YORK	DOUBLE EFFECT STEAM-FIRED ABSORPTION CHILLER	
INSTALLATION, OPERATION, MAINTENANCE	Supersedes: 155.31-ICOM2.EN.CE/GB (1117)	Form 155.31-ICOM2.EN.CE/GB (318)

Model YHAU-CW
Series EX and EXW
50 Hz
150 - 2000 TON
527 - 7,033 KW

LD22831

Issue Date:
March 29, 2018

IMPORTANT!

READ BEFORE PROCEEDING!

GENERAL SAFETY GUIDELINES

This equipment is a relatively complicated apparatus. During rigging, installation, operation, maintenance, or service, individuals may be exposed to certain components or conditions including, but not limited to: heavy objects, refrigerants, materials under pressure, rotating components, and both high and low voltage. Each of these items has the potential, if misused or handled improperly, to cause bodily injury or death. It is the obligation and responsibility of rigging, installation, and operating/service personnel to identify and recognize these inherent hazards, protect themselves, and proceed safely in completing their tasks. Failure to comply with any of these requirements could result in serious damage to the equipment and the property in which it is situated, as well as severe personal injury or death to themselves and people at the site.

This document is intended for use by owner-authorized rigging, installation, and operating/service personnel. It is expected that these individuals possess independent training that will enable them to perform their assigned tasks properly and safely. It is essential that, prior to performing any task on this equipment, this individual shall have read and understood the on-product labels, this document and any referenced materials. This individual shall also be familiar with and comply with all applicable industry and governmental standards and regulations pertaining to the task in question.

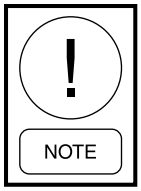
SAFETY SYMBOLS

The following symbols are used in this document to alert the reader to specific situations:

Indicates a possible hazardous situation which will result in death or serious injury if proper care is not taken.

Identifies a hazard which could lead to damage to the machine, damage to other equipment or environmental pollution if proper care is not taken or instructions and are not followed.

Indicates a potentially hazardous situation which will result in possible injuries or damage to equipment if proper care is not taken.



Highlights additional information useful to the technician in completing the work being performed properly.

External wiring, unless specified as an optional connection in the manufacturer's product line, is not to be connected inside the control cabinet. Devices such as relays, switches, transducers and controls and any external wiring must not be installed inside the micro panel. All wiring must be in accordance with Johnson Controls' published specifications and must be performed only by a qualified electrician. Johnson Controls will NOT be responsible for damage or problems resulting from improper connections to the controls or application of improper control signals. Failure to follow this warning will void the manufacturer's warranty and may cause serious damage to property or personal injury.

CHANGEABILITY OF THIS DOCUMENT

In complying with Johnson Controls' policy for continuous product improvement, the information contained in this document is subject to change without notice. Johnson Controls makes no commitment to update or provide current information automatically to the manual or product owner. Updated manuals, if applicable, can be obtained by contacting the nearest Johnson Controls Service office.

It is the responsibility of rigging, lifting, and operating/service personnel to verify the applicability of these documents to the equipment. If there is any question regarding the applicability of these documents, rigging, lifting, and operating/service personnel should verify whether the equipment has been modified and if current literature is available from the owner of the equipment prior to performing any work on the chiller.

CHANGE BARS

Revisions made to this document are indicated with a line along the left or right hand column in the area the revision was made. These revisions are to technical information and any other changes in spelling, grammar or formatting are not included.

ASSOCIATED LITERATURE

MANUAL DESCRIPTION	FORM NUMBER
Absorption Chiller Long Term Storage	50.20-NM11
Long-Term Storage Checklist - Absorption Chiller	50.20-CL10
Long-Term Storage Requirements - General	50.20-NM10
Chiller-Heater Start-up and Commissioning Checklist	155.31-CL1

NOMENCLATURE

YHAU C - W N 500 EX S JE LL

UNIT
York Absorption Unit

Design Symbol

TYPE OF ABSORPTION
W=Double Effect Steam

STEAM INLET PRESSURE
None:8bar.G(6.5bar.G<P)
N: 6bar.G(5bar.G≤P≤6.5bar.G)
L: 4bar.G(P<5bar.G)

Nominal Capacity (RT)

MODEL SERIES NAME
EX=150-800RT NOMINAL CAPACITY
EXW=900-1100RT NOMINAL CAPACITY
EXW3=1200-1600RT NOMINAL CAPACITY
EXW4=1000-2000RT NOMINAL CAPACITY

EFFICIENCY GRADE
NONE = HIGH EFFICIENCY
S = STANDARD EFFICIENCY

WASTE HOT WATER HEAT RECOVERY
NONE = NO HEAT RECOVERY
J = HEAT RECOVERY (STANDARD)
JE = HEAT RECOVERY (ENLARGED TYPE)

<Low Temp. CHW
L = 1.0°C CHW
LL = -5.0°C CHW

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

LIST OF FIGURES

LIST OF FIGURES (CONT'D)

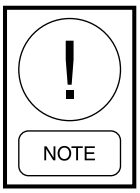
LIST OF TABLES

SECTION 1 – GENERAL CHILLER INFORMATION AND SAFETY

INTRODUCTION

YORK YHAU-CW Absorption chillers are manufactured to the highest design and construction standards to ensure high performance, reliability, and adaptability to all types of air conditioning installations.

This chiller is for air conditioning or cooling a manufacturing process. Use this chiller after installing the chilled water pump, cooling water pump, cooling tower, valves, strainers, pressure gauges, thermometers, or other necessary parts according to the water quality information contained in *SECTION 7 – MAINTENANCE*.



For Europe, this is a group 1, Class A product according to EN 55011.

This product does not generate and/or use radio-frequency energy, in the form of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material or inspection/analysis. It is suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

Because this is a Class A product, there may be potential difficulties in ensuring electromagnetic compatibility in environments other than industrial, due to conducted as well as radiated disturbances.

ABOUT THIS MANUAL

This manual and any other document supplied with the unit are the property of Johnson Controls which reserves all rights. This manual may not be reproduced, in whole or in part, without prior written authorization from an authorized Johnson Controls representative.

In addition, this manual:

- Should be read thoroughly before attempting to operate or service the unit.
- Includes suggested best working practices and procedures, which are issued for guidance only, and they do not take precedence over the stated individual responsibility and/or local safety regulations.
- Contains all the information required for correct installation and commissioning of the unit, together with operating and maintenance instructions.
- Contains detailed procedures, including installation, commissioning, and maintenance tasks that must only be performed by suitably trained and qualified personnel.

The manufacturer will not be liable for any injury of damage caused by incorrect installation, commissioning, operation, or maintenance resulting from a failure to follow the procedures and instructions detailed in this manual.

WARRANTY

Johnson Controls warrants YHAU-CW chillers in accordance with the *Limited Warranty Engineered Systems Equipment Policy (Form 50.05-NM2)*.

Johnson Controls warrants all equipment and materials against defects in workmanship and materials for a period of 18 months from the date of shipment or 12 months from the date of start-up, whichever comes first, unless labor or extended warranty has been purchased as part of the contract.

The warranty is limited to parts only replacement and shipping of any faulty part, or subassembly, which has failed due to defects in workmanship and materials. All claims must be supported by evidence that the failure has occurred within the warranty period, and that the unit was operated within the designed parameters specified.

All warranty claims must specify the unit model, serial number, order number, and run hours or starts. Model and serial number information is printed on the unit identification plate.

The unit warranty will be void if any modification to the unit is carried out without prior written approval from Johnson Controls. For warranty purposes, the following conditions must be satisfied:

- The initial start of the unit must be carried out by trained personnel from an authorized Johnson Controls Field Service Office.
- Only genuine Johnson Controls approved spare parts, oils, solutions, chemicals, and refrigerants must be used.

- All of the scheduled maintenance operations detailed in this manual must be performed at the specified times by suitably trained and qualified personnel.

Failure to satisfy any of these conditions will automatically void the warranty. Refer to *Limited Warranty (Form 50.05-NM2)* for complete details.

QUALITY ASSURANCE

Units comply with the following directives:

- GB/T 18431-2014

For CE:

- EN ISO 12100:2010
- EN 60204-1: 2006+A1: 2009
- EMC Directive 201 4/30 EC
- EN 55011: 2009+A1: 2010 (Group 1, Class A)
- EN 61000-6-2: 2005
- Pressure Equipment Directive 201 4/68/EC

For UL and GB

- Pressure Vessel Code GB 150-2011

The unit must be grounded. No installation or maintenance work should be attempted on the electrical equipment without first switching the power off, then isolating and locking-off the power supply. Servicing and maintenance on live equipment must not be attempted. No attempt should be made to gain access to the control panel or electrical enclosures during normal operation of the unit.

Components may also have sharp edges. Reasonable care should be taken when working in contact with any components to avoid risk of minor abrasions and lacerations.

EMERGENCY SHUTDOWN

In case of emergency, the control panel is fitted with an incoming supply circuit breaker with a red handle. See the picture below. Turn the handle counter clockwise to shut down the chiller.

LD20922

High Temperature and Pressure Cleaning

High temperature and pressure cleaning methods (e.g., steam cleaning) should not be used on any part of the pressure system as this may cause operation of the pressure relief devices. Detergents and solvents, which may cause corrosion, should also be avoided.

Safety Labels

For safe operation, read the instructions first.

Warning: This machine may start automatically without prior warning.

Warning: Hot surface.

Warning: Safety relief valve may discharge gas or liquid without prior warning.

Warning: Isolate all electrical sources of supply before opening or removing the cover, as lethal voltages may exist.

Risk of electric shock.

General attention symbol.

Warning: On isolating the supply it may take up to 300 seconds for the capacitor voltage to fall below 50 volts.

Warning: Risk of fire.

Warning: Risk of gas poisoning.

LD15421

Warning: Rotating object.

Caution: Prohibited.

Caution: Risk of fall.

Caution: Risk of getting hand caught in machinery.

LD20923

MATERIAL SAFETY DATA SHEET

Material Safety Data Sheets (MSDSs) are provided in the Appendix. MSDSs specify proper procedures for handling and working with applicable chemicals, including items such as physical data, toxicity, health effects, first aid, storage, disposal, and spill procedures. See *APPENDIX - MSDS*.

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 2 – PRODUCT DESCRIPTION

The principle of refrigeration is the exchange of heat and, in absorption liquid chilling, there are four basic heat exchange surfaces: the evaporator, the absorber, the generator, and the condenser. See *Figure 1 on page 15*.

Like any refrigeration system, absorption chilling uses evaporation and condensation to remove heat. The absorption cycle uses water as the refrigerant and lithium bromide (LiBr) as the absorbent. The entire process occurs in an almost complete vacuum.

