER SOURCE**

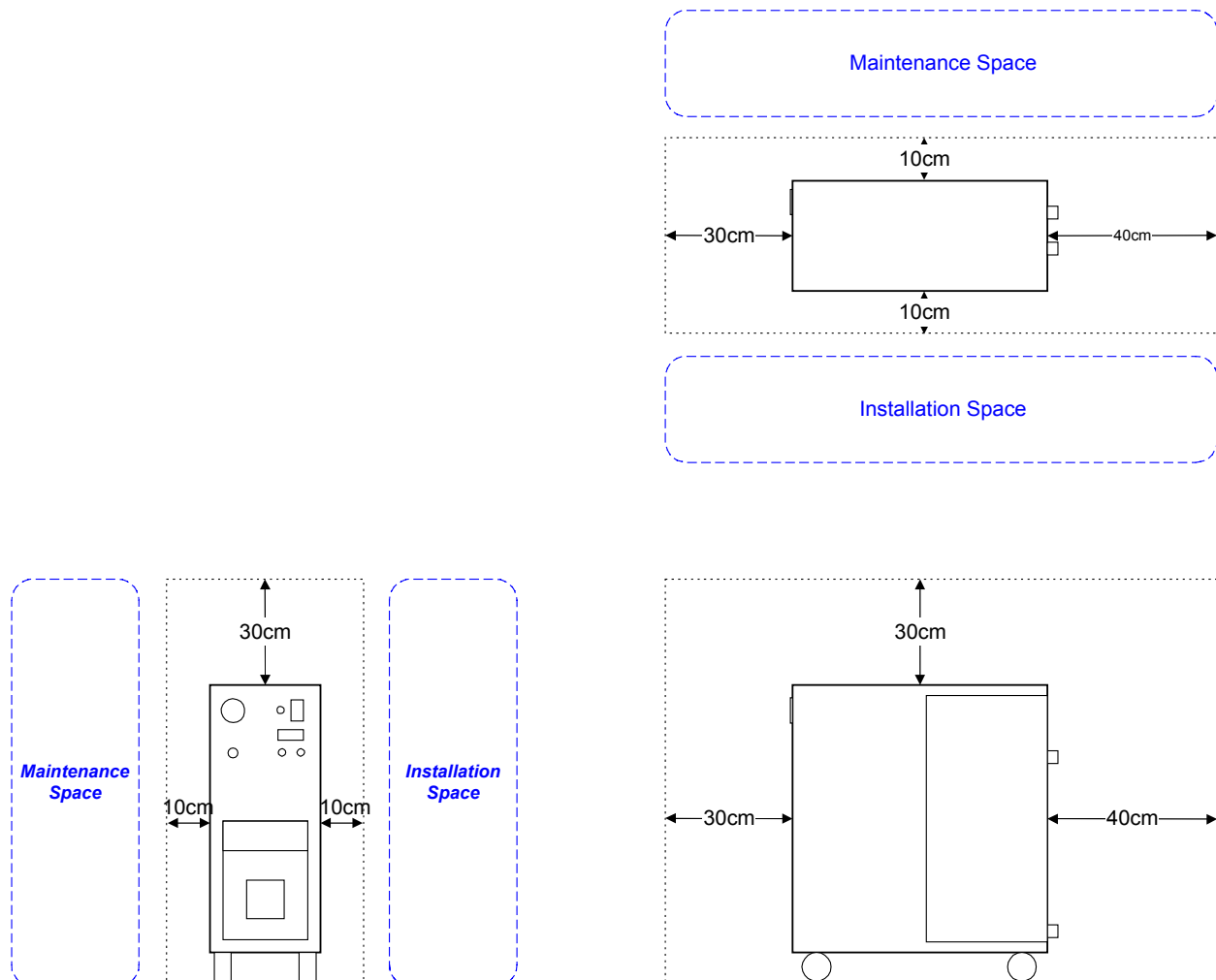
Ensure the correct AC power source is available for the Compressor Unit. See "TECHNICAL INSTRUCTION" of Compressor Unit used, for AC power source requirement.

### **SAFETY / SEISMIC REQUIREMENT**

Secure to lock the locking device of Indoor Unit castor.

### **INSTALLATION AREA**

The Indoor Unit requires enough space for heat radiation and maintenance work.  
Refer to Figure 2.4 for the site requirement.



\* Another space is required for maintenance work besides the installation space.

**Figure 2.4 REQUIRED SPACE FOR CNA-61D-E INDOOR UNIT**

## 2-2 INSTALLATION

Compressor Unit will be inspected and installed by following procedure.

### OUTDOOR UNIT

Place the Outdoor Unit on the site base and fix firmly using four (4) anchor bolts.

The Outdoor Unit should not be tilted by more than 30 degree at any time.

Install the Outdoor Unit to a level surface (less than 5 degrees).

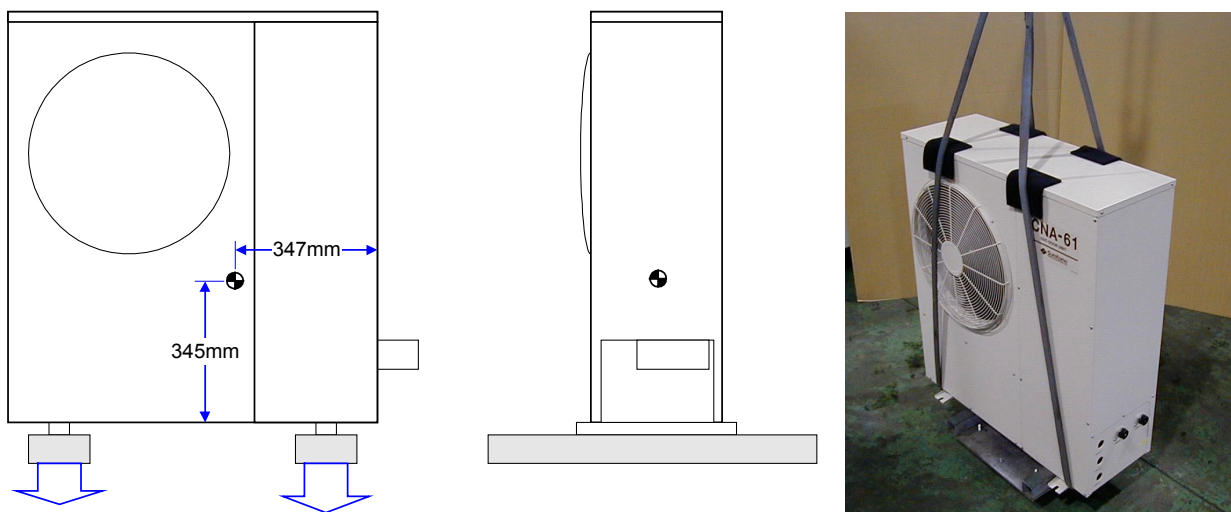
To hang the Outdoor Unit for installation, refer to the center of gravity and weight distribution for the safety.

The weight of the Outdoor Unit is approx. 120kg (265 LBS). Figure 2.5 is the example of sling hanging.

### INDOOR UNIT

Install the Indoor Unit to a level surface (less than 5 degrees).

The Indoor Unit can travel with 4 casters, and two of them are with lock-devices. After positioning the Indoor Unit, the casters can be locked.



\* The center of the gravity of the Outdoor Unit is slightly right from the front view.

**Figure 2.5 CNA-61D-C CENTER OF GRAVITY  
AND EXAMPLE OF SLING HANGING**

## **2-3 INTERCONNECTING ELECTRIC CABLES CONNECTION**

**“IMPORTANT”**

**Before install the electrical cables, see the “Installation Notice” of the “APPENDIX”.**

**“IMPORTANT”**

**Wiring number which correspond to field wiring are labeled on wiring terminal and both end of cables. Do not miss-match the number of wiring label.**

**“IMPORTANT”**

**The penetration hole to let the Interconnecting Electric Cables through will be applied putty for waterproof.**

Make electrical connection as follows;

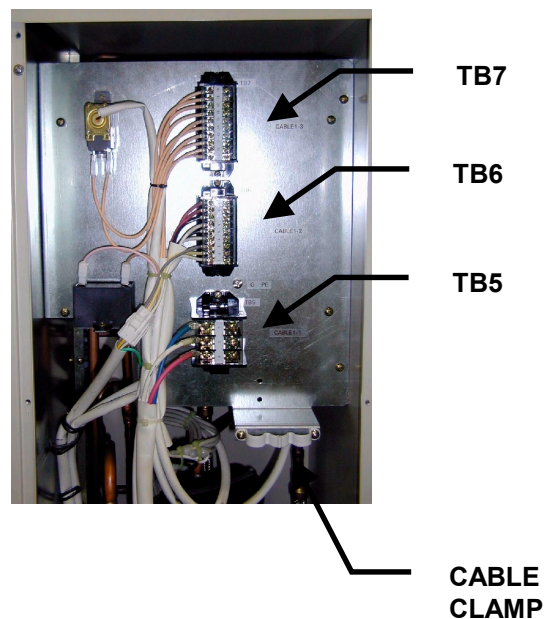
**2-3 INTERCONNECTING ELECTRIC CABLES CONNECTION**

**for OUTDOOR UNIT**

1. Remove the front panel of Outdoor Unit.



2. Remove the cover of terminal board. (unscrew the screw) Remove the cable holder at the bottom of the terminal board.



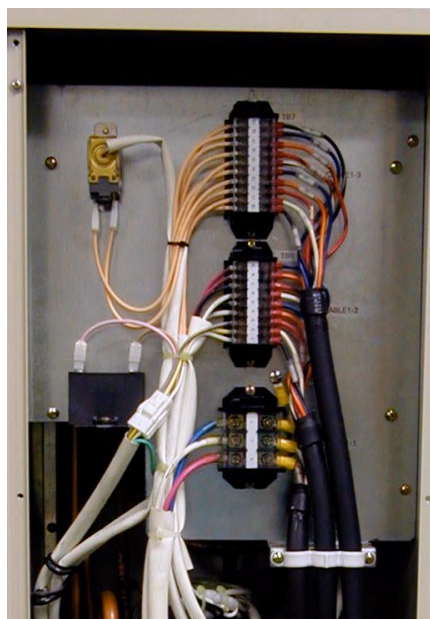
**2-3 INTERCONNECTING ELECTRIC CABLES CONNECTION**

3. Insert the Cable1-1D, Cable1-2 and Cable1-3 through the hole on the side panel and fix the cable clamp to the side panel.



4. Connect the ring terminals of Cable1-1D, Cable1-2 and Cable1-3 to the terminal TB5, TB6 and TB7. The green colored wire (G/PE) of Cable1-1D is for the ground, thus connect it to the thread of terminal board over the TB5 terminal.

**(Tighten torque of screws; TB5 : 2.0 Nm TB6 : 0.8 Nm TB7 : 0.8 Nm)**



**TB7 & Cable1-3(10-19)**



**TB6 & Cable1-2(1-9)**



**TB5 & Cable1-1D(R,S,T,G/PE)**

**2-3 INTERCONNECTING ELECTRIC CABLES CONNECTION**

5. Fix the three (3) cables by cable holder and coordinate the cables not to touch the compressor capsule. Tighten the cable clamp at the bottom of side panel.



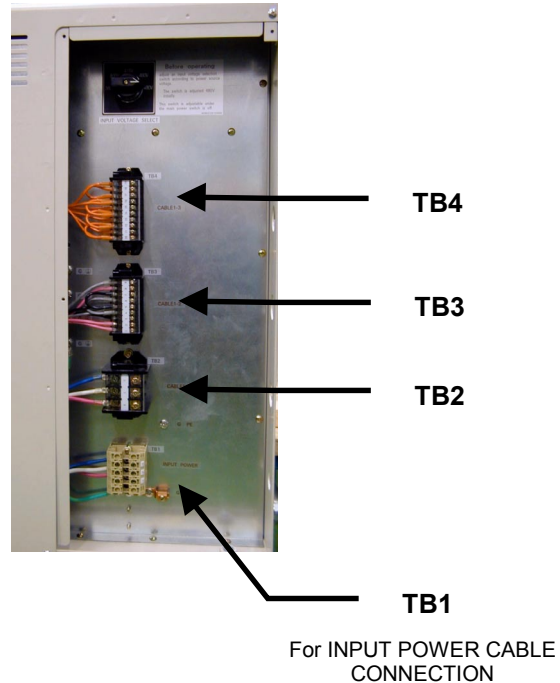
6. Attach the terminal board cover and front panel of Outdoor Unit.



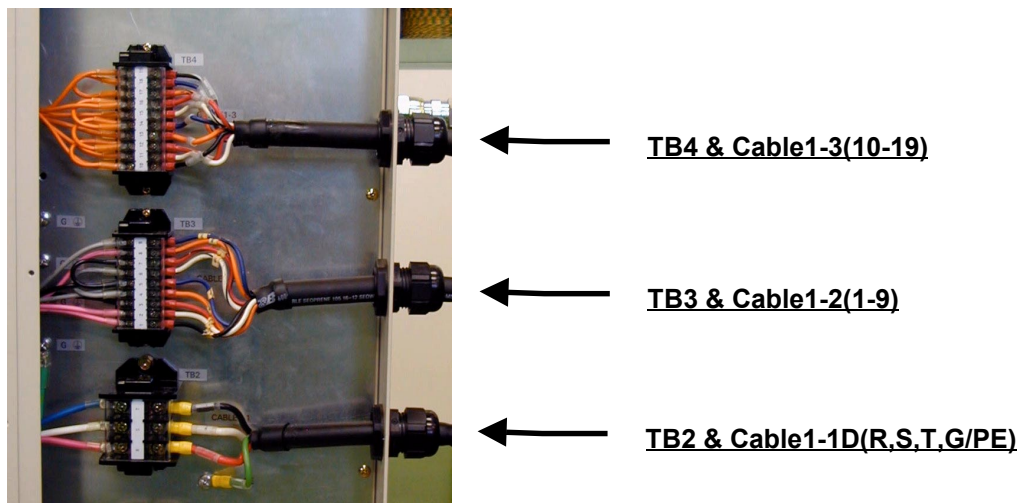
**2-3 INTERCONNECTING ELECTRIC CABLES CONNECTION**

**for INDOOR UNIT**

1. Remove the side panel of Indoor Unit.



2. Insert the Cable1-1D, Cable1-2 and Cable1-3 through the hole on the rear panel and fix the cable holder to the side panel.
3. Connect the ring terminals of Cable1-1D, Cable1-2 and Cable1-3 to the terminal TB2, TB3 and TB4. The green colored wire (G/PE) of Cable1-1D is for the ground, thus connect it to the thread of terminal board under the TB2 terminal.  
(Tighten torque of screws; TB2 : 2.0 Nm TB3 : 0.8 Nm TB4 : 0.8 Nm)



**2-3 INTERCONNECTING ELECTRIC CABLES CONNECTION**

4. Attach the side panel.



## 2-4 INPUT POWER CABLE CONNECTION

**“IMPORTANT”**

**Before install the electrical cables, see the “Installation Notice” of the “APPENDIX”.**

**“IMPORTANT”**

**This cryocooler is provided with a phase reverse protection circuit for the input power. If the input power is connected with reverse phase, the cryocooler does not start.**

**“IMPORTANT”**

**Do not use inverter for the main power source of the compressor unit. Operating with inverter may result in the damage or malfunction of the compressor electric circuit.**

**“IMPORTANT”**

**Avoid using the transformer for the main power source of the compressor unit. If the transformer is installed at the upstream of the unit, lacking phase protection circuit with the cryocooler occurs in a malfunction. That may result in misoperation or malfunction. When using the transformer, install the other lacking phase protection device in upstream of the transformer.**

**“IMPORTANT”**

**See the “ELECTRICAL SCHEMATIC” of CNA-61D Compressor Unit, for detail.**

**“IMPORTANT”**

**See the “INPUT POWER CABLE HV” of “APPENDIX” for detail.**

Make electrical connection as follows;

**Upstream Protection**

Use the 3 x max. 30A time delay fuse or circuit breaker.