CHILLER COMPONENTS

The absorption chiller consists of the following components:

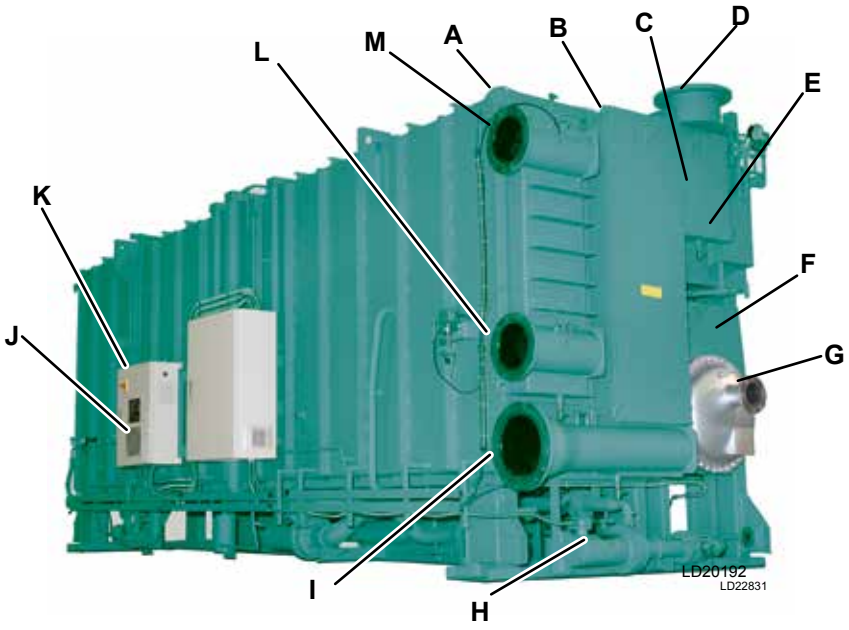
- evaporator
- absorber
- condenser
- generators
- solution heat exchangers to heighten the cycle efficiency
- pumps to circulate the refrigerant and solution in the cycle
- purge unit to remove non-condensable gas from the machine

CONTROL PANEL

The absorption chiller comes with a factory mounted and pre-wired control system. The control panel enclosure is equipped with a hinged access door with lock and key. The control panel includes a touch panel showing all system parameters in various languages with numeric data in metric units. For details of the control panel, see *SECTION 6 – OPERATION*.

The unit is also equipped with two methods to start and stop operations:

- touch panel
- external signal

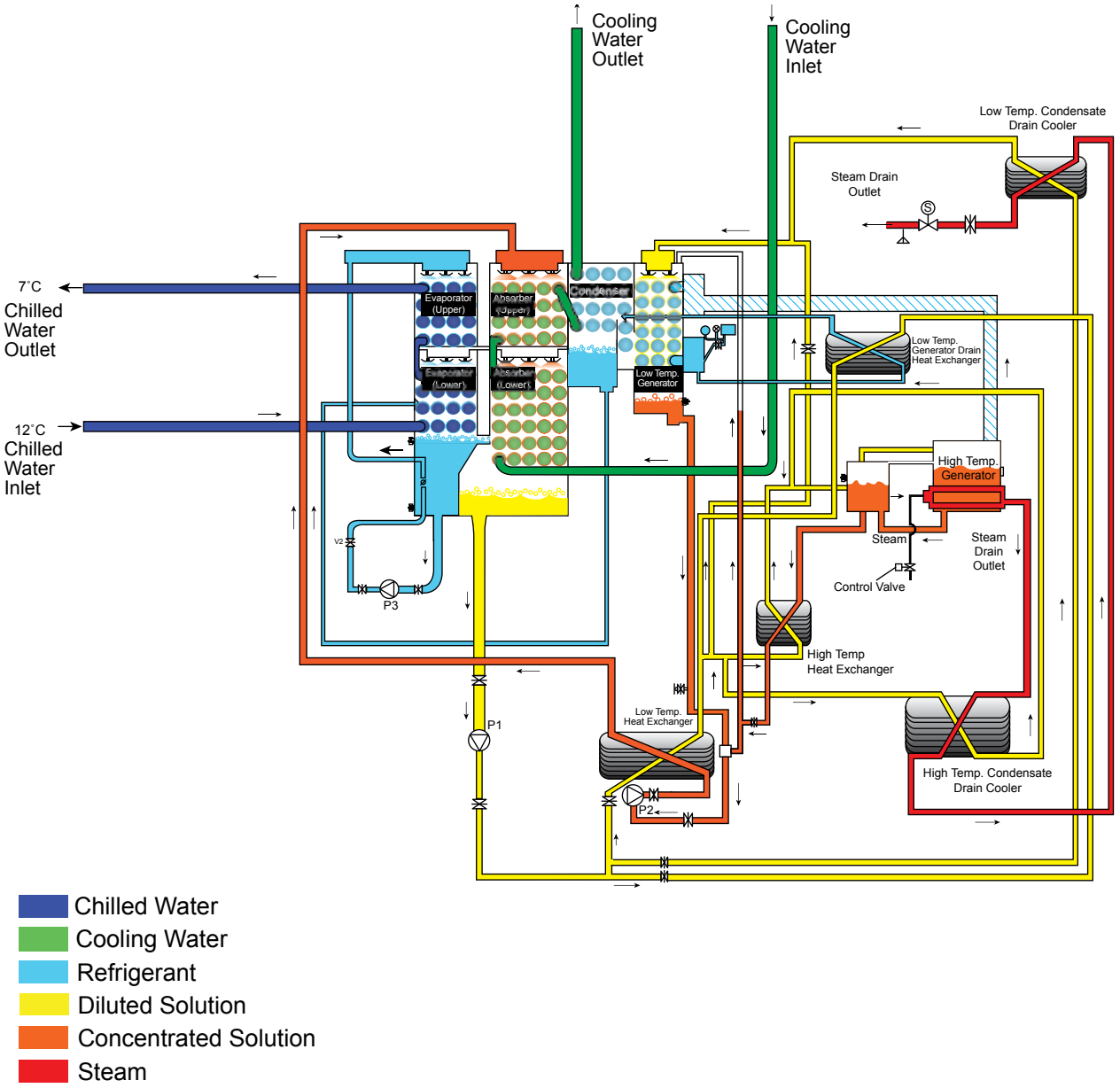


	COMPONENTS
A	Evaporator
B	Absorber
C	Condenser
D	Cooling Water Outlet
E	Low Temperature generator
F	High Temperature Generator
G	Steam Inlet
H	Solution Pump
I	Cooling Water Inlet
J	Touch Panel Display
K	Control Panel
L	Chilled Water Inlet
M	Chilled Water Outlet

FIGURE 1 - YHAU-CW COMPONENTS

HOW IT WORKS

The double effect (steam fired) absorption chiller cycle uses deionized water as the refrigerant and lithium bromide as the absorbent. The vapor pressure of the lithium bromide solution is lower than the vapor pressure of the refrigerant. The vapor pressure of the LiBr solution is directly related to the amount of refrigerant present in solution with the LiBr salt and the solution temperature.



NOTE: Temperatures and pressures on this graphic are representative; actual values may differ.

LD19871c

FIGURE 2 - DOUBLE EFFECT STEAM-FIRED ABSORPTION CHILLER CYCLE DIAGRAM

EVAPORATOR

Liquid refrigerant enters the evaporator and is distributed over the top of the tube bundle. As the refrigerant droplets cover the outside surface of the tubes, the heat from the returning chilled water passing through the tubes causes the refrigerant to flash from a liquid to a vapor. The temperature at which this happens depends on the evaporator shell pressure which is dictated by the absorber section of the chiller. The refrigerant vapor passes through the mist eliminators and into the absorber section of the chiller. As the liquid refrigerant passes down through the bundle of evaporator tubes, more and more refrigerant vaporizes. The refrigerant remaining in a liquid state at the bottom drains into the refrigerant tank and is pumped back up to the top of the tube bundle where the process is repeated.

ABSORBER

Concentrated LiBr solution enters the absorber section of the chiller and is sprayed over the absorber tube bundle. Because the vapor pressure of the concentrated solution is very low, the refrigerant (water) vapor from the evaporator flows into the absorber and is absorbed into the LiBr solution. This mass transfer process lowers the concentration of LiBr solution as the refrigerant (water) is absorbed into the solution. This dilution process generates heat and if not cooled will eventually stop as the solution temperature rises with a corresponding increase in vapor pressure. This would be similar to closing the vanes or slowing down a centrifugal compressor on a chiller where the load was constant. The water flowing inside the absorber tube bundle comes from the cooling tower and serves to cool the LiBr solution as it flows down over the tube bundle. This allows the absorption process to continue and the solution becomes more diluted as it absorbs more refrigerant vapors. When the LiBr solution reaches the bottom of the absorber section and goes into the suction of the solution pump where it is pumped back into the generators.

The following section describes the unique 2-step evaporator-absorber design of the YHAU-CW steam chiller.

TWO-STEP EVAPORATOR-ABSORBER

The evaporator as well as the absorber is split into two sections. This design, similar to a series-counter-flow chiller arrangement along with the parallel flow cycle, enables lower lithium bromide solution concentrations. This reduces crystallization risk, reduces pressure and the potential for corrosion, as well as improves efficiency in conjunction with other advanced components described later in this section.

The two evaporators are in series with respect to the chilled water flow through the tubes. In other words, the chilled water flows through the lower evaporator tubes first and then to the upper evaporator tubes. Each evaporator operates at a slightly different temperature and pressure. The refrigerant in the lower evaporator boils at a slightly higher temperature than in the upper evaporator, consequently cooling the chilled water in 2 steps.

The two absorber sections are split as well, with the strong solution first entering the top of the uppermost absorber and flowing down through the top absorber bundle. It then flows into the top of the lower absorber section. The strong solution entering the upper absorber takes advantage of its lower vapor pressure allowing the upper Evaporator to operate at a lower pressure and temperature.

When the LiBr solution enters the lower absorber section it is somewhat diluted from the refrigerant vapor that boiled off in the upper evaporator. At this lower concentration the solution vapor pressure would normally not be sufficient to provide an evaporator pressure low enough to satisfy the leaving chilled water design. However, the lower evaporator is the first step of the chilled water cooling cycle, and the dilute solution's vapor pressure is adequate to maintain the lower evaporator at the required temperature and pressure in the lower evaporator.

The cooling tower water enters the lower absorber section first, keeping the vapor pressure of the weaker solution as low as possible.

Both the refrigerant (water) and LiBr dispersion system are gravity fed and made of stainless steel.

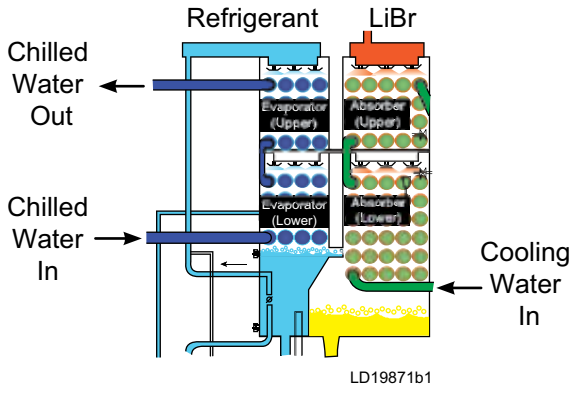
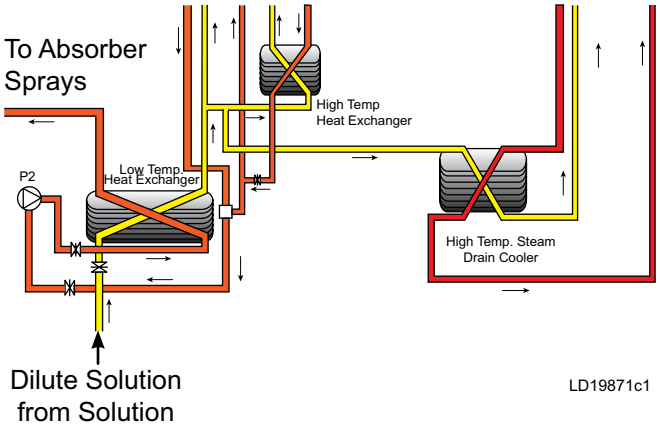


PLATE TYPE HEAT EXCHANGERS

The diluted (weak) lithium bromide solution leaving the absorber section is pumped through various plate type heat exchangers (such as the low temperature heat exchanger, low temperature steam drain cooler, high temperature heat exchanger, high temperature steam drain cooler and LTG refrigerant condensate heat exchanger) before it enters the high temperature generator and low temperature generator sections. These plate type heat exchangers improve cycle efficiency by pre-heating the dilute solution. Pre-heating the dilute solution reduces the load of the driving heat source in the high temperature generator section. The concentrated solution flows out of the generators and back through the various heat exchangers.

The relatively high temperature solution streams from the two generators and the heat of the steam condensate is used to pre-heat the weak solution stream leaving the absorber.



PARALLEL FLOW

The unique parallel flow divides the solution between the low temperature generator and the high temperature generator sections into two parallel, balanced paths. The result is a safer and more efficient operation at a much lower pressure than conventional series-flow designs. The various solution to solution plate type heat exchangers optimize efficiency by enabling effective heat transfer between the diluted (weak) and the concentrated lithium bromide solutions.

HIGH TEMPERATURE GENERATOR (HTG)

The high temperature generator section is a flooded design. The steam passes through the stainless steel tubes and further heats up the pre-heated dilute solution from the high temperature heat exchanger and high temperature steam drain cooler.

The hot refrigerant vapor boiled off from the dilute solution is sent to the low temperature generator. This leaves behind strong solution which is returned to the high temperature heat exchanger.

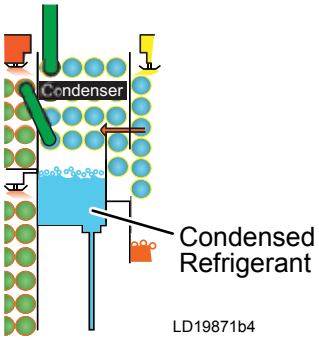
LOW TEMPERATURE GENERATOR (LTG)

The hot refrigerant vapor from the high temperature generator heats up the dilute solution coming from the low temperature heat exchanger and low temperature steam drain cooler. The additional refrigerant vapor produced migrates to the condenser. The refrigerant vapor from the high temperature generator condenses into liquid and flows to the condenser.

The low temperature generator is a falling film design, ensuring superior heat transfer and enhanced life by eliminating wear and tear at the tube supports.

CONDENSER

The refrigerant vapor from the low temperature generator as well as the condensed refrigerant from the high temperature generator enter the condenser where they condense into a liquid state (by the cooling (condenser) water from the absorber section). The cooled refrigerant is sent to the bottom evaporator section through a U-pipe (liquid seal).



CRYSTALLIZATION

All absorption chillers that use lithium bromide and water as the solution / refrigerant pair are subject to crystallization. This is due to the fact that some areas of the unit operate with solution liquid concentration levels that are only possible at higher than the normal ambient temperature surrounding the unit. For example, the solution concentration in the generator of a single stage absorption unit is typically 64.3% lithium bromide by weight. LiBr solutions begin to crystallize at 43.3 °C.

Crystallization happens when the LiBr solution temperature drops too low or the concentration is too high. The LiBr solution becomes like slush. At this point the LiBr solution cannot absorb any more water and will start to solidify (crystallize).

Crystallization occurs in the solution heat exchanger. In addition, it may happen in the generator. It also happens in pipes that are not well insulated and are located in rooms where the temperature can affect the solution moving through the pipes.

You can prevent crystallization by making sure you keep the solution temperature high and the concentration at the optimum percentage (64%).

Since the solution temperature in the generator is normally high enough, no crystallization will occur as long as the higher temperature is maintained. Before the unit is shut down, make sure the solution is sufficiently diluted in all areas of the unit to prevent crystallization during the off cycle. Remember, the solution temperature will eventually become equal to the ambient temperature of the room.

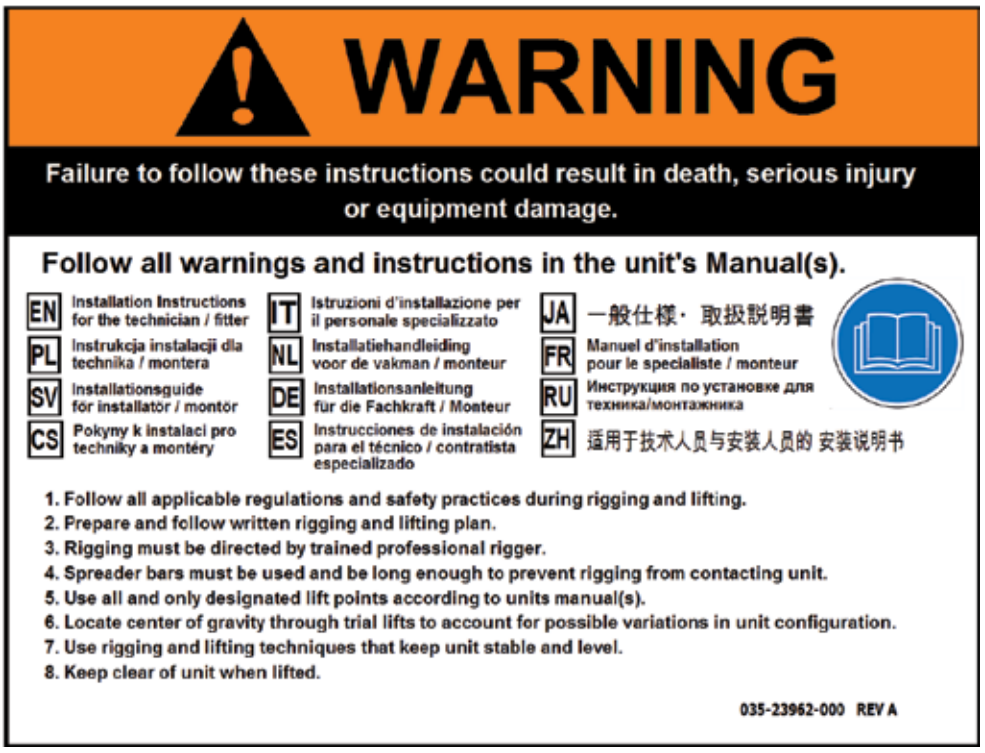
To prevent crystallization all units employ a dilution cycle. As long as the unit is allowed to dilute itself during an orderly shutdown sequence, the unit should be able to sit idle at fairly low plant room ambient temperatures without any threat of crystallization. Typically, after a dilution cycle, the average solution concentration within the chiller will be below 45% lithium bromide by weight. Although the crystallization line on *Figure 63 on page 157* does not extend that far, you can see that the solution at 45% concentration will not have a tendency to crystallize at normal ambient temperatures.

Why Does Crystallization Occur?

The most common reason for crystallization is power failure. If a chiller is running at full load and power is interrupted for a sufficient length of time, the concentrated solution in the high side of the unit will eventually cool down. Since no dilution cycle was performed, the solution concentration in some areas of the unit will still be high. If the temperature of this concentrated solution is allowed to fall enough, the solution will reach its crystallization point. Plant room temperature, insulation quality and the solution concentration all play a part in the determination of how long it will take before the unit will crystallize. See *Water Quality Control on page 148* for information on water quality control and crystallization. The Duhring Diagram / PTX Chart shows the specific temperatures and pressures of the crystallization area. See *Figure 63 on page 157* and *Figure 64 on page 158*.

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 3 – HANDLING, STORAGE, INSTALLATION AND REASSEMBLY



LD18119

FIGURE 3 - WARNING

Rigging and lifting should only be done by a professional rigger in accordance with a written rigging and lifting plan. The most appropriate rigging and lifting method will depend on job specific factors, such as the rigging equipment available and site needs. Therefore, a professional rigger must determine the rigging and lifting method to be used, and it is beyond the scope of this manual to specify rigging and lifting details.

This chiller is for air conditioning or a cooling manufacturing process. Transport, store, and use this chiller under the following conditions:

Installation location:	Indoor, non-explosion area
Ambient temperature:	10 ~ 40 °C
Humidity:	10 ~ 90% (RH%)
Altitude:	1000 m or lower

If the temperature in the plant room drops below 10 °C, you must have the cold ambient option.

INSPECTION

The unit must be inspected prior to customer use by a Johnson Controls Service representative. All damage or possible damage must be reported to the transportation company. For more information, see *SECTION 5 - COMMISSIONING*.

INSTALLATION GUIDELINES

When evacuating the nitrogen charge (from the factory), be sure the area is properly ventilated. Failure to do this could result in suffocation.

When storing the absorption chiller unit after it has been delivered, note the following potential issues:

1. Problems with machine in storage:
    a. Breaking of thin pipes caused by freezing of the refrigerant (water) sealed in the machine and resulting air leak
    b. Breaking and air leak due to external damage
    c. Deterioration of electrical parts caused by soot and dust
    d. Deterioration of electrical parts caused by rainwater (moisture)
    e. Rusting of the machine body caused by rainwater (moisture). Air leaks can cause serious damage and are costly repairs. Therefore, use diligence in keeping the machine body free from moisture at all times.
2. Problems and Preventative Measures

PROBLEM	PREVENTATIVE MEASURE
Freezing of refrigerant in machine	Store the machine where the ambient temperature is higher than 0°C. If the ambient temperature drops below 0°C, use a heater to warm the machine. If a heater is not accessible, the following options are available to prevent freezing: • Extraction of the refrigerant • Addition of antifreeze to the refrigerant • Installation of a band heater For further instruction, contact your nearest authorized Johnson Controls Service Center.
External Damage	Avoid storing the machine in a place which is easily accessible or near a construction site. If this is unavoidable, use diligence to protect the machine. For further information contact your nearest authorized Johnson Controls Service Center.
Soot & Dust	To protect the machine from soot & dust (or other air particulates) cover the entire machine, including the control panel, instruments and gauges located on top of the machine with a vinyl sheet. Use caution not to apply too much pressure to the controls to prevent damage.
Rainwater	Avoid storing the machine in areas that are exposed to rainwater or other standing water.

3. Periodic Inspection and Maintenance
    a. Inspect the machine weekly for damage.
    b. Check the machine compound gauge daily to verify there is no decline in vacuum and record the vacuum value (-101 to -95kPa). If the vacuum is below the low limit, contact your nearest authorized Johnson Controls Service Center immediately.
    c. If the vacuum has dropped as a result of improper machine operation, contact your nearest authorized Johnson Controls Service Center immediately.

Use care that foreign matter does not enter the drain valve and air vent valve in the water chamber casing. Keep these valves fully open while the machine is in storage.

HOISTING THE MACHINE

When hoisting the machine, attach a shackle to each of the four eye plates and lift the machine using care that the angle formed by the wire is within 60 degrees as shown in the figure below.

Use care not to apply shock to the machine. The machine is a high-vacuum vessel containing a corrosive solution. Use diligence in protecting the machine as repair is labor intensive and costly.