**Power Supply Conductor and Protective Earth Conductor**

Use 75 deg.C wiring sized to 60 deg.C ampacity.

Use copper conductor only. AWG 12 (3.3 mm<sup>2</sup>) or larger.

**Compressor Unit Side**

*Power Supply Conductors*

Striping Length: 12 mm

Tightening Torque: 1.3 Nm (13 kgf cm)

*Protective Earth Conductor*

Striping Length: 12 mm

Tightening Torque: 1.8 Nm (18 kgf cm)

**User's Power Source Side**

*Power Supply Conductors*

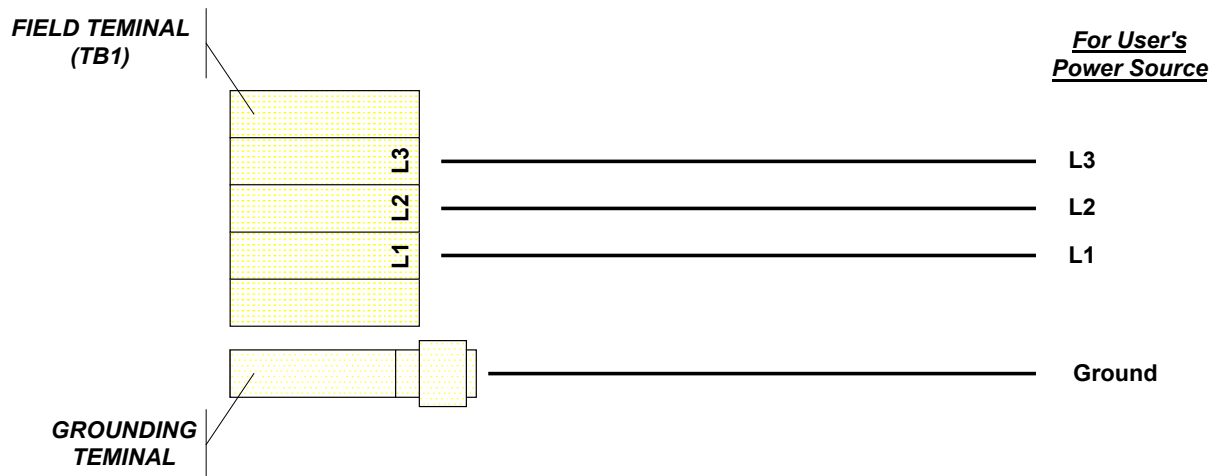
Striping Length: 12 mm

*Protective Earth Conductor*

Striping Length: 12 mm

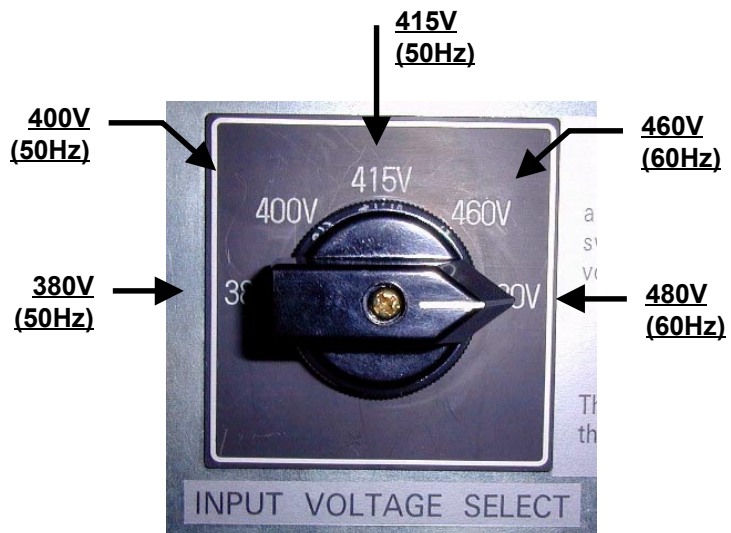
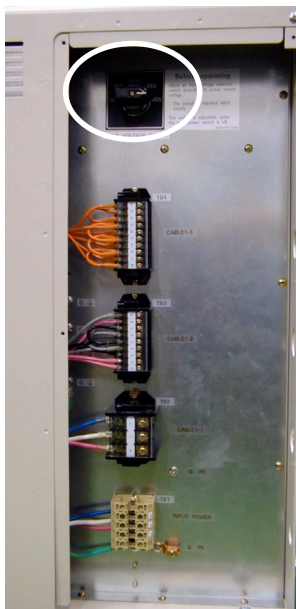
**2-4 INPUT POWER CABLE CONNECTION**

See the **Table 1.1** for power requirements. The cables are marked with label and connect as follows:



**Input Power Voltage Setting**

The Compressor Unit can be operated on various input power voltage by changing the dial switch position in the Indoor Unit. **Initial factory setting is AC480V / 60Hz.**



## 2-5 BUZZER UNIT CONNECTION

### **“IMPORTANT”**

**See the “ELECTRICAL SCHEMATIC” of CNA-61D Compressor Unit, for detail.**

CNA-61BZ, Buzzer Unit is available as an option.

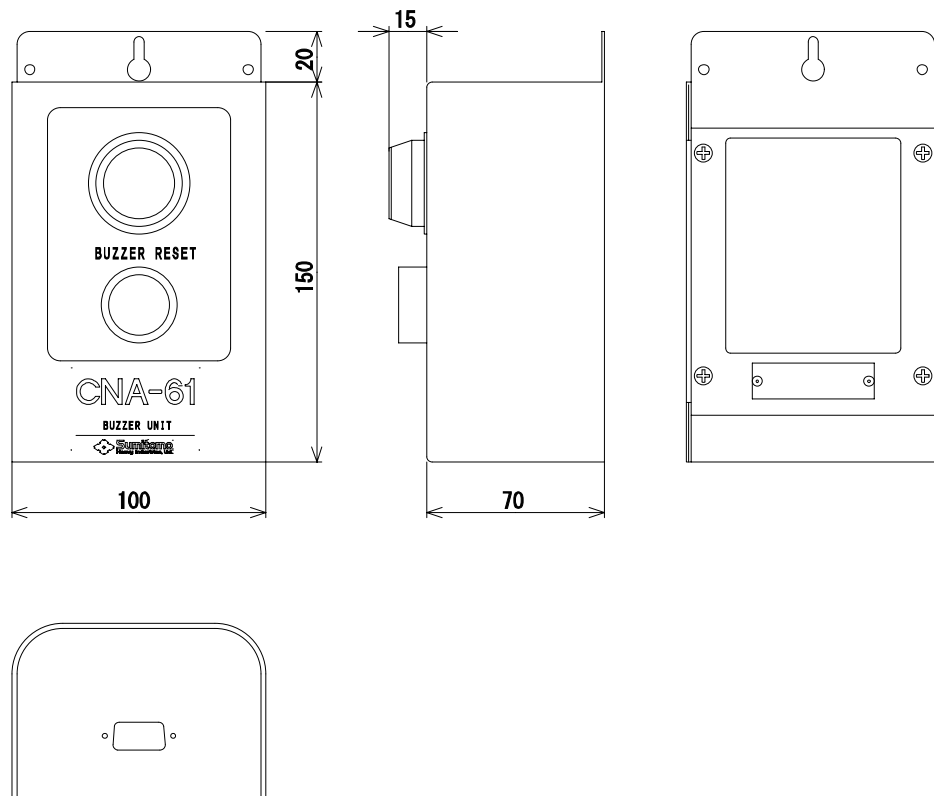
The function of the Buzzer Unit is to alarm of abnormal operation at the initial stage of trouble. The alarm sound and LED illumination of the Buzzer Unit is synchronized with the “PRESSURE DROP” and “OVER TEMPERATURE” indication lamps on the front panel of Indoor Unit.

The “PUSH BUTTON” is furnished on the Buzzer Unit to reset the alarm sound.

The function of this PUSH BUTTON is only for the reset of buzzer; therefore the cryocooler abnormal operation will not reset.

Connect the cable of the Buzzer Unit to “BUZZER JR” on the rear panel of Indoor Unit. The 20m cable is attached to Buzzer Unit.





**Figure 2.6 OUTLINE VIEW OF BUZZER UNIT**

### 3 MAINTENANCE

#### 3-1 PERIODICAL MAINTENANCE

The CNA-61D Compressor Unit is to be required the routine maintenance. The basic maintenance work is to replace the oil mist Adsorber of the Compressor Unit for every 20,000 Hrs. operation as mentioned Table 3.1.

**Table 3.1 MAINTENANCE SCHEDULE**

MAINTENANCE	FREQUENCY	REMARK
Replace Compressor Adsorber	Every 20,000 Hrs.	User's Maintenance.
Charge Helium Gas to Compressor	As required	User's Maintenance.
Cleaning Air Cooler	At least one time in one year	User's Maintenance. Depending on the Compressor site conditions.
Compressor Fuse Replacement	As required	User's Maintenance.

**Table 3.2 RENEWAL PARTS LIST (FRU'S)**

ITEM	DESCRIPTION	Q'TY	NOTES	SHI PART NUMBER	GE PART NUMBER
1	Adsorber	1	OD155 × H447	RE71TN0408	2172241
2	Fuse (F1, F2, F3)	3	MT4-4A (AC250V, 4A)	RE40WT1059	2191112-11
3	Fuse (F4, F5, F6)	3	AG2 (AC600V, 2A)	RE40WT1060	2191112-12

**3-1-1 REPLACEMENT OF THE COMPRESSOR ADSORBER**

The Oil Mist Adsorber is required to replace for every 20,000 Hrs operation.

**Table 3.3 ADSORBER FOR COMPRESSOR UNIT**

ITEM	DESCRIPTION	Q'TY	NOTES	SHI PART NUMBER	GE PART NUMBER
1	Adsorber	1	OD155 x H447	RE71TN0408	2172241

**Table 3.4 REQUIRED TOOLS FOR ADSORBER REPLACEMENT**

	TOOLS	REMARK
1	1" open-end wrench	For Aero-quip coupling
2	1-1/8" Open-end wrench	For Aero-quip coupling
3	1-3/16" Open-end wrench	For Aero-quip coupling
4	Snoop liquid	For leak check
5	Cotton wipers	For leak check
6	13 mm Open-end wrench	For fixing nut for Adsorber
7	Screw driver (phillips(+))	For side panel of Compressor Unit.

Replace the Adsorber instructed as follows;

**PREPARATION**

- 1) Shut down the Cryocooler.
- 2) Disconnect the Input Power Cable from the Indoor Unit.
- 3) Disconnect the Supply and Return Flex Lines from the Indoor Unit.

**REMOVING THE USED ADSORBER**

- 1) Loosen the screws that hold the Indoor Unit side panel and remove the panel.



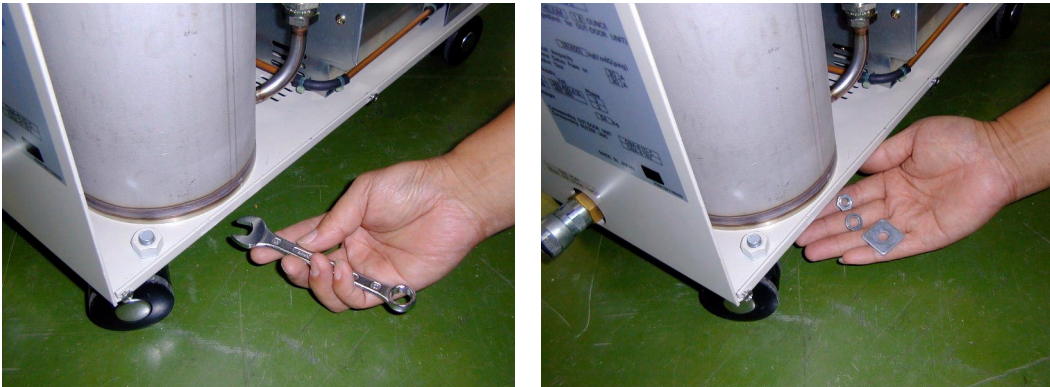
- 2) Disconnect the Adsorber Self-Sealing Coupling. Use three wrenches.



- 3) Remove the Nut secured the Adsorber to Rear Panel. Use two wrenches.



- 4 ) Remove the Nut and Washer secured the Adsorber to the base panel of the Indoor Unit.



- 5 ) Remove the used Adsorber from the Indoor Unit frame.



**INSTALLING NEW ADSORBER**

- 1 ) Set a new Adsorber.
- 2 ) Secure the Adsorber to the base panel of the Indoor Unit by tighten Nut and Washer.
- 3 ) Secure the Adsorber to Rear Panel by tightening Nut.
- 4 ) Connect the Adsorber Self-Sealing Coupling.
- 5 ) Reinstall the panels and secure them by tightening the screws.
- 6 ) Ensure that the pressure gauge indication is specified value for the type of Cold Head. Charge helium gas, in case of low pressure indicating.

### 3-1-2 CLEANING THE OUTDOOR UNIT COOLER

**“IMPORTANT”**

**Heat exchanger of the Outdoor Unit can be cleaned with water and/or rinse. The wastewater will be drained from the bottom hole of Outdoor Unit.**

Periodical cleaning for the air cooled heat exchanger for lub. oil / gas cooler of the Compressor Unit is essential part to maintain the Cryocooler performance and reliability.

Clean the heat exchanger at least once a year.