Be sure to lift the machine horizontally. If the machine is inclined, the solution and refrigerant inside will shift producing an offset load. This can cause damage to the machine and pose a risk to the machine installer or persons moving the unit.

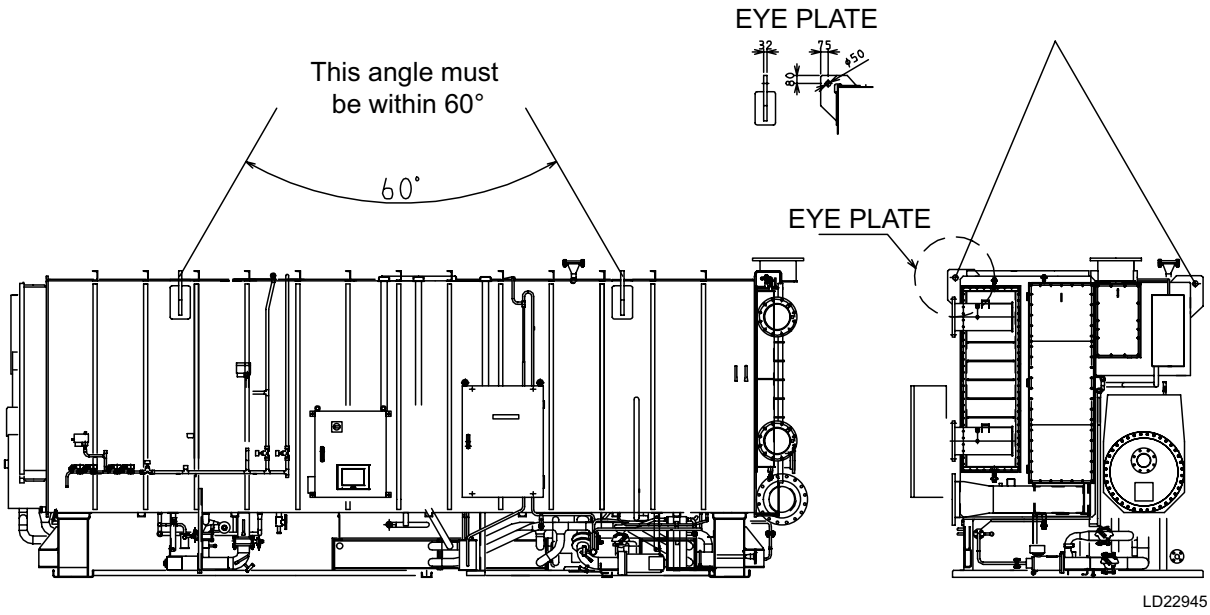


FIGURE 4 - HOISTING PROCEDURES

MOVING THE MACHINE ON ROLLERS

Plan the entrance of the machine.

Do not incline the machine more than 10 degrees. If the machine has to be inclined more than 10 degrees, the solution and refrigerant will need to be extracted beforehand.

Use care not to apply shock to the machine. The machine is a high-vacuum vessel containing a corrosive solution. Use diligence in protecting the machine as repair is labor intensive and costly.

When a skid base is used to move the machine on rollers, secure the skid base and place the machine legs evenly on the skid base before moving the machine on rollers.

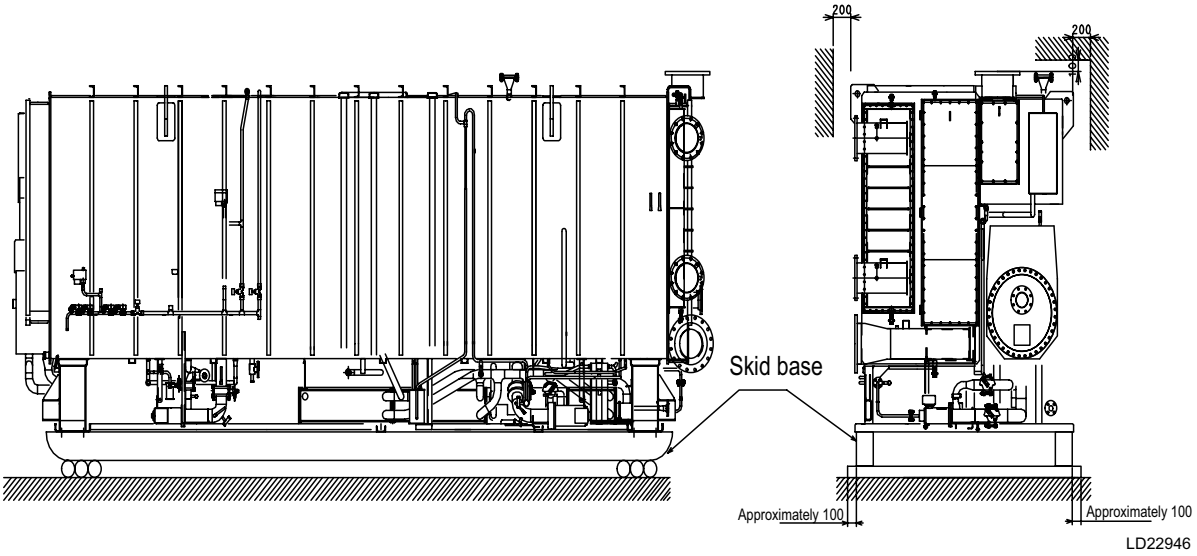


FIGURE 5 - MOVING THE MACHINE ON ROLLERS

If using a tir roller to move the machine, fit the tir roller set to each of the four holes shown in the figure below.

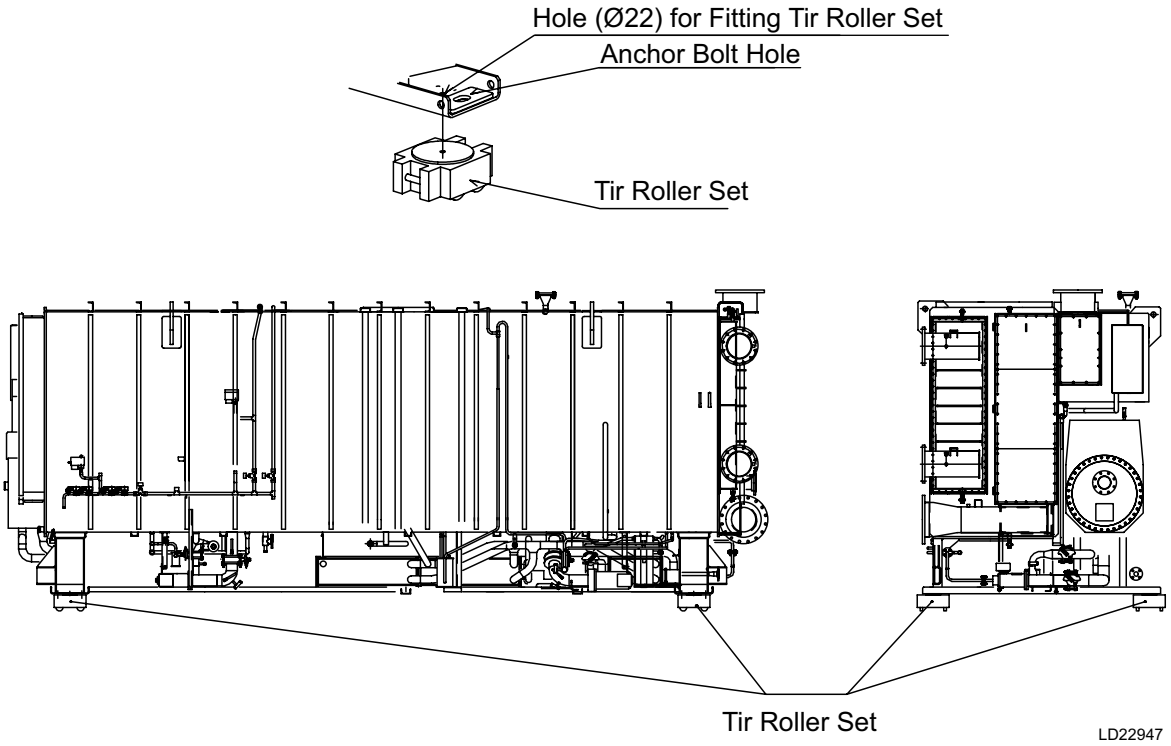


FIGURE 6 - MOVING THE MACHINE ON TIR ROLLERS

JACK UP PROCEDURE

When jacking the machine, be sure to fit the jack in each of the jack-up supports as shown below.

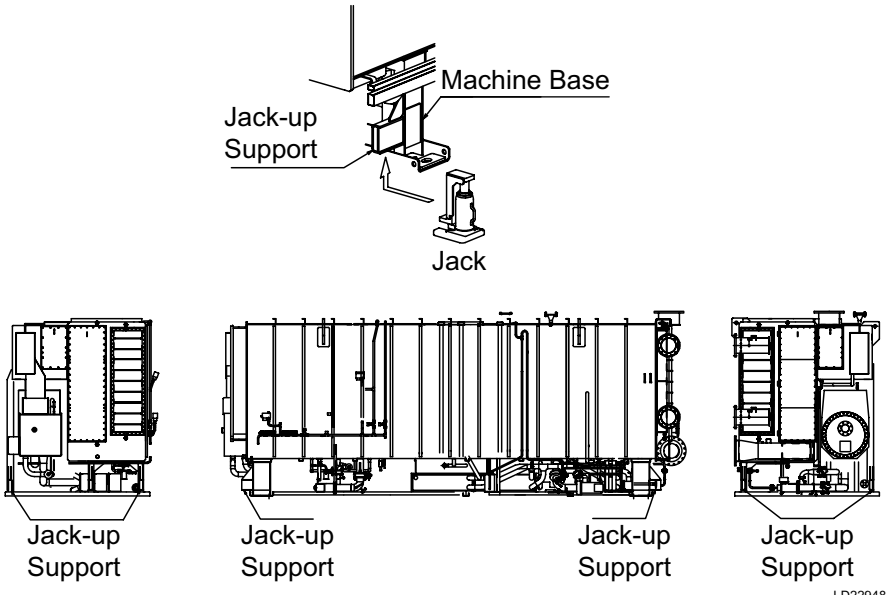


FIGURE 7 - JACK-UP PROCEDURE

Operate the front and rear jacks alternately.

Do not jack up the machine more than 20 mm at a time. Each time the machine is jacked up, adhere it with a suitable crosstie.

Use the jack-up support on the main shell of the body as shown below. If using a high temperature generator, use secondary jack-up support.

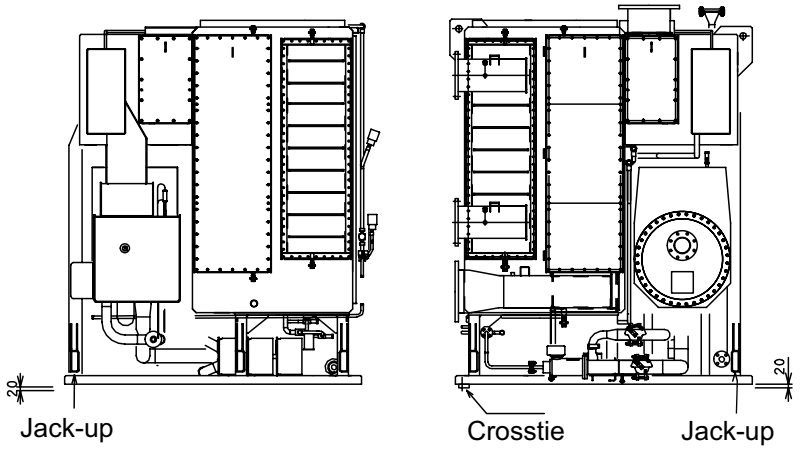


FIGURE 8 - JACK-UP PROCEDURE

STRUCTURAL SUPPORT AND INSTALLATION

Structural support of the unit must be provided as indicated for maximum efficiency. Maintain adequate maintenance space around the chiller so work can be safely performed. To ensure there is adequate clearance for tube removal, the maintenance space at the end of the unit should equal 1.25 x the length of the unit.

Foundation bolts should be installed in level concrete to secure the unit and prevent shifting in the event of an earthquake. Rubber vibration isolator pads must be fit to the machine base before installation as shown on *Figure 9 on page 29*. The tolerance for leveling is 1 inch in 1,000 inches or 1 mm in 1,000 mm.

Waterproof the floor on which the machine will be installed in case of future leaks.

Dimensions can be found in *Table 2 on page 31*. For the external dimensions of the machine and foundation, see the full view of the machine and the foundation drawing.

For serviceability and maintenance, leave a minimum of 1,000 mm space on all sides of the chiller. To be sure there is enough clearance for tube removal, the maintenance space at the end of the unit should equal 1.25 times the length of the unit. See *Table 13 on page 44*.

INDOOR AND OUTDOOR INSTALLATION

This chiller is designed to be used indoors. Exposure to the elements can damage the thermal insulation. The minimum allowable temperature for outdoor installation is 0 °C, provided that the chiller includes the cold ambient option. Outdoor installations will be considered on a case-by-case basis by a Johnson Controls Service Representative

ELECTRICAL

The electrical work must be performed in accordance with the wiring diagrams, delivery specifications, and technical standards for electrical equipment found in *SECTION 4 - TECHNICAL DATA*. Use the specified cables to complete the wiring, and fasten them to the according terminals securely. Loose fitting cables can cause the terminals to heat up, resulting in fire or electrical shock.

The chiller does NOT arrive with a ground fault (earth leakage) circuit breaker installed. Be sure to have the customer install one at the primary side of the unit.

Electrical work must be supervised or completed by a Johnson Controls Service Representative.

PRECAUTIONS FOR USE

A caution label for a rotating object is pasted around the belt cover of the vacuum pump. When replacing the oil in the vacuum pump, belt, or performing maintenance work, stop the chiller. Be sure to turn off the main circuit breaker (MCB1) and lockout or tagout the unit. If this is not done, the vacuum pump could start abruptly and cause injury or damage to the unit.

Do not place anything heavy on the machine or its control panel. It may fall and injure someone.

Do not climb up the machine without safety harnessing.

Contact your local Johnson Controls service office for inspection and maintenance of the machine. Improper inspection and maintenance can not only cause a machine problem but also injure workers.

Keep the chilled water, cooling water, and steam under the maximum usage pressure. If they exceed the maximum usage pressure, they may spout or leak. That, in turn, may cause an electric shock and a burn.

Do not change the set values of the safety devices and protective devices. Operation with incorrect values can cause a unit malfunction.

The shut off valve for the pressure release valve must remain open except during servicing. The unit must never be operated with this shut off valve closed.

A caution label for high temperature is pasted at the control panel, solution pump, and vacuum pump. Be sure not to touch the pump during pump operation. It may cause a burn.

Wear protective gloves and goggles when operating the control valve, or other potentially hazardous parts of the chiller.

During service and maintenance work, be sure to turn OFF the main circuit breaker (MCB1) and follow all required lockout/tagout procedures. Close the main valve of the steam line to prevent electric shock and injury.

If the cables of the solution pump, refrigerant pump, or vacuum pump are disconnected for service and maintenance work, be sure to check the rotating direction of the pump motor. If not, the chiller may malfunction. When changing the oil of the vacuum pump, be sure to stop the purge operation.

In case of an accident, use the emergency stop device (external handle of MCB1) to stop the chiller immediately.

LEAK TESTING

When leak testing, verify the area is properly ventilated. Failure to do so may result in suffocation.

ELECTRICAL SHOCK CAUTIONS

Do not touch the control panel with wet hands. This can cause electric shock. Do not touch the wiring in the control panel.

Do not touch any part other than the control panel of the machine and the valves described in the operating manual. This can cause a unit malfunction and injury.

Apply only the specified source voltage. Application of a different voltage can cause a fire and electric shock.

Welding should only be done in certain circumstances. If welding is done, be careful not to compromise the integrity of the vessel. Prior to welding, be absolutely certain that the electrical system is grounded properly.

Do not splash water over the machine and its control panel; this can cause an electric shock.

A warning label for electric shock is pasted at the control panel, solution pump, refrigerant pump, and the terminal box of the vacuum pump motor. Before opening the terminal box, be sure to stop the chiller and turn OFF the main circuit breaker (MCB1).

VIBRATION AND ISOLATION DETAILS

Before you install the unit, fit rubber vibration isolators to the unit base as shown in *Figure 9 on page 29*.

Use liners to adjust the levelness of the unit. For unit dimensions, see *Table 7 on page 36*, *Table 8 on page 37*. *Table 9 on page 38*, and *Table 10 on page 39*.

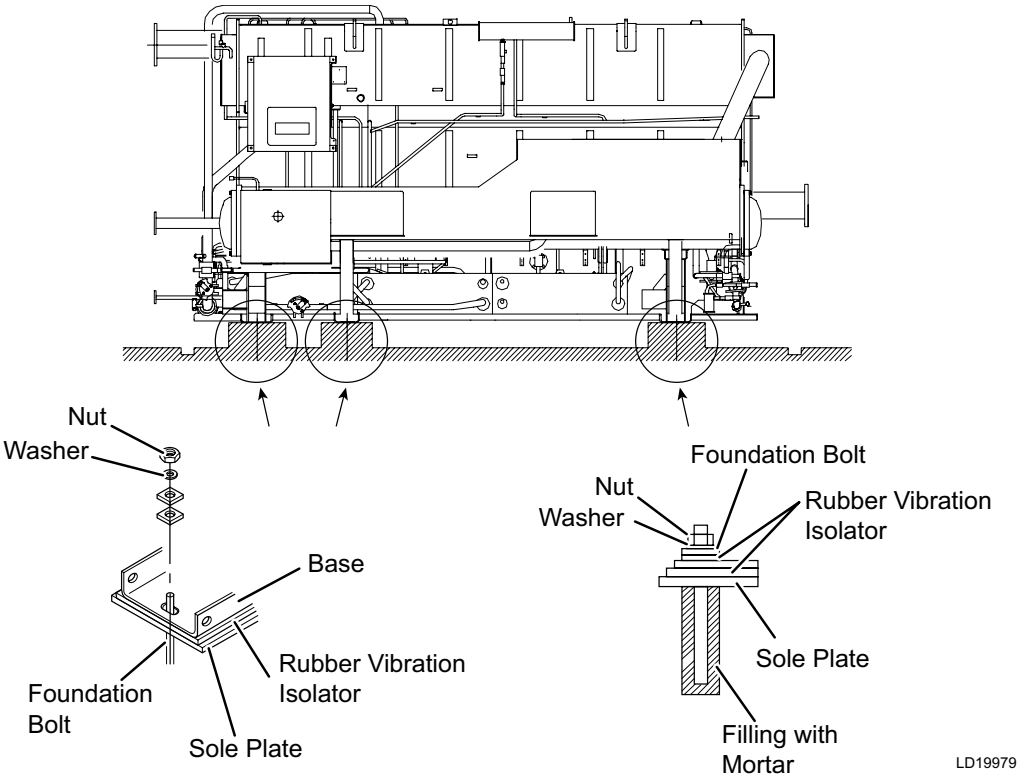


FIGURE 9 - VIBRATION AND ISOLATION DETAILS

TABLE 1 - SPLIT SHIPMENT

DOUBLE EFFECT STEAM FIRED ABSORPTION CHILLER									
YHAU-CW	MAIN SHELL UNIT				SOLUTION HEAT EXCHANGER UNIT				
	LENGTH (M)	WIDTH (M)	HEIGHT (M)	WEIGHT (TON)	LENGTH (M)	WIDTH (M)	HEIGHT (M)	WEIGHT (TON) STANDARD	WEIGHT (TON) HIGH EFF.
150EX(S)	3	2	2.3	4.3	3.0	2	1.5	2.0	2.1
180EX(S)	3.6	2	2.3	4.6	3.6	2	1.5	3.1	3.2
240EX(S)	4.3	2	2.3	5	4.3	2	1.5	3.6	3.8
300EX(S)	4.8	2	2.3	6	4.8	2	1.5	4.0	4.2
360EX(S)	5.8	2	2.3	7.2	5.7	2	1.7	6.2	6.5
400EX(S)	6.3	2	2.3	8	6.2	2	1.7	6.9	7.2
450EX(S)	4.87	2.3	2.6	8.6	4.77	2.3	1.9	5.0	5.2
500EX(S)	5.37	2.3	2.6	9.6	5.27	2.3	1.9	5.6	5.8
560EX(S)	5.87	2.3	2.6	10.7	5.77	2.3	1.9	6.2	6.5
600EX(S)	6.4	2.3	2.6	11.5	6.3	2.3	1.9	6.7	7
700EX(S)	7.2	2.3	2.6	13.7	7.1	2.3	1.9	7.7	8
800EX(S)	8.1	2.3	2.6	15.5	8.0	2.3	1.9	8.8	9.2
900EXW(S)	6.8	2.7	2.7	20.2	6.7	2.8	2.0	8.0	8.3
1000EXW(S)	7.4	2.7	2.7	21.6	7.3	2.8	2.0	8.5	8.9
1100EXW(S)	8.1	2.7	2.7	23.4	8.0	2.8	2.0	9.1	9.5
1200EXW3(S)	8.1	2.7	2.9	25.5	8.0	2.8	2.1	10.4	10.8
1300EXW3(S)	8.6	2.7	2.9	27	8.5	2.8	2.1	11.2	11.7
1400EXW3(S)	9.1	2.7	2.9	28.5	9.0	2.8	2.1	12.2	12.7
1500EXW3(S)	9.6	2.7	2.9	29.6	9.5	2.8	2.1	131.	13.7
1600EXW3(S)	10.1	2.7	2.9	30.8	10	2.8	2.1	41.4	15
1000EXW4(S)	6.2	2.7	3.4	21.3	6.1	2.8	2.2	8.6	9
1120EXW4(S)	6.9	2.7	3.4	23.4	6.8	2.8	2.2	9.3	9.7
1250EXW4(S)	7.5	2.7	3.4	25	7.4	2.8	2.2	10.1	10.5
1400EXW4(S)	8.2	2.7	3.4	26.8	8.1	2.8	2.2	10.9	11.4
1500EXW4(S)	8.7	2.7	3.4	28.1	8.6	2.8	2.2	11.8	12.3
1600EXW4(S)	9.2	2.7	3.4	29.5	9.1	2.8	2.2	12.8	13.3
1680EXW4(S)	9.7	2.7	3.4	30.8	9.6	2.8	2.2	13.7	14.3
1800EXW4(S)	10.2	2.7	3.4	32.1	10.1	2.8	2.2	14.9	15.5
1900EXW4(S)	10.7	2.7	3.4	33.4	10.6	2.8	2.2	16.0	16.7
2000EXW4(S)	11.2	2.7	3.4	34.7	11.1	2.8	2.2	17.2	17.9