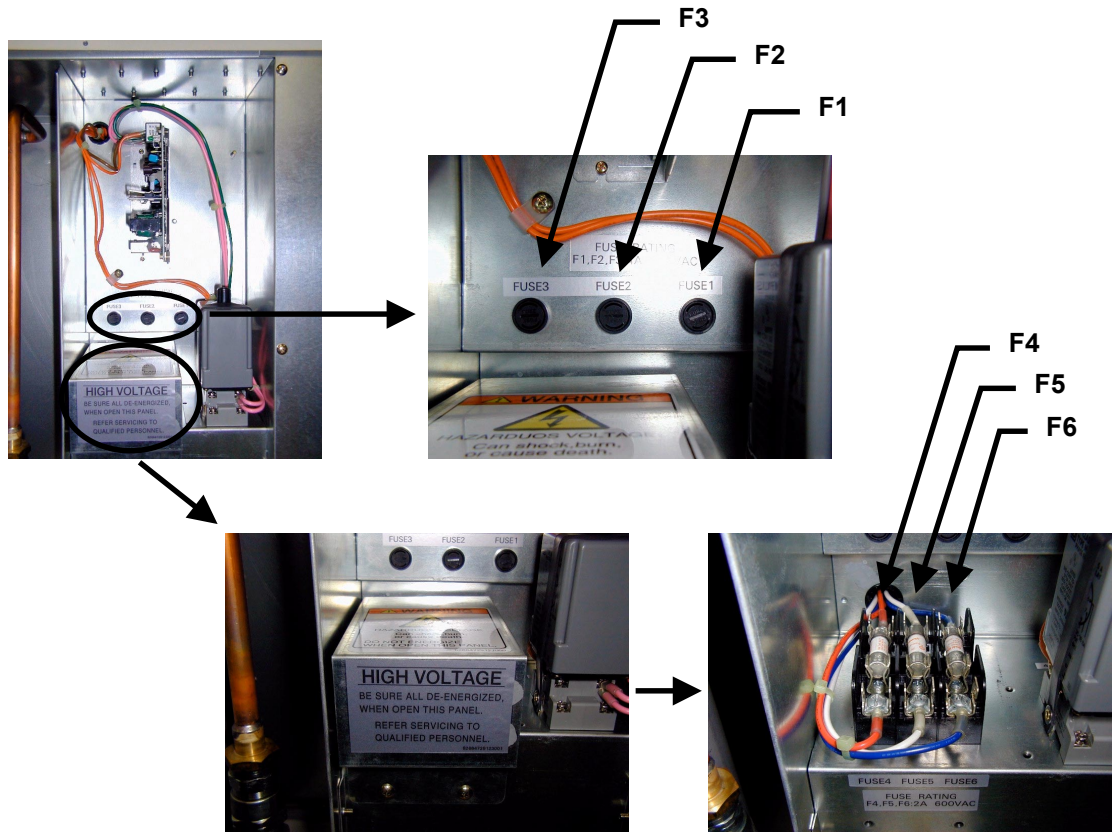
A clean environment without dirt and oil mist will be recommended to install the Outdoor Unit in the field, or frequent cleaning of heat exchanger will be required.

**CLEANING PROCEDURE**

- 1 ) Stop the cryocooler and confirm that the cooling fan stops.
- 2 ) Sweep the dust attached to the heat exchanger. Do not damage the fins of heat exchanger.
- 3 ) In case the heat exchanger is dirty, clean it with water or rinse for heat exchanger. Do not damage the fins of heat exchanger.

### 3-2 FUSE REPLACEMENT

Fuses are located at the side panel of Indoor Unit.



**Table 3.5 LIST OF FUSES**

Fuse No.	Description	SHI Part Number	GE Part Number	Remarks
F1, F2, F3	MT4-4A (AC250V, 4A)	RE40WT1059	2191112-11	For DC Circuit For Fan Motor
F4, F5, F6	AG2 (AC600V, 2A)	RE40WT1060	2191112-12	For Transformer

### **FUSE REPLACING PROCEDURE**

- 1 ) Confirm the system does not energized.
- 2 ) Remove the side panel on Indoor Unit.
- 3 ) Replaced the fuse.
- 4 ) Attach the side panel of Indoor Unit.

**APPENDIX****ELECTRICAL SCHEMATIC**

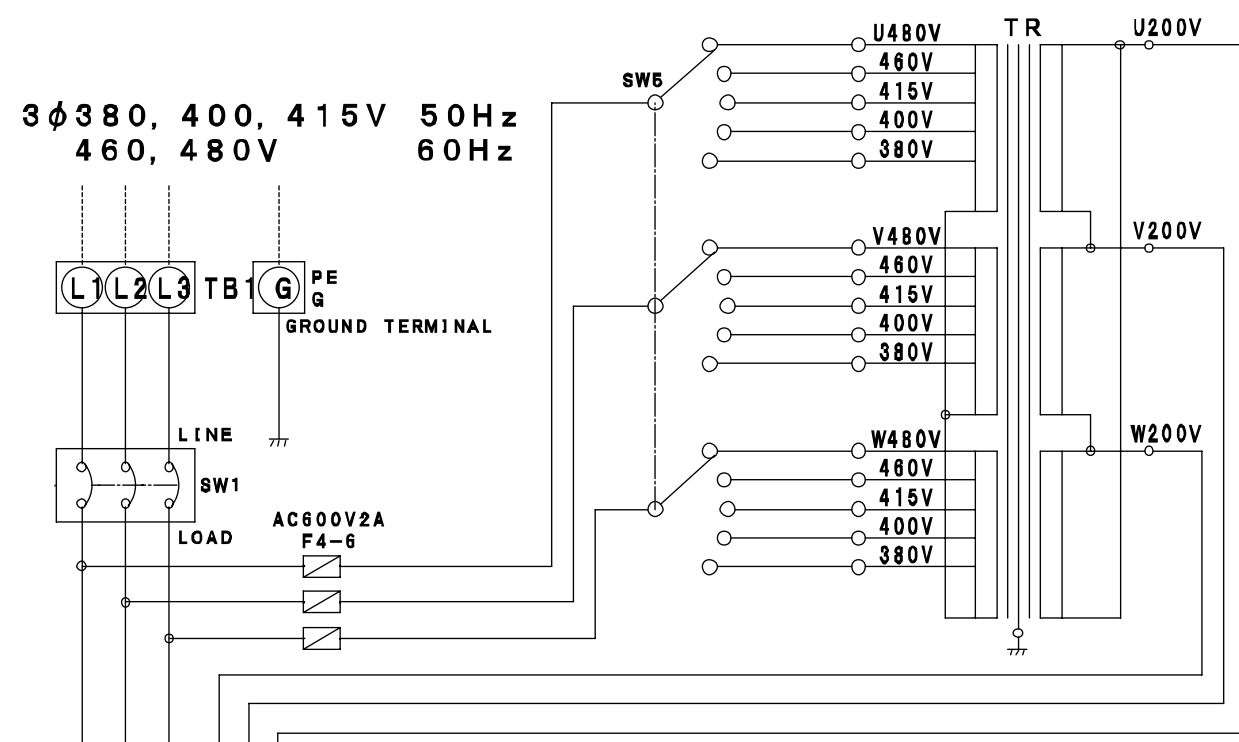
No.	PART NAME
1	ELECTRICAL SCHEMATIC of CNA-61D

**DRAWINGS**

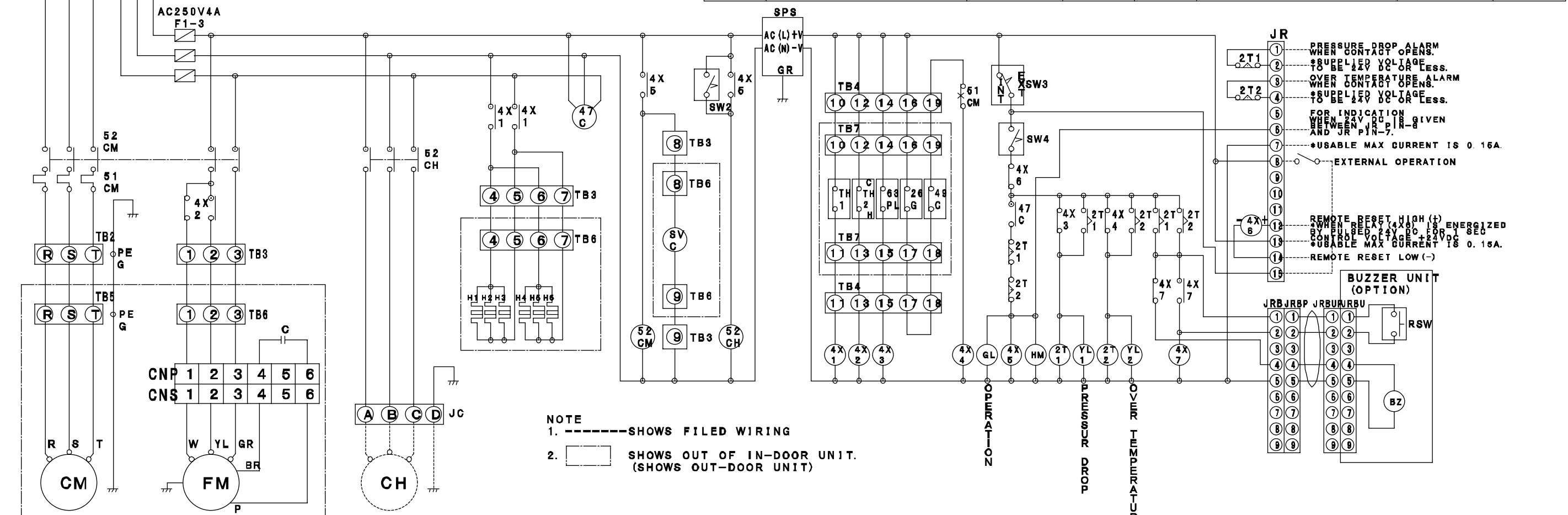
No.	PART NAME
1	ADSORBER
2	INPUT POWER CABLE HV
3	ELECTRICAL CABLE : CABLE 1-1D (20m)
4	ELECTRICAL CABLE : CABLE 1-2 (20m)
5	ELECTRICAL CABLE : CABLE 1-3 (20m)

**INSTALLATION NOTICE**

No.	PART NAME
1	Installation Notice for CNA-61D



SYMBOL	NAME	REMARKS	UL FILE NO.	SYMBOL	NAME	REMARKS	UL FILE NO.
BZ	BUZZER	DC24V	E44592	SW1	MAIN POWER SWITCH	POWER	E90584
C	FAN MOTOR RUNNING CAPACITOR	FOR FM	E83871	SW2	COLD HEAD DRIVE SWITCH	FOR COLD HEAD	E35901
CH	COLD HEAD MOTOR	FIELD SUPPLY		SW3	REMOTE DRIVE SWITCH	INT-EXT	E35901
CM	MOTOR-COMPRESSOR	AC480V	SA4960	SW4	DRIVE SWITCH (RUNNING SWITCH)	RUN	E35901
CNP	CONNECTOR FOR FAN MOTOR		E60389	SW5	INPUT VOLTAGE SELECTION SWITCH	380V-480V	E68981
CNS	CONNECTOR FOR FAN MOTOR		E60389	TB1	TERMINAL BASE	800V 70A 3P POWER	E60893
F1-3	FUSE	4A 250VAC	E39265	TB2	TERMINAL BASE	800V 80A 3P POWER	E70906
F4-6	FUSE	2A 600VAC	E2137	TB3	TERMINAL BASE	300V 10A 9P POWER	E70906
FM	COOLING FAN MOTOR	AC200V	E104758	TB4	TERMINAL BASE	800V 10A 10P CONTROL	E70906
GL	OPERATION INDICATION LAMP	DC24V	E44592	TB5	TERMINAL BASE	800V 80A 3P POWER	E70906
H1-6	HEATER	AC200V 20W	SA6865	TB6	TERMINAL BASE	300V 10A 9P POWER	E70906
HM	TIME COUNTER	DC24V	E67871	TB7	TERMINAL BASE	800V 10A 10P CONTROL	E70906
JC	CONNECTOR FOR COLD HEAD	4P 13A250V	E67741				
JR	CONNECTOR FOR EXTERNAL	15P D-SUB		TH1	THERMOSTAT	30°C OPEN 20°C CLOSE	E43273
JRB	CONNECTOR FOR BUZZER UNIT	9P D-SUB		TH2	THERMOSTAT	10°C OPEN 6°C CLOSE	E43867
JRBP	CONNECTOR FOR BUZZER UNIT	9P D-SUB		TR	TRANSFORMER	380V-480V/200V	SA11906SP
JRBU	CONNECTOR FOR BUZZER UNIT	9P D-SUB					
JRBUP	CONNECTOR FOR BUZZER UNIT	9P D-SUB		26G	TEMPERATURE LIMITOR	OFF ABOVE 120°C	E50387
YL1	PRESSURE DROP INDICATION LAMP	DC24V	E44592	2T1.2	TIME DELAY RELAY	DC24V 1sec 2A250VAC/10VDC	E41515
YL2	OVER TEMPERATURE INDICATION LAMP	DC24V	E44592	4X1-7	AUXILIARY RELAY	DC24V 5A240VAC/28VDC	E41515
PE	GROUND TERMINAL		E52164	47C	PHASE FAILURE RELAY	5A	E42240
RSW	BUZZER RESET SWITCH	AC600V 10A	E44592	49C	OVER TEMPERATURE PROTECTOR	OFF ABOVE 130°C	E16962
SPS	SWITCHING POWER SUPPLY	AC240-240V0.6A/DC24V1.1A	E106644	51CM	THERMAL OVERLOAD RELAY	12A-18A	
SVC	SOLENOID VALVE COIL	AC200V	MH12118	52CM	MAGNETIC CONTACTOR	AC200V	E42419
				52CH	POWER RELAY	AC200V 10A240VAC	E41643
				63PL	LOW PRESSURE SWITCH	OFF BELOW 0.098MPa	E43867



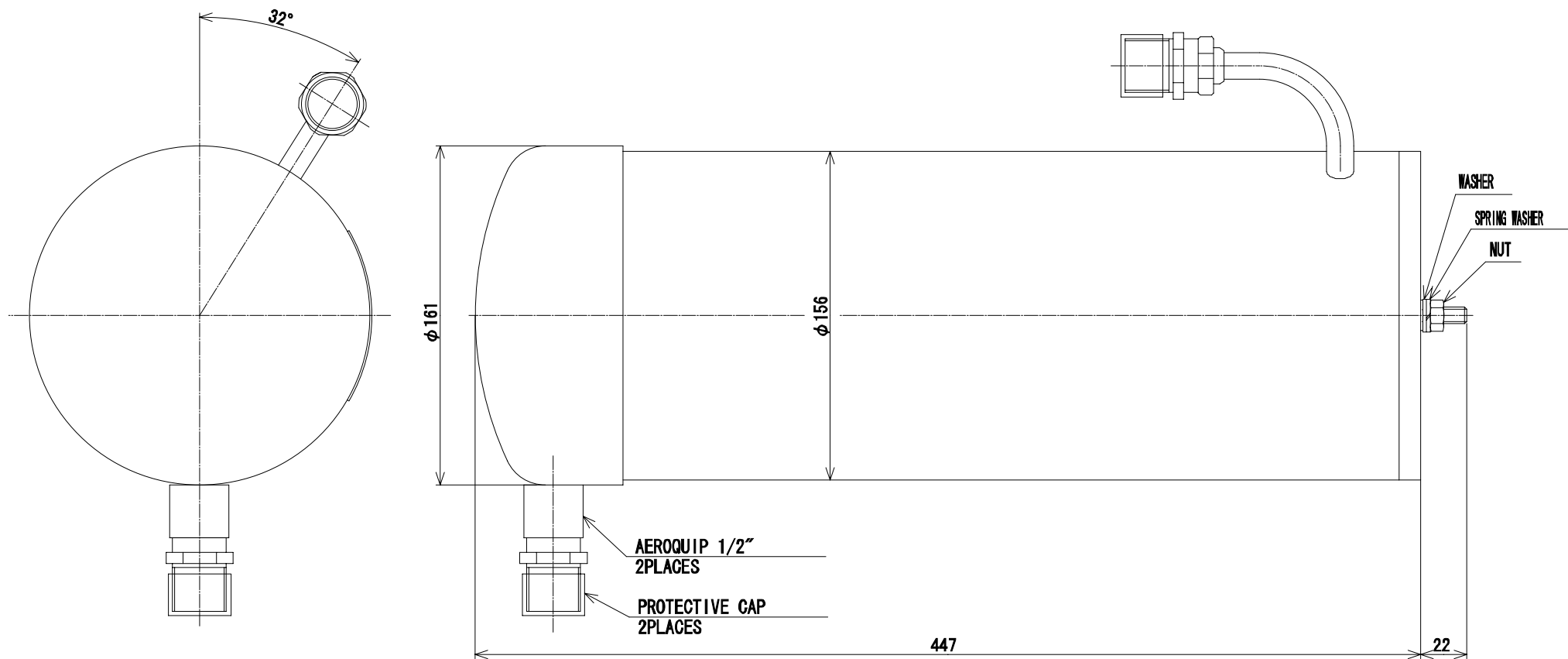
MOTOR-COMPRESSOR  
LRA=71A/76A

COOLING FAN MOTOR  
FLA=0.6A/0.71A  
LRA=0.7A/0.71A

COLDHEAD MOTOR  
FULL LOAD CURRENT=0.5A  
STARTING CURRENT=0.5A

NOTE  
1. ----- SHOWS FIELD WIRING  
2. [ ] SHOWS OUT OF IN-DOOR UNIT.  
(SHOWS OUT-DOOR UNIT)

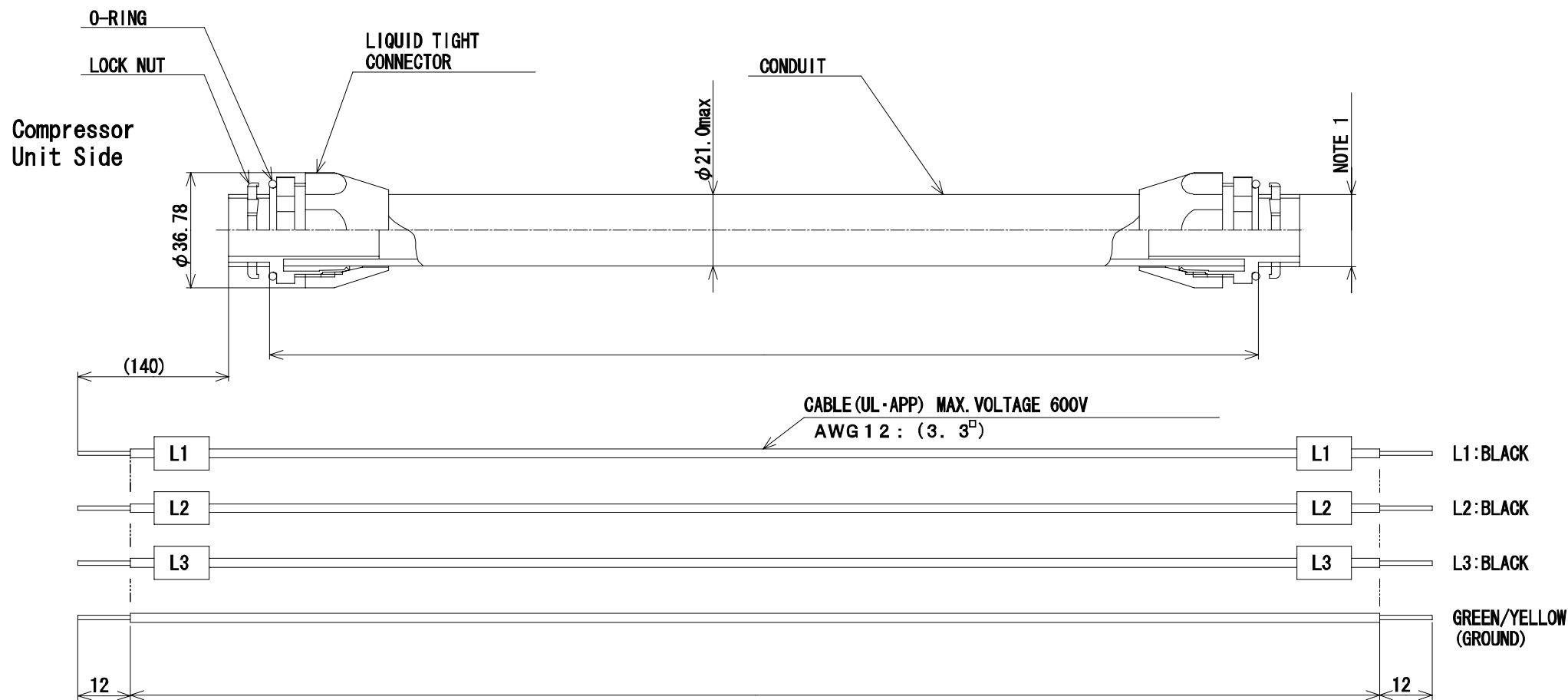
ELECTRICAL SCHEMATIC WIRING DIAGRAM



#### NOTE

- (1) CHARGED HELIUM GAS 16.5 kg (16.5 MPa).
- (2) WEIGHT 11 kg.

## ADSORBER

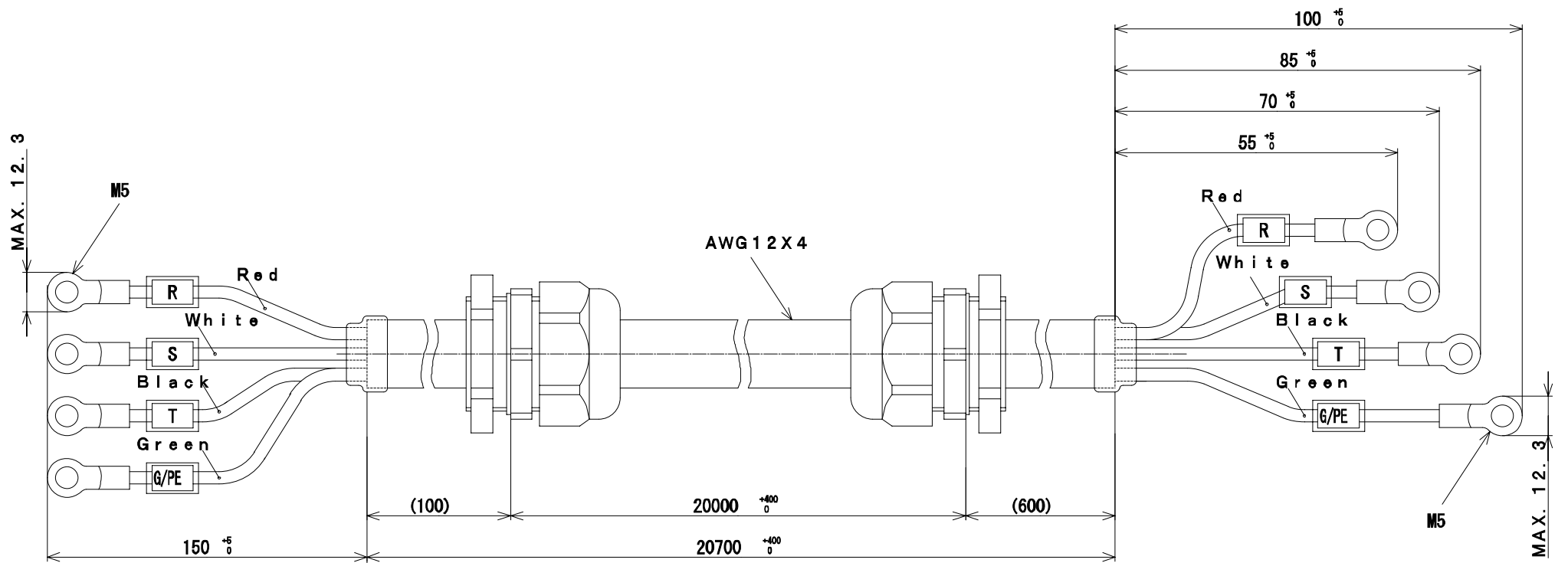


# NOTE

(1) HOLE SIZE : MIN  $\phi 22mm$ .

(2) PART TO BE BAGGED OR BOXED AND SEALED FROM DIRT AND MOISTURE.

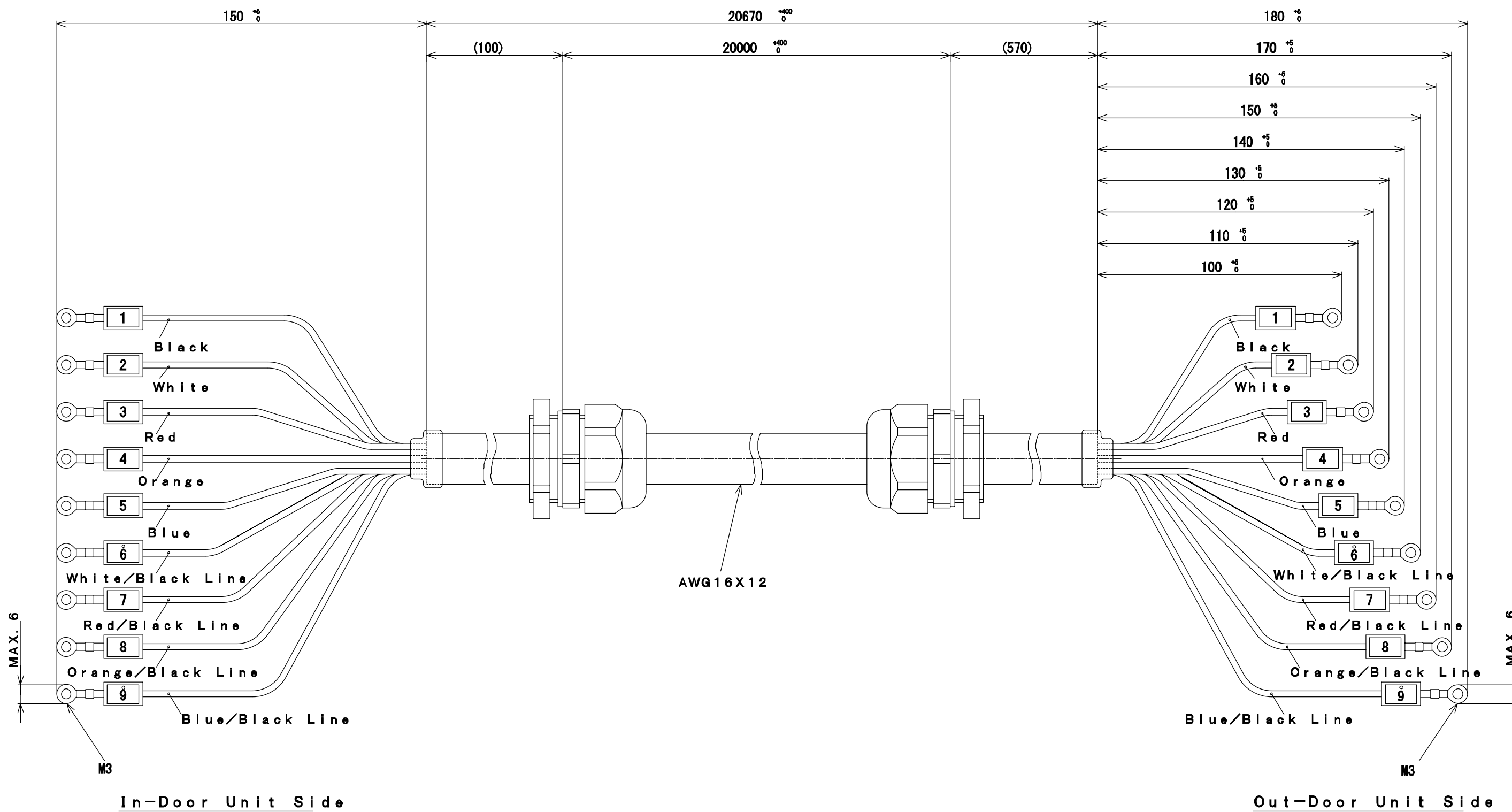
INPUT POWER CABLE HV



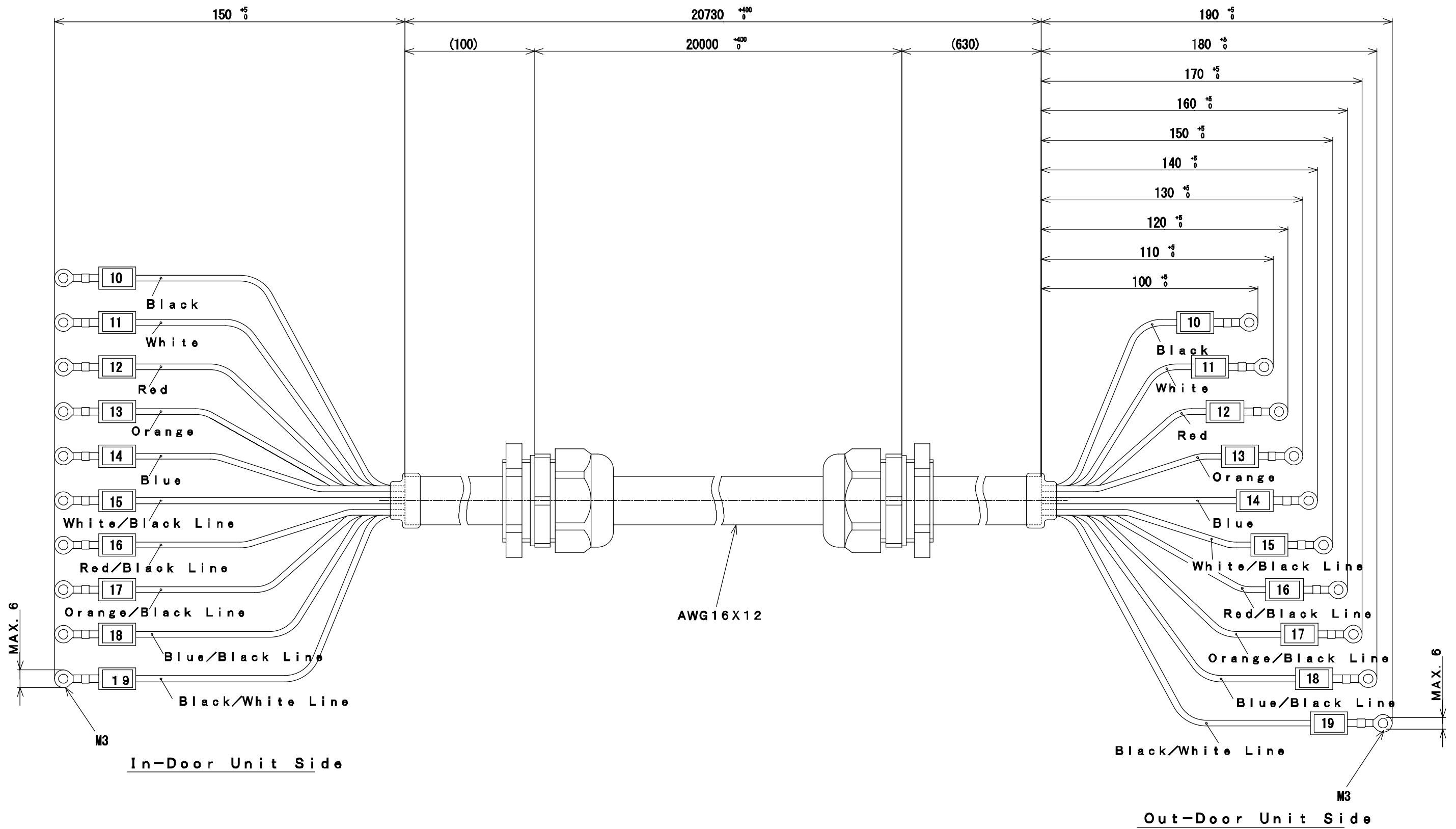
In-Door Unit Side

Out-Door Unit Side

**CABLE 1-1D (20m)**



**CABLE 1-2 (20m)**



CABLE 1-3 (20m)



Sumitomo Heavy Industries, Ltd.