TABLE 2 - SPLIT SHIPMENT COMPONENT DIMENSIONS*

YHAU-CW	MAIN SHELL UNIT				SOLUTION HEAT EXCHANGER UNIT			
	L1 (M)	W1 (M)	H1 (M)	WEIGHT (TON)	L2 (M)	W2 (M)	H2 (M)	WEIGHT (TON)
150EX(S)	3.1	2.0	2.3	4.0	2.8	2.1	1.5	2.0
180EX(S)	3.6	2.0	2.3	4.3	3.3	2.1	1.5	3.0
240EX(S)	4.3	2.0	2.3	4.7	4.0	2.1	1.5	3.6
300EX(S)	5.1	2.0	2.3	5.6	4.8	2.1	1.5	4.0
400EX(S)	5.0	2.3	2.7	7.0	5.0	2.3	1.9	4.4
500EX(S)	6.0	2.3	2.7	10.0	6.0	2.3	1.9	5.7
630EX(S)	7.3	2.3	2.7	13.0	7.3	2.3	1.9	6.6
700EX(S)	8.0	2.3	2.7	14.8	8.0	2.3	1.9	7.4
750EX(S)	8.5	2.3	2.7	16.2	8.5	2.3	1.9	7.7
800EX(S)	9.0	2.3	2.7	17.6	9.0	2.3	1.9	7.9
630EXW(S)	5.5	2.6	2.7	16.3	5.0	2.6	2.0	6.6
700EXW(S)	6.0	2.6	2.7	17.5	5.5	2.6	2.0	7.4
800EXW(S)	6.7	2.6	2.7	19.2	6.0	2.6	2.0	7.9
900EXW(S)	7.3	2.6	2.7	20.6	6.6	2.6	2.0	8.5
1000EXW(S)	8.0	2.6	2.7	22.3	7.3	2.6	2.0	9.0
1120EXW(S)	9.0	2.6	2.7	24.7	9.0	2.6	2.0	9.8
1250EXW(S)	10.0	2.6	2.7	27.1	10.0	2.6	2.0	10.9
1400EXW(S)	11.0	2.6	2.7	29.5	11.0	2.6	2.0	11.7
1000EXW4(S)	6.2	2.8	3.3	21.3	6.2	2.8	2.2	8.0
1120EXW4(S)	6.9	2.8	3.3	23.4	6.9	2.8	2.2	8.7
1250EXW4(S)	7.5	2.8	3.3	25.0	7.5	2.8	2.2	9.5
1400EXW4(S)	8.2	2.8	3.3	26.8	8.2	2.8	2.2	10.4
1500EXW4(S)	8.7	2.8	3.3	28.1	8.7	2.8	2.2	11.3
1600EXW4(S)	9.2	2.8	3.3	29.5	9.2	2.8	2.2	12.3
1680EXW4(S)	9.7	2.8	3.3	30.8	9.7	2.8	2.2	13.3
1800EXW4(S)	10.2	2.8	3.3	32.1	10.2	2.8	2.2	14.5
1900EXW4(S)	10.7	2.8	3.3	33.4	10.7	2.8	2.2	15.7
2000EXW4(S)	11.2	2.8	3.3	34.7	11.2	2.8	2.2	16.9

NOTES: Please allow additional time for installation (1 day), welding (2 days), pressure test (2 days), evacuation (2 days), solution charging (1 day). Values can vary due to site conditions.

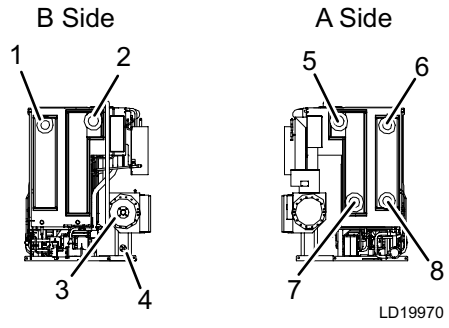
* See *Figure 10 on page 32.*

TABLE 3 - NOZZLE ARRANGEMENTS 150-300EX(S), 360-800EX(S), 900-1100EXW(S), 1200-1600EXW3(S), 1000-2000EXW4(S)

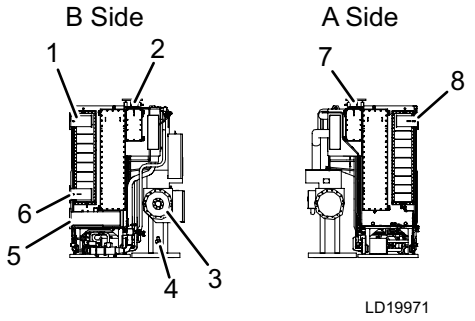
YHAU-CW	NOZZLE LOCATION							
	CHILLED WATER (CHW)			COOLING WATER (COW)			STEAM (STM)	STEAM DRAIN (DRN)
	INLET	OUTLET		INLET	OUTLET		INLET	OUTLET
150-300EX(S)	A	ODD PASS	B	A	ODD PASS	B	B	B
		EVEN PASS	A		EVEN PASS	A		
360-800EX(S) 900-1100EXW(S) 1200-1600EXW4(S) 1000-2000EXW4(S)	B	ODD PASS	A	B	ODD PASS	A	B	B
		EVEN PASS	B		EVEN PASS	B		

NOTE: These images are representations of nozzle arrangements. Reference general arrangement drawings found in the contract documents for detailed nozzle locations for each specific unit.

Steam (150-300EX(S))



360-800 EX(S)
900~1100EXW(S)
1200~1600EXW3(S)
1000~2000EXW4(S)



ITEM	DESCRIPTION
1	Chilled Water Outlet (Odd Pass)
2	Cooling Water Outlet (Odd Pass)
3	Steam Inlet
4	Drain Outlet
5	Cooling Water Outlet (Even Pass)
6	Chilled Water Outlet (Even Pass)
7	Cooling Water Inlet
8	Chilled Water Inlet

ITEM	DESCRIPTION
1	Chilled Water Outlet (Even Pass)
2	Cooling Water Outlet (Even Pass)
3	Steam Inlet
4	Drain Outlet
5	Cooling Water Inlet
6	Chilled Water Inlet
7	Cooling Water Outlet (Odd Pass)
8	Chilled Water Outlet (Odd Pass)

FIGURE 10 - YHAU-CW150-300EX(S), 360-800EX(S), 900-1100EXW(S), 1200-1600EXW3(S), 1000-2000EXW4(S) NOZZLE LOCATIONS

HOT INSULATION OR COLD INSULATION PROCEDURE

4. The recommended materials and their thickness for hot insulation or cold insulation are shown in *Table 4 on page 33*.
5. Use a bonding agent, iron wire, iron band, or other recommended bonding agents to fix the hot insulation or cold insulation materials. Never rivet the insulation materials. The use of welding pins is not permitted.
6. Make the outer covering, flanged parts, and evaporator water chamber casing easily removable to facilitate servicing.
7. The points that require hot insulation or cold insulation are shown in the table below.
8. The casing of the absorber and condenser water chamber does not require hot insulation or cold insulation. If insulation is used, make it easy to remove.
9. For the high temperature generator, install insulation in a way that makes it easy to remove the front, sides, and rear separately.

TABLE 4 - INSULATING MATERIAL AND THICKNESS

	HOT INSULATION	COLD INSULATION
MATERIAL	Rock wool or glass wool	Polyurethane foam, polystyrene foam, or glass wool
THICKNESS	50 mm	50 mm

TABLE 5 - POINTS REQUIRING HOT OR COLD INSULATION

REQUIRES HOT INSULATION	REQUIRES COLD INSULATION	MUST NOT BE HEAT-INSULATED
High Temperature Generator	Evaporator Shell	Sight Glass
Heat Exchanger for Drain	Evaporator Water Chamber Case	Valve Manipulator
Drain Piping	Refrigerant Spray Piping	
Heat Exchanger	Refrigerant Blow Piping	Pressure Gauge
Low Temperature	Point Carrying Cold Insulation Label	Thermometer Insertion Hole
Point Carrying Hot Insulation Label	Valve for vacuuming (factory use only)	Relay Insertion Hole