MANUAL NUMBER: CD32ZZ-174F

DATE: January 12 / 2006

# **INSTALLATION NOTICE**

## ***For CNA-61D OUTDOOR USED COMPRESSOR UNIT***

***For Service Personnel Only***

***Sumitomo Heavy Industries, Ltd.  
Cryogenics Division***

***2-1-1 Yato-cho, Nishitokyo-City,  
Tokyo 188-8585, Japan***

**E-mail: [cryo@shi.co.jp](mailto:cryo@shi.co.jp)  
URL: <http://www.shicryogenics.com>**



**Notes to the person who is responsible for the electrical installation of the CNA-61D Compressor Unit**

- 1) The CABLE 1-1D<sup>1</sup>, 1-2<sup>2</sup>, and 1-3<sup>3</sup> are recommended by SHI and supplied with the CNA-61D helium compressor. If these cables do not conform to national and local electrical code regulations, the person who is in charge of the electrical installation must exchange the cables so that any national and local electrical code regulations and the electrical requirements and specifications given by SHI (see table "Requirements and Specifications for the wires from SHI") are fulfilled.
- 2) Regarding the installation of the appropriate cables, the person who is in charge of the electrical installation of the cables must install the wires/cables so that the installation is conform to national and local electrical code regulations.
- 3) If any regulations require installing an electrical device (e.g. disconnecting switch), the person in charge of the electrical installation must select, obtain, and install this device regarding the national and local electrical code regulations.
- 4) The person who is in charge of the electrical installation must contact an electrical code inspector at the installation site for details of the local and national electrical code regulation requirements and to get a certificate that the installation is conform to all local and national electrical code regulations.
- 5) The person who is in charge of the electrical installation is responsible that the installation of the cables and wires is conform to all electrical code regulations.

Notes 1 ) "Type SEOOW" from COLEMAN CABLE Cat. No. 22428 (see cable drawing on page 16 and data sheet on page 4).

Notes 2) "Type STOW" from COLEMAN CABLE Cat. No. 31206 (see cable drawings on page 17 and data sheet on page 5).

Notes 3) "Type STOW" from COLEMAN CABLE Cat. No. 31206 (see cable drawings on page 18 and data sheet on page 5).

The following information is necessary to install the cables. Please halt the installation and contact SHI if you do not receive any of the following documents with your shipment.

a) System Configuration of the Cryocooler .....	p.3
b) Connection Diagram of the Electrical Cables between the Out-door Unit ..... and In-door Unit	p.3
c) Product data sheet of CABLE 1-1D .....	p.4
d) Product data sheet of CABLE 1-2, 1-3 .....	p.5
e) Requirements and Specifications for the wires from SHI .....	p.6
f) Position of the pass through hole and terminals of each unit .....	p.7
g) SHI recommendations for wiring a CNA-61D Compressor Unit ..... according to the NEC (National Electrical Code, US)	p.12
h) Electrical Schematic of CNA-61D Compressor Unit .....	p.15
i) Drawings of the CABLE 1-1D, 1-2, 1-3 .....	p.16

a) System Configuration of the Cryocooler

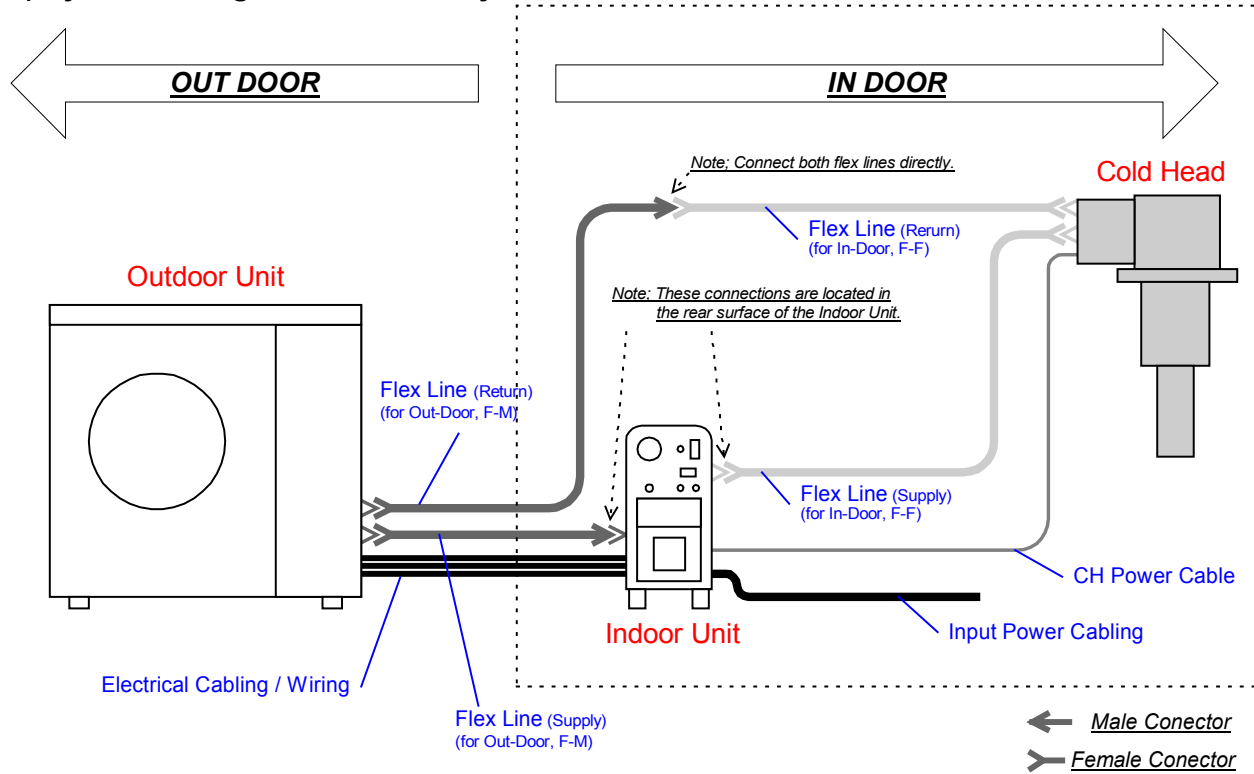


Figure 1 SYSTEM CONFIGURATION OF THE CRYOCOOLER

b) Connection Diagram of the Electrical Cables between the Out-door Unit and In-door Unit

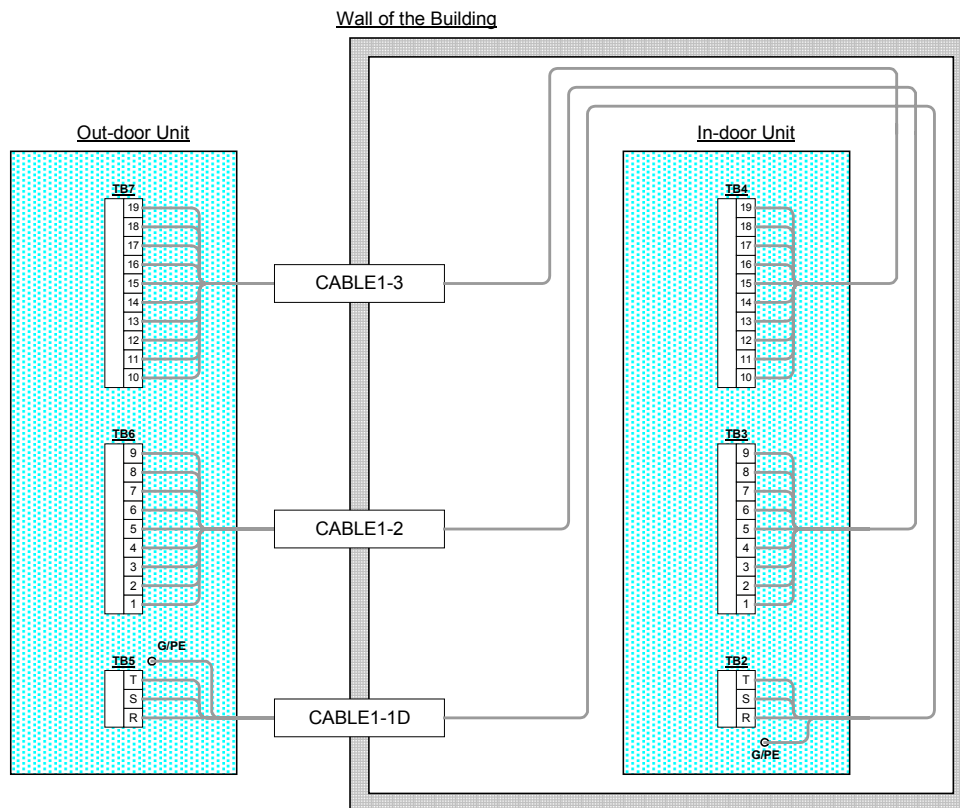


Figure 2 CONNECTION DIAGRAM OF THE ELECTRICAL CABLES BETWEEN THE OUT-DOOR UNIT AND IN-DOOR UNIT

**c) Product data sheet of CABLE 1-1D**



**PRODUCT DATA SHEET**

1586 South Lakeside Drive  
Waukegan, IL 60185  
Toll-Free (800) 323-9355  
Fax: (847) 689-1192

**PART NUMBER:** 22428  
**DESCRIPTION:** 12/4 STRANDED TYPE SEOWW SUBMERSIBLE FLEXIBLE POWER CABLE  
**CONSTRUCTION:** This cable consists of four bare copper insulated conductors cabled with fillers and an overall jacket.  
**APPROVALS:** UL Standard 62, CSA 22.2 No. 49, NEC Article 400.  
**APPLICATION:** 600V Portable Oil and Water Resistant Submersible Outdoor Flexible Power Cable

**Construction Parameters:**


Conductor	12 AWG Bare Copper
Stranding	65/30
Insulation Material	105C TPE
Insulation Thickness	0.046" Nom.
Insulated Conductor Diameter	0.184" Nom.
Number of Conductors	4
Lay Length	3.75" Nom.
Filler Type	Polypropylene
Separator/Wrap	Paper Tissue
Jacket Material	105C TPE
Jacket Thickness	0.097" Nom.
Overall Cable Diameter	0.645" Nom.
Approximate Cable Weight	247.4 Lbs/1M' Nom.
Flame Rating	UL/CSA Horizontal Flame Test

**Electrical Properties:**

Temperature Rating	-50°C to 105°C
Operating Voltage	600 V RMS Max.
DC Resistance per Conductor @ 20°C	1.59 Ohms/1M' Nom.
Max Ampacity per Conductor (Per NEC Table 400-5a)	20 amps/cond (Assume three current carrying conductors) (Note: Because of 105C temperature rating, higher current can be used under engineering supervision)

Insulation Colors	Black White Red Green
Jacket Color	Black (Other colors available for minimum order)

**Legend**

 **COLEMANCABLE** SEOPRENE 105 12 AWG (3.30mm<sup>2</sup>)  
4/C SEOWW (UL) 600V -50C TO 105C CSA LL39753 STOWW(TPE)  
-50C TO 105C FT2 WATER RESISTANT  
(White Surface Ink Print - P-241-3-MSHA in indent)

On special orders, the customer will accept all factory lengths and +/- 10 percent of total order requested.

The information presented here is, to the best of our knowledge, is true and accurate. However, since conditions of use are beyond our control, all recommendations or suggestions are presented without guarantee or responsibility on our part. We disclaim all liability in connection with the use of information contained herein or otherwise.

This specification is proprietary intellectual property of Coleman Cable. Any information contained herein shall not be disclosed to any party without written consent of Coleman Cable.

Customer Name \_\_\_\_\_ Date Signed \_\_\_\_\_

Customer Approval \_\_\_\_\_

Specification Issue Date: February 10, 2004

1-800-323-9355 (Phone)  
1-847-689-1192 (Fax)

22428

Designed By: PEP  
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**Figure 3 PRODUCT DATA SHEET OF CABLE 1-1D**

**d) Product data sheet of CABLE 1-2, 1-3**



**COLEMANCABLE**

Toll-Free (800) 323-9355

Wiring The World

Fax: (847) 689-1192

**PRODUCT DATA SHEET**

PART NUMBER: 31206  
 DESCRIPTION: 16/12 STRANDED TYPE SEOW FLEXIBLE POWER CABLE  
 CONSTRUCTION: This cable consists of twelve bare copper insulated conductors cabled with fillers and an overall jacket.  
 APPROVALS: UL Standard 62, CSA 22.2 No. 49, NEC Article 400.  
 APPLICATION: 600V Portable Oil and Water Resistant Outdoor Flexible Power Cable

**Construction Parameters:**

Conductor	16 AWG Bare Copper
Stranding	26/30
Insulation Material	TPE
Insulation Thickness	0.031" Nom.
Insulated Conductor Diameter	0.120" Nom.
Number of Conductors	12
Lay Length	6.75" Nom.
Filler Type	Polypropylene
Separator/Wrap	Paper Tissue
Jacket Material	TPE
Jacket Thickness	0.095" Nom.
Overall Cable Diameter	0.690" Nom.
Approximate Cable Weight	280.1 Lbs/1M' Nom.
Flame Rating	UL/CSA Horizontal Flame Test

**Electrical Properties:**

Temperature Rating	-40°C to 105°C
Operating Voltage	600 V RMS Max.
DC Resistance per Conductor @ 20°C	4.00 Ohms/1M' Nom.

Insulation Colors	Black White Red Green Orange Blue White/Black Red/Black Green/Black Orange/Black Blue/Black Black/White
Jacket Color	Black (Other colors available for minimum order - consult factory)
Legend (White Surface Ink Print - MSHA in indent)	COLEMAN CABLE SEOPRENE 105 16-12 SEOW (UL) 600V 105C P-241-3- MSHA CSA LL39753 16-12 STOW (TPE) 105C(-50C) FT2 WATER-RESISTANT

On special orders, the customer will accept all factory lengths and +/- 10 percent of total order requested.

The information presented here is, to the best of our knowledge, is true and accurate. However, since conditions of use are beyond our control, all recommendations or suggestions are presented without guarantee or responsibility on our part. We disclaim all liability in connection with the use of information contained herein or otherwise.

This specification is proprietary intellectual property of Coleman Cable. Any information contained herein shall not be disclosed to any party without written consent of Coleman Cable.

Customer Name \_\_\_\_\_ Date Signed \_\_\_\_\_

Customer Approval \_\_\_\_\_

Specification Issue Date: June 19, 1998

1-800-323-9355 (Phone)  
 1-847-689-1192 (Fax)

31206

Designed By: PEP  
 Specification Print Date: 10/12/99  
 © 1998 Coleman Cable Systems, Inc.