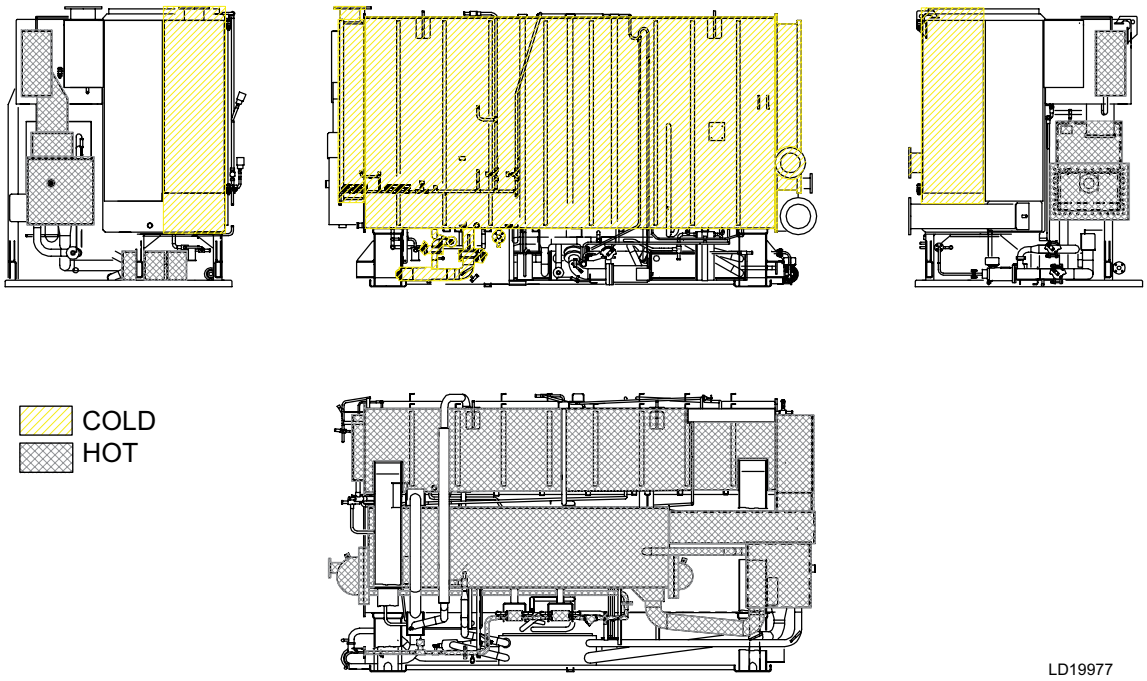


FIGURE 11 - HOT AND COLD INSULATION

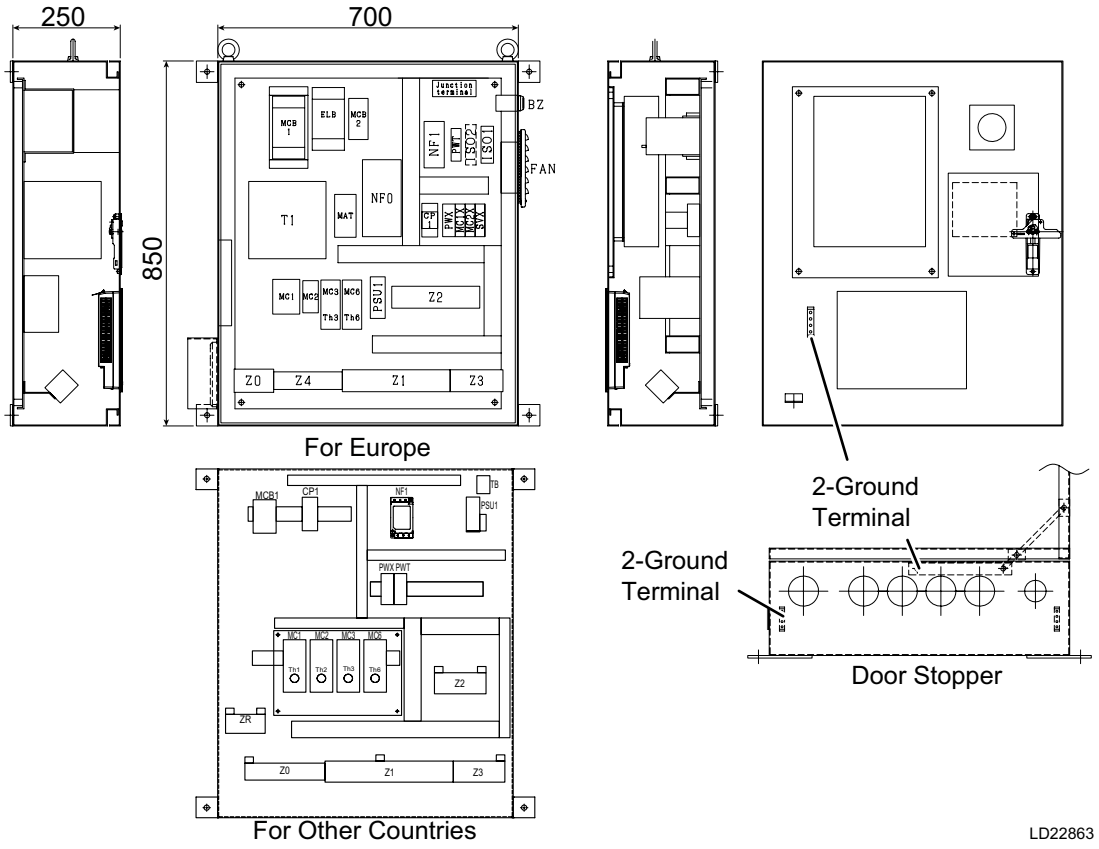


FIGURE 12 - INTERIOR OF CONTROL PANEL

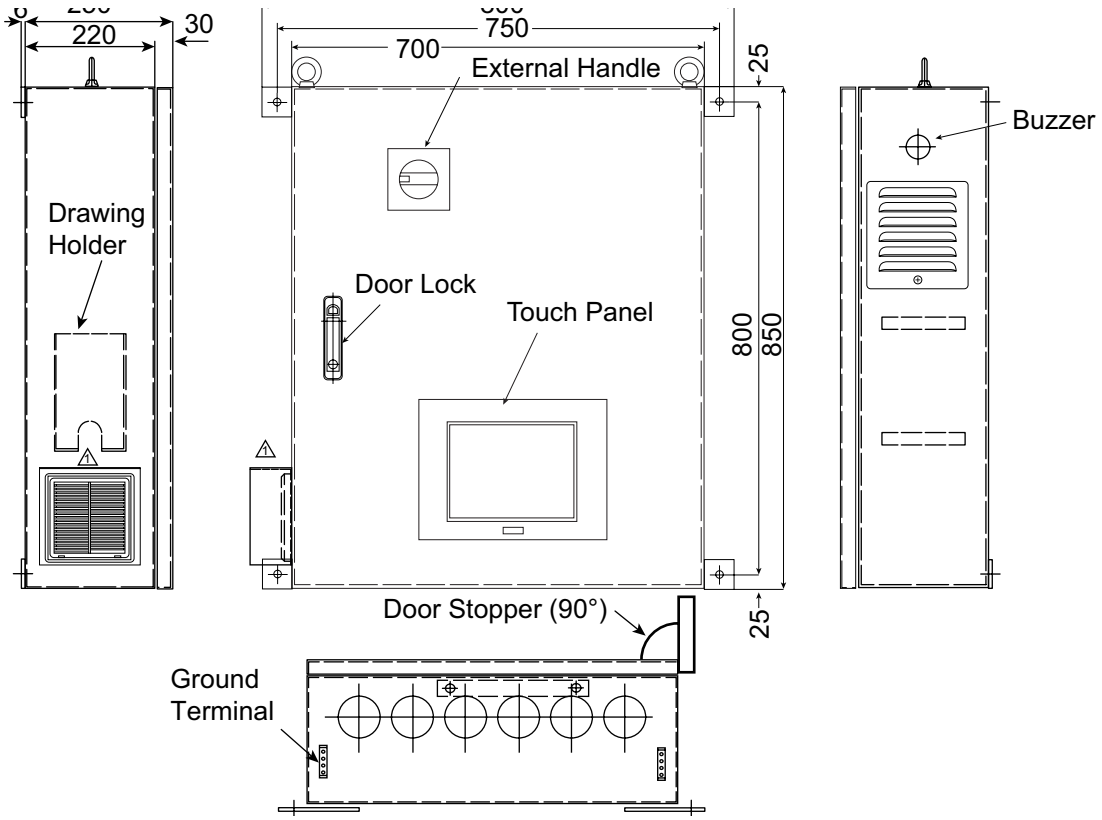


FIGURE 13 - EXTERIOR OF CONTROL PANEL (MM)

SECTION 4 - TECHNICAL DATA

This section includes technical information about the unit, such as weight, dimensions, electrical data, wiring, and sound data.

TABLE 6 - TYPICAL OPERATIONAL RANGE

PARAMETER	ALLOWABLE RANGES
Chilled Water In	7 - 25 °C
Chilled Water Out	4 - 16 °C
Cooling Water In	20 - 37 °C
Cooling Water Out	25 - 42 °C
Steam Inlet Pressure	2 - 10 bar(g)
Condensate Outlet	~ 60 °C

The numbers shown in *Table 6 on page 35* are the allowable ranges for each parameter. Not all combinations are possible. Please check with your Johnson Controls Service Center to see if your temperature differential is possible.

TABLE 7 - HIGH EFFICIENCY WEIGHTS AND DIMENSIONS

MODEL YHAU-CW	DIMENSION (METERS)				WEIGHT (TONS)		
	LENGTH	WIDTH	HEIGHT	TUBE EXTRACTING SPACE (M)	MAXIMUM SHIPPING	OPERATION	EMERGENCY (FILLED WITH WATER)
150EX	3.0	2.3	2.6	2.0	6.6	7.2	10.5
180EX	3.6	2.4	2.5	2.6	7.8	8.5	12.7
240EX	4.3	2.4	2.5	3.2	9.1	9.9	15.2
300EX	4.8	2.4	2.5	4.0	10.6	11.6	18.1
360EX	5.8	2.4	2.5	5.0	14.4	15.8	26.1
400EX	6.3	2.4	2.5	5.5	16.2	17.6	29.9
450EX	4.8	2.6	3.1	4.0	15.3	17.1	27.0
500EX	5.3	2.6	3.1	4.5	18.2	20.2	30.6
560EX	5.8	2.6	3.1	5.0	19.7	21.8	34.2
600EX	6.4	2.6	3.1	5.5	22.0	24.3	37.8
700EX	7.2	2.6	3.1	6.3	24.4	26.9	42.4
800EX	8.1	2.6	3.1	7.0	27.2	30.1	47.3
900EXW	6.8	3.1	3.2	5.7	29.7	33.5	50.4
1000EXW	7.4	3.1	3.2	6.3	32.4	36.5	55.1
1100EXW	8.1	3.1	3.2	7.0	35.0	39.4	59.1
1200EXW3	8.1	3.1	3.2	7.0	38.9	44.1	70.6
1300EXW3	8.6	3.1	3.3	7.5	41.6	47.1	75.4
1400EXW3	9.1	3.1	3.3	8.0	44.4	50.1	80.1
1500EXW3	9.6	3.1	3.3	8.5	47.2	53.2	85.1
1600EXW3	10.1	3.1	3.3	9.0	50.0	56.2	89.9
1000EXW4	6.2	3.1	3.9	5.0	34.5	40.3	60.1
1120EXW4	6.9	3.1	3.9	5.7	38.9	45.2	67.7
1250EXW4	7.5	3.1	3.9	6.3	42.2	48.9	73.7
1400EXW4	8.2	3.1	3.9	7.0	46.2	53.3	81.0
1500EXW4	8.7	3.1	3.9	7.5	49.1	56.5	86.2
1600EXW4	9.2	3.1	3.9	8.0	52.0	59.8	91.4
1680EXW4	9.7	3.1	3.9	8.5	44.6	61.5	95.1
1800EXW4	10.2	3.1	3.9	9.0	47.0	64.7	100.3
1900EXW4	10.7	3.1	3.9	9.5	49.5	68.1	105.6
2000EXW4	11.2	3.1	3.9	10.0	52.0	71.4	110.9

NOTE: Refer to the general arrangement drawings for specific center of gravity locations and data.

TABLE 8 - HIGH EFFICIENCY PHYSICAL DATA

YHAU-CW	COLD INSULATION AREA (M^2)	HOT INSULATION AREA (M^2)	RADIATION HEAT LOSS (WITH INSULATION, AMBIENT TEMP. 10°C) (KW)	RADIATION HEAT LOSS (WITHOUT INSULATION, AMBIENT TEMP. 10°C) (KW)	WATER VOLUME		
					CHILLED WATER (EVAP) (M^3)	COOLING WATER (ABS AND COND) (M^3)	STEAM (GEN) (M^3)
150EX	8	19	1	9	0.21	0.33	0.04
180EX	10	21	1	11	0.25	0.39	0.04
240EX	12	24	1	15	0.3	0.46	0.04
300EX	14	28	2	19	0.36	0.56	0.06
360EX	14	33	2	22	0.46	0.83	0.07
400EX	15	36	2	25	0.5	0.89	0.08
450EX	14	33	3	28	0.55	1.17	0.08
500EX	16	36	3	31	0.60	1.25	0.09
560EX	17	39	3	35	0.65	1.39	0.10
600EX	19	40	4	37	0.71	1.48	0.11
700EX	20	41	4	43	0.79	1.61	0.13
800EX	23	46	5	50	0.88	1.88	0.15
900EXW	32	50	5	56	1.24	2.36	0.17
1000EXW	35	53	6	62	1.34	2.52	0.19
1100EXW	38	58	7	68	1.46	2.71	0.21
1200EXW3	43	64	7	74	1.68	3.28	0.24
1300EXW3	46	70	8	80	1.80	3.40	0.26
1400EXW3	48	76	8	87	1.89	3.55	0.28
1500EXW3	51	82	9	93	1.99	3.70	0.29
1600EXW3	53	88	10	99	2.08	3.85	0.31
1000EXW4	34	40	6	62	2.09	3.53	0.19
1120EXW4	37	45	7	69	2.25	3.80	0.21
1250EXW4	40	49	7	77	2.40	4.03	0.23
1400EXW4	44	53	8	87	2.56	4.29	0.26
1500EXW4	47	56	9	93	2.68	4.48	0.28
1600EXW4	49	59	10	99	2.79	4.68	0.30
1680EXW4	52	63	10	104	2.91	4.87	0.31
1800EXW4	54	66	11	111	3.03	5.06	0.33
1900EXW4	57	69	11	118	3.15	5.25	0.35
2000EXW4	59	72	12	124	3.26	5.44	0.37