**Figure 4 PRODUCT DATA SHEET OF CABLE 1-2, 1-3**

**e) Requirements and Specifications for the wires from SHI**

**Table 1 REQUIREMENTS AND SPECIFICATIONS FOR THE WIRES FROM SHI**

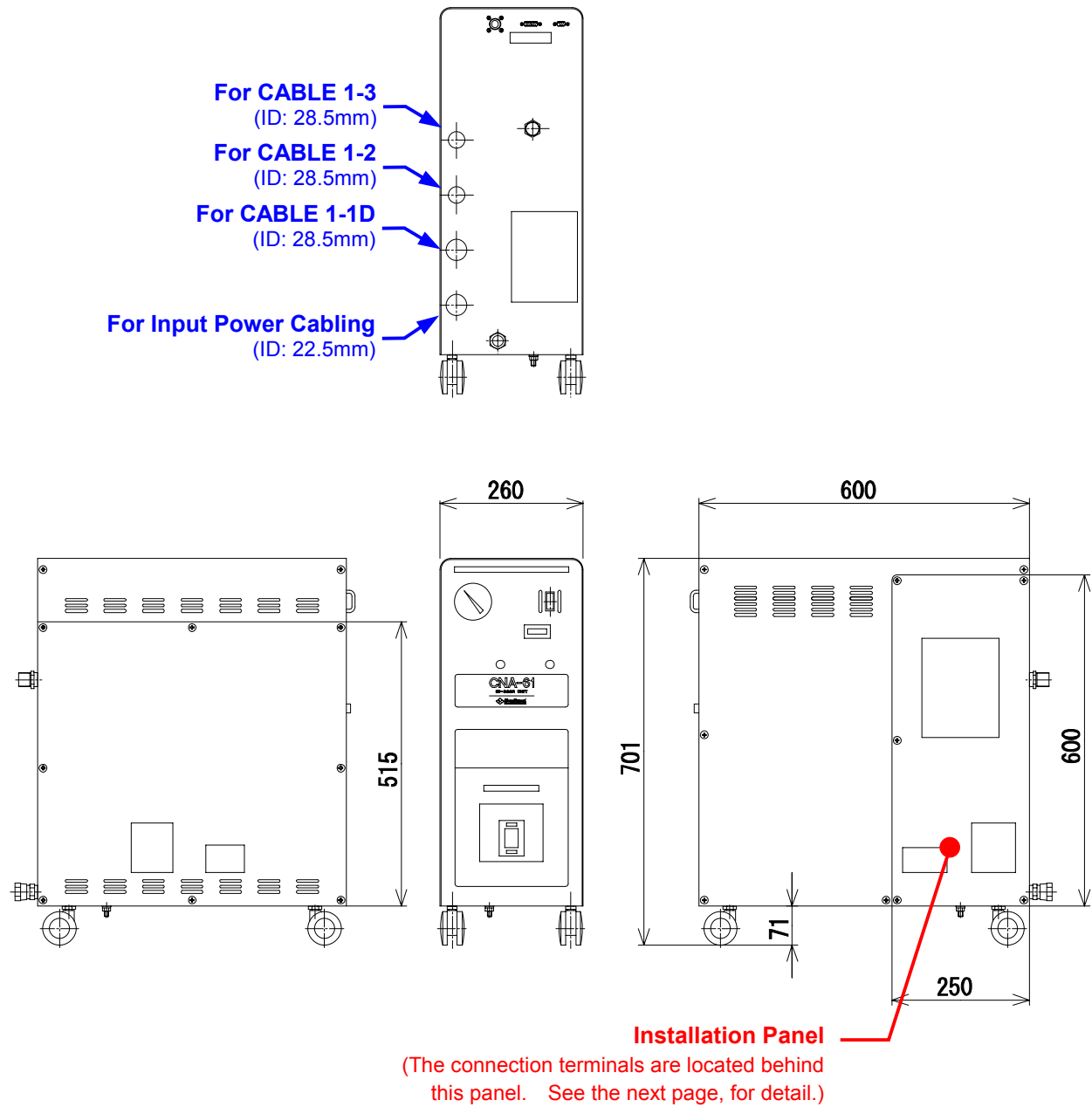
	for CABLE 1-1D		for CABLE 1-2	for CABLE 1-3	for Input Power Cabling	
Maximum length	30m		30m	30m	30m	
Numbers of the wire	3 conductors and 1 ground		9 conductors	10 conductors	3 conductors and 1 ground	
Pass through hole size of each unit	ID 28.5mm (see Notes 5)		ID 28.5mm (see Notes 5)	ID 28.5mm (see Notes 5)	ID 22.5mm	
Thickness of unit panel						
In-door Unit	t 2.3mm		t 2.3mm	t 2.3mm	t 2.3mm	
Out-door Unit	t 3.2mm		t 3.2mm	t 3.2mm	N/A	
Use	Power Line for the Compressor Capsule	Ground Line	Control line for AC	Control Line for DC	Input Power Line	Ground Line
Indication	R, S, T	G/PE	1 to 9	10 to 19	L1, L2, L3	GND
Connect terminal No.						
In-door Unit side	TB2		TB3	TB4	TB1	
(Tighten torque)	2.0Nm		0.8Nm	0.8Nm	1.3Nm	1.8Nm
Out-door Unit side	TB5		TB6	TB7	N/A	
(Tighten torque)	2.0Nm		0.8Nm	0.8Nm	N/A	
Wire size	Min. AWG12		Min. AWG16	Min. AWG16	Min. AWG12	
Conductor material	Copper		Copper	Copper	Copper	
Temperature rating	Min. 75deg.C		Min. 75deg.C	Min. 75deg.C	Min. 75deg.C	
Voltage rating	Min. 600V		Min. 600V	Min. 600V	Min. 600V	
Recommended Wire Type	TYPE THHN or THWN or THHW		TYPE THHN or THWN or THHW	TYPE THHN or THWN or THHW	TYPE THHN or THWN or THHW	
(Operating voltage)	480VAC	N/A	200VAC	24VDC	480VAC	N/A
(Operating current)	Max. 13.5A	N/A	Max. 0.71A	Max. 1.1A	Max. 13.5A	N/A
Shield	Not Required		Not Required	Not Required	Not Required	
Recommended insulation color	Black (see Notes 2)	Green with Yellow Line	Red (see Notes 2, 3)	Blue (see Notes 2)	Black	Green with Yellow Line
Terminal treatment	UL approved Ring Terminal (for M5 Bolt: ID 5.5mm, OD 12.3mm or less)		UL approved Ring Terminal (for M3 Bolt: ID 3.5mm, OD 5.5mm or less)	UL approved Ring Terminal (for M3 Bolt: ID 3.5mm, OD 5.5mm or less)	Bare Line (Striping Length : 12mm)	
Extra length to the terminal from the unit surface for easy installation						
In-door Unit side	approx. 250mm		approx. 250mm	approx. 250mm	approx. 140mm	
Out-door Unit side (see Notes 4)	approx. 700mm		approx. 750mm	approx. 800mm	N/A	

**Notes:**

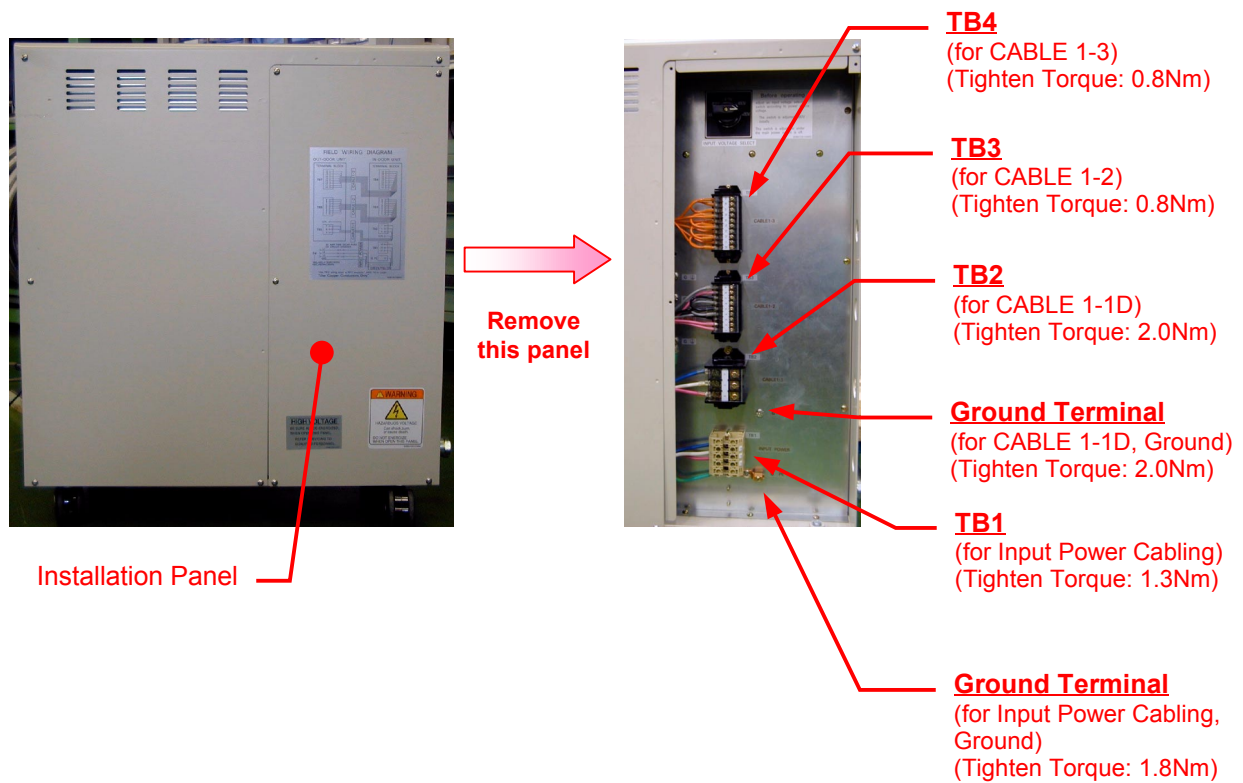
- 1) Be sure to do the indication which is the same as the indication of the connection terminal at the end of each wires to prevent mis-wiring.
- 2) You had better color coded the wiring to prevent mis-wiring.
- 3) Be extremely careful not to mis-wiring the wiring No.6 and No.9.
- 4) This extra length must not touch the compressor capsule and internal piping.
- 5) Make sure that the connection between the conduit (required by NEC or other local regulations) and the Out-door Unit is water tight.

**f) Position of the pass through hole and terminals of each unit**

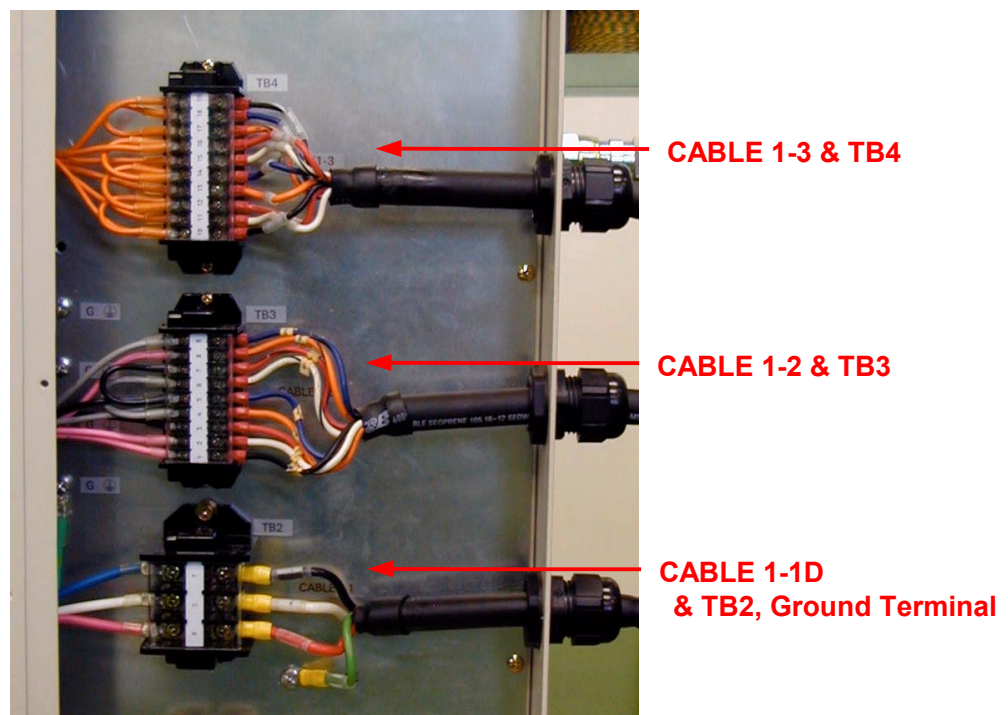
**1) In-door Unit**



**Figure 5 PASS TROUGH HOLE POSITION OF IN-DOOR UNIT**

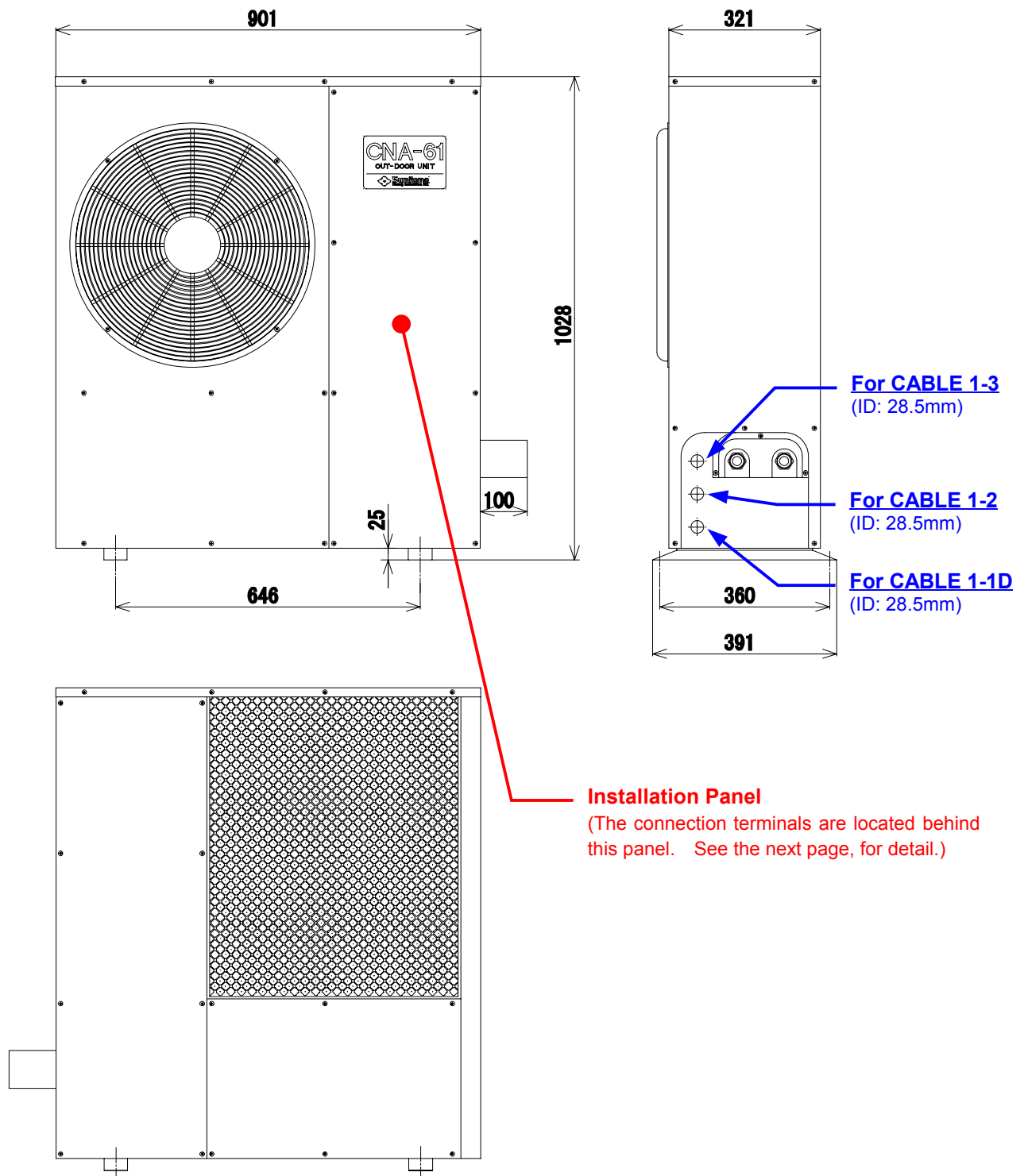


**Figure 6 CONNECTION TERMINALS OF IN-DOOR UNIT**

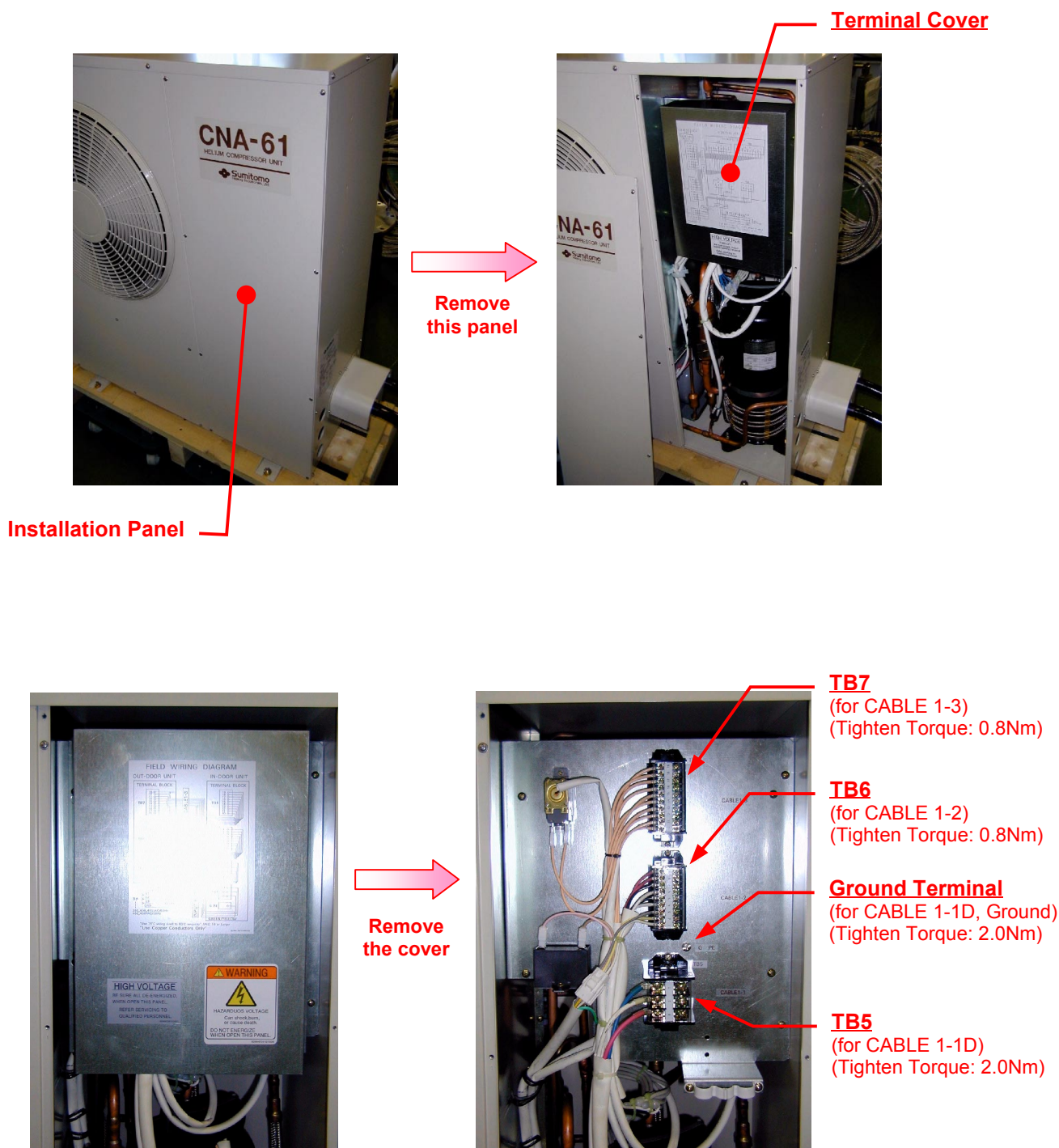


**Figure 7 EXAMPLE OF CABLE CONNECTION FOR IN-DOOR UNIT**

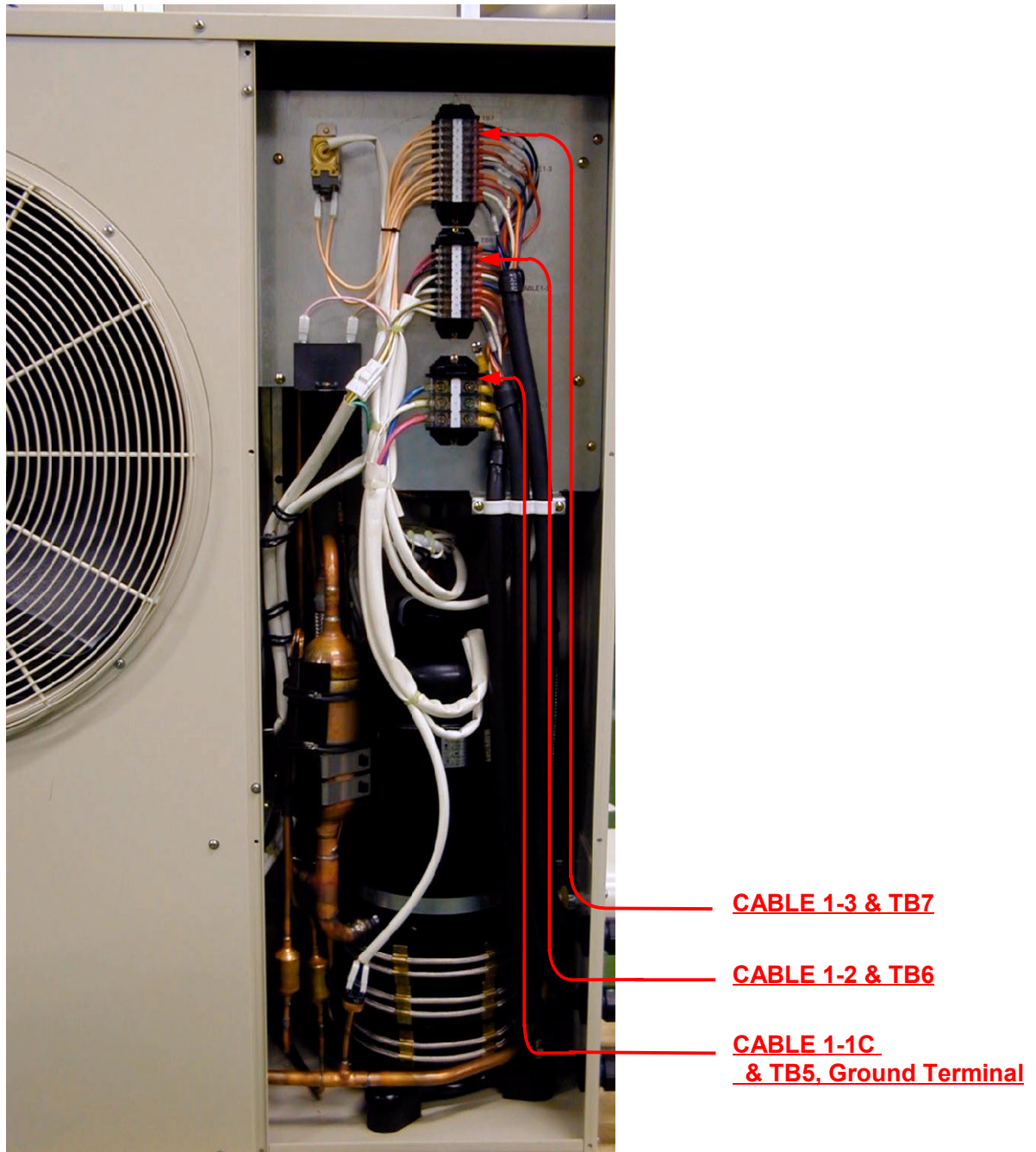
## 2) Out-door Unit



**Figure 8 PASS TROUGH HOLE POSITION OF OUT-DOOR UNIT**



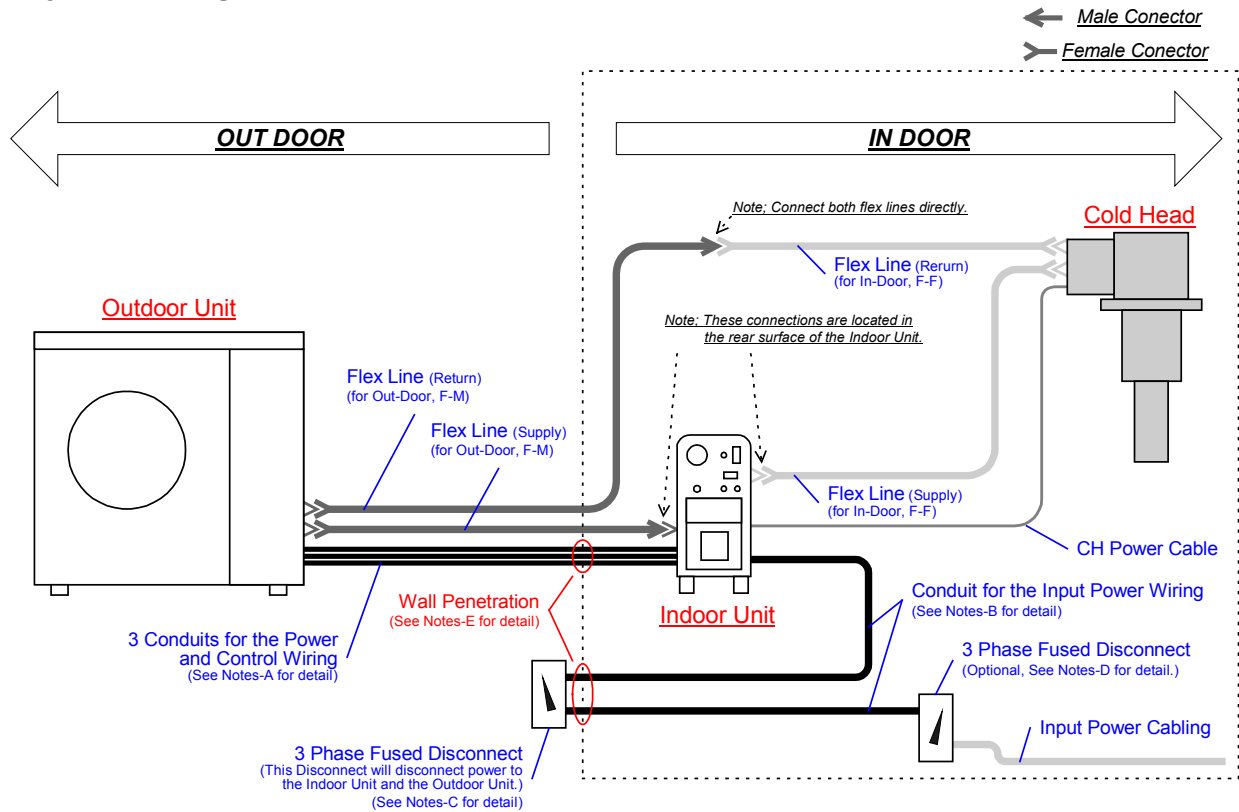
**Figure 9 CONNECTION TERMINALS OF OUT-DOOR UNIT**



**Figure 10 EXAMPLE OF CABLE CONNECTION FOR OUT-DOOR UNIT**

**g) SHI recommendations for wiring a CNA-61D Compressor Unit according to the NEC (National Electrical Code, US)**

**<System Configuration>**



**<NOTES>**

This section does not include local electrical code requirements due to the specific nature of these requirements in each locale.

Wiring and protection recommendations listed below conform to NEC (National Electrical Code) requirements. Local electrical code restrictions may also apply.

Please contact the local code inspector for additional requirements prior to installation.

**Notes-A; for the 3 Conduits for the Power and Control Wiring.**

We recommend use of UV rated “Flexible Metal Conduit” or “Rigid Metal Conduit” for the installation of power and control wiring. However, “Flexible Metal Conduit” may not be acceptable in hazardous locations or locations where conduit will be easily damaged. NEC article 344, 350 and 351.

We recommend using as a minimum; 3/4” conduit for each of the one power wiring conduit (Replacement of the Cable1-1D; Min. 12AWG x4) and the two control wiring conduits (Replacement of the Cable1-2; Min.16AWG x9, Replacement of the Cable1-3; Min.16AWG x10).

Wiring shall be Type THHN or THWN or THHW for commercial type installations rated for 600V. The wiring can be color coded to match existing terminals as well as terminated with ring terminal connections.

Liquid-tight or rigid conduit connections will need to be installed on the Outdoor Unit housing and the Indoor Unit.

Make sure that the connection between the conduit and the Outdoor Unit housing is water tight.

About the Requirements and Specifications for the wires, see the **page 6** for more detail.

**Notes-B; for the Conduit for the Input Power Wiring.**

We recommend use of UV rated “Flexible Metal Conduit” or “Rigid Metal Conduit” for the installation of power and control wiring. However, “Flexible Metal Conduit” may not be acceptable in hazardous locations or locations where conduit will be easily damaged. NEC article 344, 350 and 351.

We recommend using as a minimum; 1/2” conduit. (Min.12AWG x4)

Wiring shall be Type THHN or THWN or THHW for commercial type installations rated for 600V. The wiring can be color coded to match existing terminals as well as terminated with ring terminal connections.

Liquid-tight or rigid conduit connections will need to be installed on the Indoor Unit housing and the Disconnect Switch housing.

Make sure that the connection between the conduit and the Disconnect Switch housing is water tight.

About the Requirements and Specifications for the wires, see the **page 6** for more detail.

**Notes-C; for the 3 Phase Fused Disconnect in the outdoor.**

A 3 Phase Fused Disconnect must be installed within sight of the Outdoor Unit and plainly labeled as the 'disconnect' for the Indoor Unit and the Outdoor Unit. NEC article 440.

This Disconnect should be fused to protect the 12AWG conductors at 30 amp or less. Fuses should be sized to protect the cables.

This Disconnect must be lockable and weather-tight.

Outdoor rated unit required.

The indoor unit should be labeled to indicate that the power disconnect is located at the outdoor unit.

**Notes-D; for the 3 Phase Fused Disconnect in the indoor.**

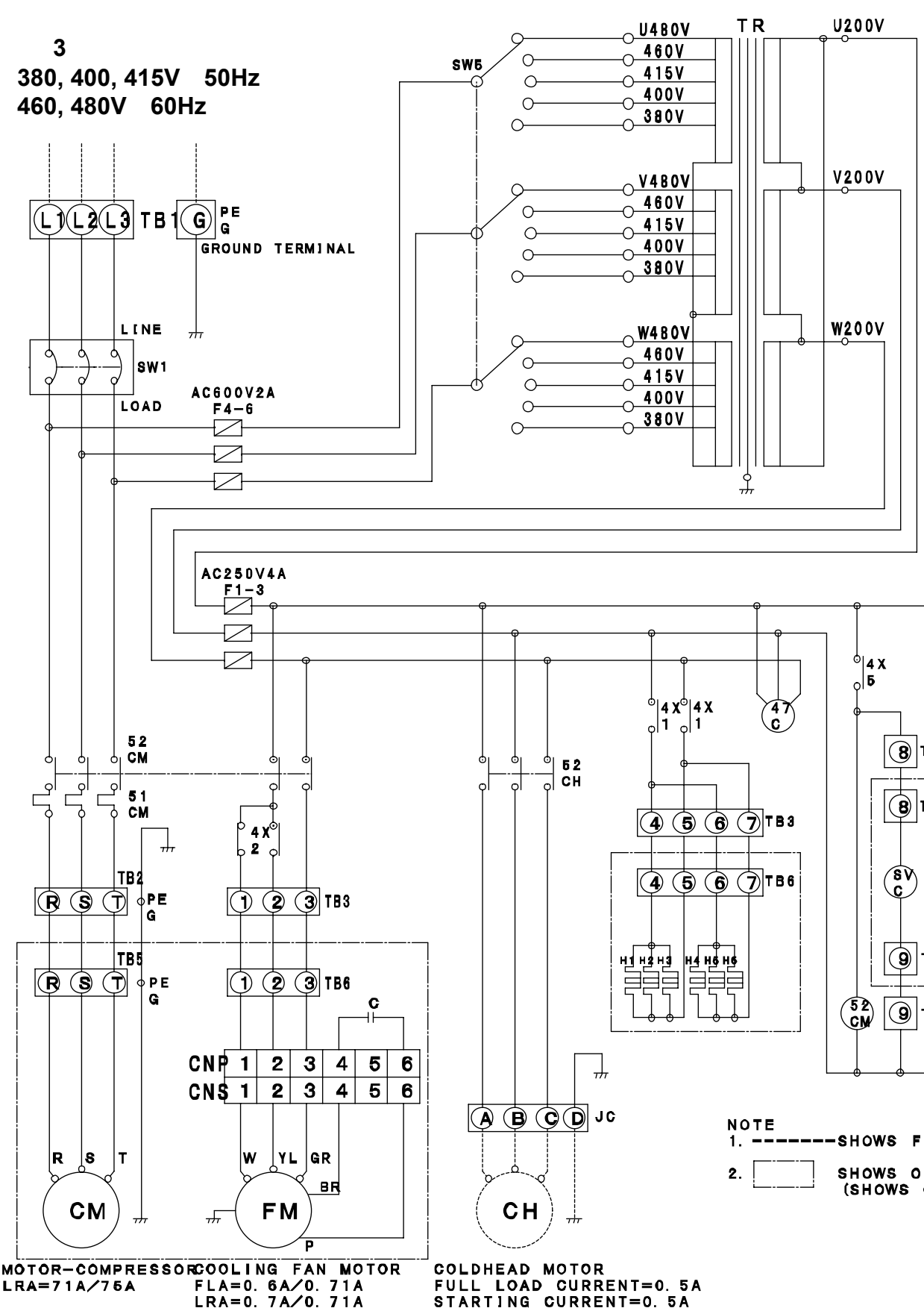
An additional Disconnect for main power maybe required in the room where the Indoor Unit is installed. If a Power Disconnect in the form of a breaker or fused disconnect is available in the room, this fused disconnect will not be necessary. The main disconnect shall be labeled as the main disconnect for the indoor/outdoor cryogenic unit.

This Disconnect should be fused to protect the 12AWG conductors at 30 amp or less. Fuses should be sized to protect the cables.

**Notes-E; for the Wall Penetration.**

The penetration of conduits through the exterior wall will need to comply with NEC article 300.21 and the National fire code.

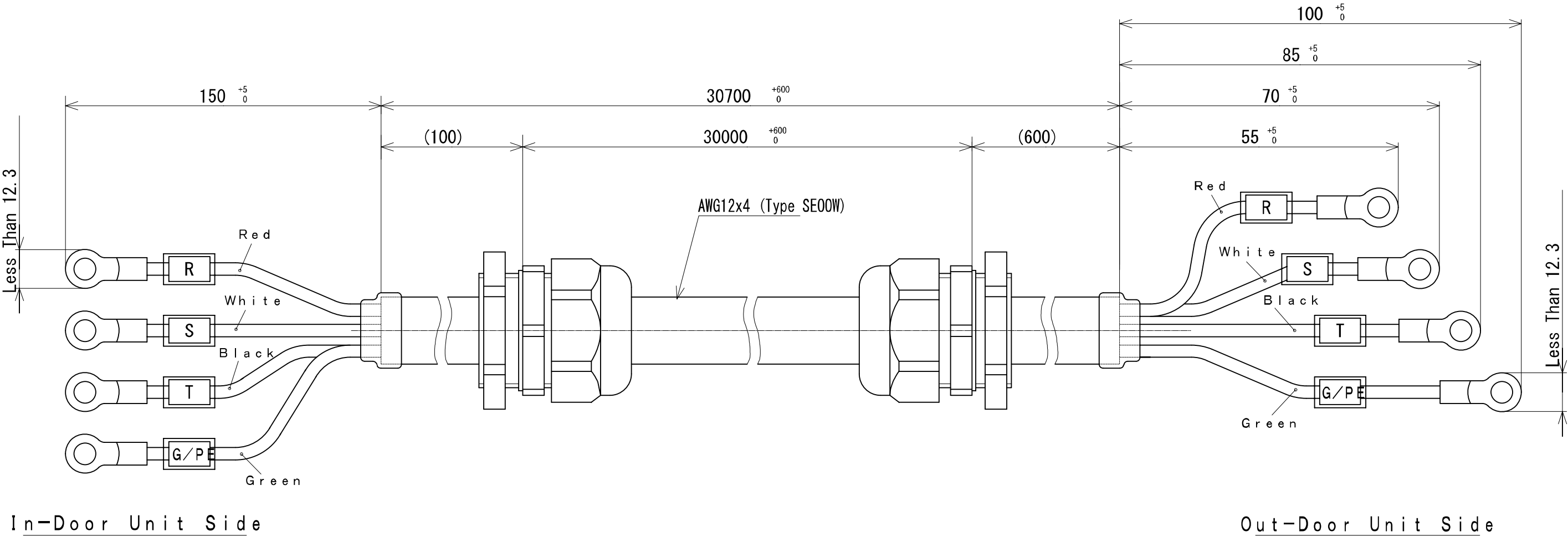
Fire code rating of wall must be preserved.



SYMBOL	NAME	REMARKS	UL FILE NO.	SYMBOL	NAME	REMARKS	UL FILE NO.
BZ	BUZZER	DC24V	E44592	SW1	MAIN POWER SWITCH	POWER	E90584
C	FAN MOTOR RUNNING CAPACITOR	FOR FM	E83871	SW2	COLD HEAD DRIVE SWITCH	FOR COLD HEAD	E35901
CH	COLD HEAD MOTOR	FIELD SUPPLY		SW3	REMOTE DRIVE SWITCH	INT-EXT	E35901
CM	MOTOR-COMPRESSOR	AC480V	SA4960	SW4	DRIVE SWITCH (RUNNING SWITCH)	RUN	E35901
CNP	CONNECTOR FOR FAN MOTOR		E60389	SW5	INPUT VOLTAGE SELECTION SWITCH	380V-480V	E68981
CNS	CONNECTOR FOR FAN MOTOR		E60389	TB1	TERMINAL BASE	800V 70A 3P POWER	E60693
F1-3	FUSE	4A 260VAC	E39265	TB2	TERMINAL BASE	800V 80A 3P POWER	E70906
F4-6	FUSE	2A 600VAC	E2137	TB3	TERMINAL BASE	300V 10A 9P POWER	E70906
FM	COOLING FAN MOTOR	AC200V	E104758	TB4	TERMINAL BASE	300V 10A 10P CONTROL	E70906
GL	OPERATION INDICATION LAMP	DC24V	E44592	TB5	TERMINAL BASE	800V 80A 3P POWER	E70906
H1-6	HEATER	AC200V 20W	SA6865	TB6	TERMINAL BASE	300V 10A 9P POWER	E70906
HM	TIME COUNTER	DC24V	E67871	TB7	TERMINAL BASE	300V 10A 10P CONTROL	E70906
JC	CONNECTOR FOR COLD HEAD	4P 13A250V	E67741				
JR	CONNECTOR FOR EXTERNAL	15P D-SUB		TH1	THERMOSTAT	30°C OPEN 20°C CLOSE	E43273
JRB	CONNECTOR FOR BUZZER UNIT	9P D-SUB		TH2	THERMOSTAT	10°C OPEN 6°C CLOSE	E43867
JRBP	CONNECTOR FOR BUZZER UNIT	9P D-SUB		TR	TRANSFORMER	380V-480V/200V	SA119066P
JRBU	CONNECTOR FOR BUZZER UNIT	9P D-SUB					
JRBUP	CONNECTOR FOR BUZZER UNIT	9P D-SUB					
YL1	PRESSURE DROP INDICATION LAMP	DC24V	E44592	26G	TEMPERATURE LIMITOR	OFF ABOVE 120°C	E50367
YL2	OVER TEMPERATURE INDICATION LAMP	DC24V	E44592	2T1.2	TIME DELAY RELAY	DC24V 1s 3A250VAC/40VDC	E41515
PE	GROUND TERMINAL		E52164	4X1-7	AUXILIARY RELAY	DC24V 6A240VAC/28VDC	E41515
RSW	BUZZER RESET SWITCH	AC600V 10A	E44592	47C	PHASE FAILURE RELAY	5A	E42240
SPS	SWITCHING POWER SUPPLY	AC240-240V0.6A/DC24V1.1A	E106544	49C	OVER TEMPERATURE PROTECTOR	OFF ABOVE 130°C	E16962
SVC	SOLENOID VALVE COIL	AC200V	MH12113	51CM	THERMAL OVERLOAD RELAY	12A-18A	
				52CM	MAGNETIC CONTACTOR	AC200V	E42419
				52CH	POWER RELAY	AC200V 10A240VAC	E41843
				53PL	LOW PRESSURE SWITCH	OFF BELOW 0.098MPa	E43867

NOTE  
1. ----- SHOWS FIRED WIRING  
2. [ ] SHOWS OUT OF IN-DOOR UNIT.  
(SHOWS OUT-DOOR UNIT)

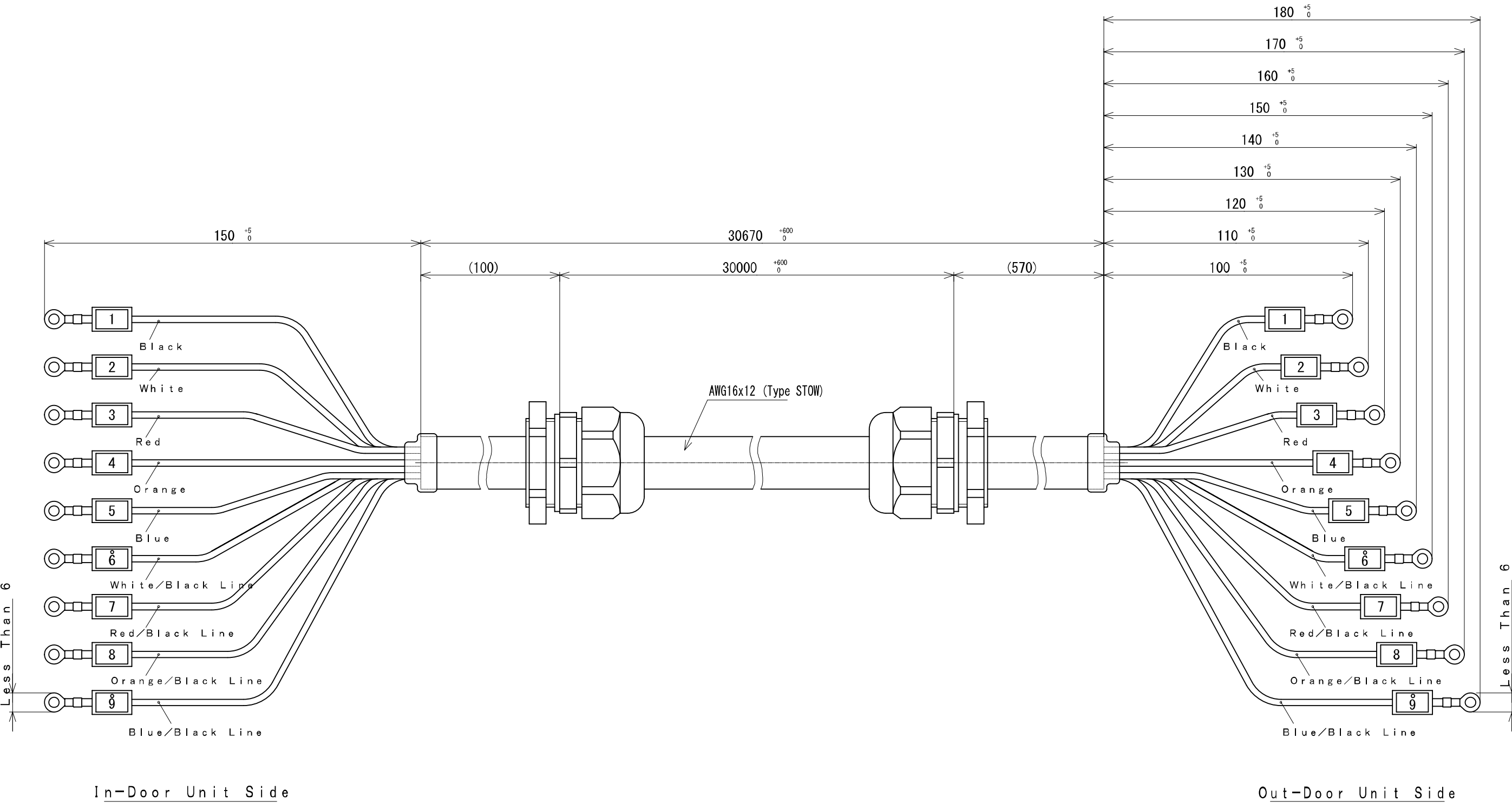
ELECTRICAL SCHEMATIC OF CNA-61D



CABLE1-1D (30m)

DRAWING OF THE CABLE 1-1D (30m)

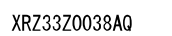
XRZ33Z0032AQ



CABLE1-2 (30m)

XRZ33Z0035AQ

DRAWING OF THE CABLE 1-2 (30m)



**for CNA-61D**

## REVISION CONTROL

Manual No.	Revision	Remarks	Date
CD32ZZ-174	-A	Publication of first edition.	APR. 09 / 2004
	-B	The "SHI Recommendation" was added.	MAY 28 / 2004
	-C	The "SHI Recommendation" was revised.	JUN. 17 / 2004
	-D	The System Configuration was corrected.	JUL. 19 / 2004
	-E	The description of the "Recommended Insulation Color for the Input Power Cable" in the Table 2.1 was corrected.	SEP. 14 / 2004
	-F	The information of the SHI inquiries and typographical error was corrected.	JAN. 12 / 2006

## REVISION CONTROL

## REVISION CONTROL

Manual No.	GE Revision	SHI Revision	Remarks	Date
CD32ZZ-181	Revision 0	-A	Publication of first edition.	JAN. 12 / 2006