TABLE 9 - STANDARD WEIGHTS AND DIMENSIONS

MODEL YHAU-CW	DIMENSION (METERS)				WEIGHT (TONS)		
	LENGTH	WIDTH	HEIGHT	TUBE EXTRACTING SPACE (M)	MAXIMUM SHIPPING	OPERATION	EMERGENCY (FILLED WITH WATER)
150EXS	3.0	2.3	2.6	2.0	5.9	6.7	9.5
180EXS	3.6	2.3	2.6	2.6	7.0	7.9	11.5
240EXS	4.3	2.3	2.6	3.2	8.2	9.2	13.9
300EXS	4.8	2.3	2.6	4.0	9.2	10.7	16.4
360EXS	5.8	2.4	2.5	5.0	13.7	15.1	24.7
400EXS	6.3	2.6	3.1	4.0	13.8	16.9	24.6
450EXS	4.87	2.55	3.1	4.0	14.6	16.4	26.3
500EXS	5.3	2.6	3.1	5.0	17.5	18.6	30.9
560EXS	5.87	2.55	3.1	5.0	18.6	20.8	33.2
600EXS	6.4	2.55	3.1	5.5	20.9	23.1	36.6
700EXS	7.2	2.6	3.1	7.0	23.9	25.6	42.4
800EXS	8.1	2.6	3.1	8.0	26.9	28.5	47.9
900EXWS	6.8	2.9	3.2	6.3	29.0	31.9	51.7
1000EXWS	7.4	2.9	3.2	7.0	31.5	34.5	56.6
1100EXWS	8.1	3.1	3.15	7.0	33.0	37.4	56.1
1200EXW3S	8.1	3.1	3.3	7.0	36.7	41.9	67.0
1300EXW3S	8.6	3.1	3.3	7.5	39.3	44.8	71.7
1400EXW3S	9.1	3.1	3.3	8.0	41.9	47.7	76.3
1000EXW4S	9.6	3.1	3.9	5.0	32.9	38.7	58.5
1100EXW4S	10.1	3.1	3.9	5.7	37.0	43.2	65.8
1250EXW4S	7.5	3.1	3.9	6.3	40.2	46.9	71.7
1400EXW4S	8.2	3.1	3.9	7.0	44.0	51.1	78.8
1500EXW4S	8.7	3.1	3.9	7.5	46.8	54.2	83.9
1600EXW4S	9.2	3.1	3.9	8.0	49.5	57.3	88.9
1680EXW4S	9.7	3.1	3.9	8.5	42.5	58.7	92.3
1800EXW4S	10.2	3.1	3.9	9.0	44.8	61.8	97.4
1900EXW4S	10.7	3.1	3.9	9.5	47.0	64.9	102.4
2000EXW4S	11.2	3.1	3.9	10.0	49.3	67.9	107.4

NOTE: Refer to the general arrangement drawings for specific center of gravity locations and data.

TABLE 10 - STANDARD PHYSICAL DATA

YHAU-CW	COLD INSULATION AREA (M^2)	HOT INSULATION AREA (M^2)	RADIATION HEAT LOSS (WITH INSULATION, AMBIENT TEMP. 10°C) (KW)	RADIATION HEAT LOSS (WITHOUT INSULATION, AMBIENT TEMP. 10°C) (KW)	WATER VOLUME		
					CHILLED WATER (EVAP) (M^3)	COOLING WATER (ABS AND COND) (M^3)	STEAM (GEN) (M^3)
150EXS	8	19	1	10	0.21	0.33	0.04
180EXS	10	21	1	12	0.25	0.39	0.04
240EXS	12	24	2	16	0.30	0.46	0.04
300EXS	14	28	2	20	0.36	0.56	0.06
360EXS	14	33	2	24	0.46	0.83	0.07
400EXS	15	36	3	27	0.50	0.89	0.08
450EXS	14	33	3	30	0.55	1.17	0.08
500EXS	16	36	3	33	0.60	1.25	0.09
560EXS	17	39	4	37	0.65	1.39	0.10
600EXS	19	40	4	40	0.71	1.48	0.11
700EXS	20	41	4	47	0.79	1.61	0.13
800EXS	23	46	5	53	0.88	1.88	0.15
900EXWS	32	50	6	60	1.24	2.36	0.17
1000EXWS	35	53	6	67	1.34	2.52	0.19
1100EXWS	38	58	7	73	1.46	2.71	0.21
1200EXW3S	43	64	8	80	1.68	3.28	0.24
1300EXW3S	46	70	8	87	1.80	3.40	0.26
1400EXW3S	48	76	9	93	1.89	3.55	0.28
1500EXW3S	51	82	10	100	1.99	3.70	0.29
1600EXW3S	53	88	10	107	2.08	3.85	0.31
1000EXW4S	34	40	6	67	2.09	3.53	0.19
1120EXW4S	37	45	7	75	2.25	3.80	0.21
1250EXW4S	40	49	8	83	2.40	4.03	0.23
1400EXW4S	44	53	9	93	2.56	4.29	0.26
1500EXW4S	47	56	10	100	2.68	4.48	0.28
1600EXW4S	49	59	10	107	2.79	4.68	0.30
1680EXW4S	52	63	11	112	2.91	4.87	0.31
1800EXW4S	54	66	12	120	3.03	5.06	0.33
1900EXW4S	57	69	12	127	3.15	5.25	0.35
2000EXW4S	59	72	13	133	3.26	5.44	0.37

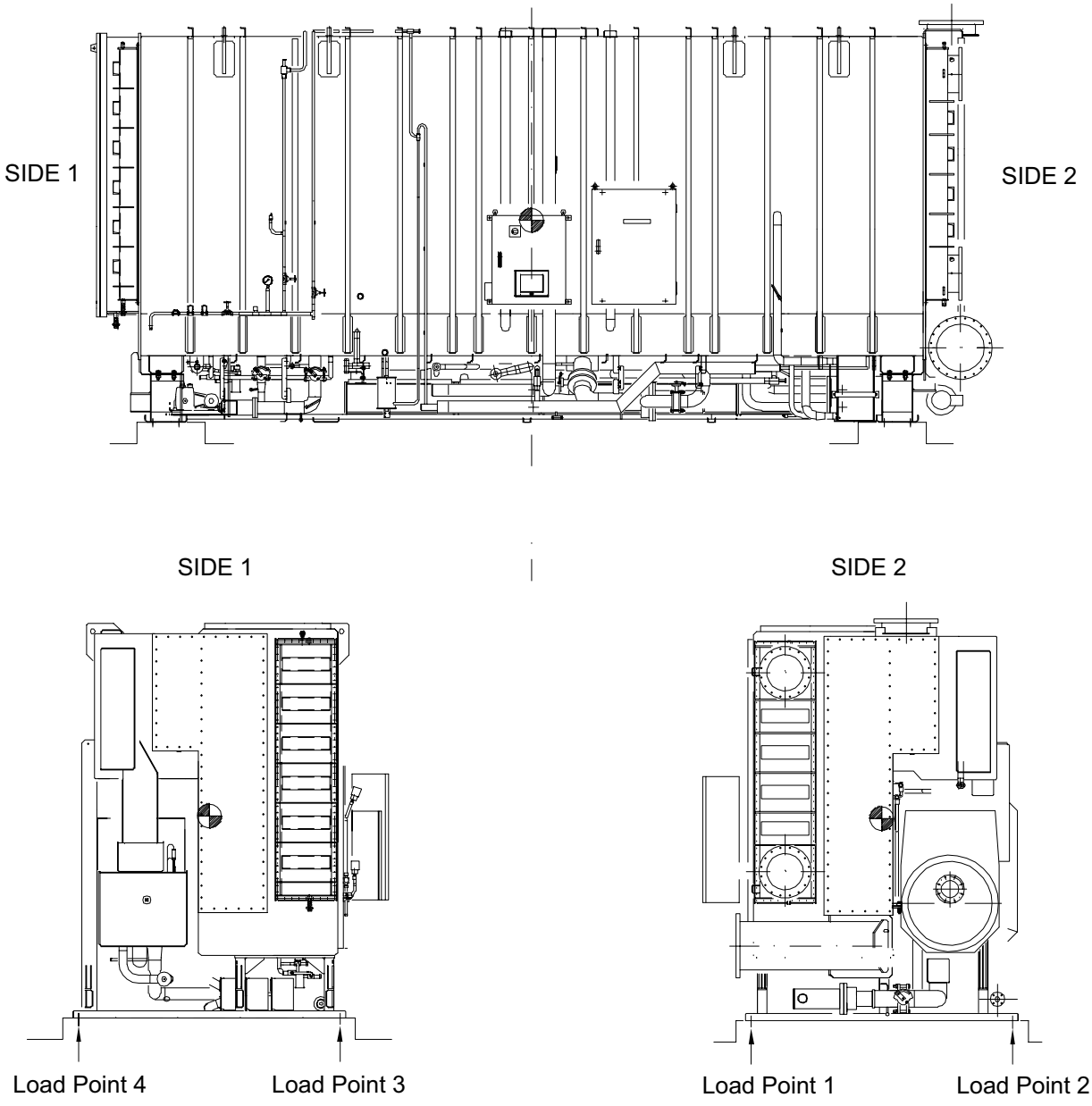


FIGURE 14 - LOAD POINTS FOR DOUBLE-EFFECT STEAM UNITS

THIS PAGE INTENTIONALLY LEFT BLANK.

TABLE 11 - LOAD POINTS FOR DOUBLE-EFFECT EX & EXW UNITS - HIGH EFFICIENCY

	LOAD POINT 1	LOAD POINT 2	LOAD POINT 3	LOAD POINT 4
150EX	1.84	1.99	1.62	1.75
180EX	2.04	2.36	1.90	2.20
240EX	2.34	2.70	2.25	2.61
300EX	2.70	3.12	2.68	3.10
360EX	3.95	3.95	3.95	3.95
400EX	4.40	4.40	4.40	4.40
450EX	4.42	4.13	4.42	4.13
500EX	5.22	4.88	5.22	4.88
560EX	5.63	5.27	5.63	5.27
600EX	6.28	5.87	6.28	5.87
700EX	6.95	6.50	6.95	6.50
800EX	7.78	7.27	7.78	7.27
900EXW	8.38	8.38	8.38	8.38
1000EXW	9.13	9.13	9.13	9.13
1100EXW	9.85	9.85	9.85	9.85
1200EXW3	11.0	11.1	11.0	11.1
1300EXW3	11.7	11.8	11.7	11.8
1400EXW3	12.5	12.6	12.5	12.6
1500EXW3	13.2	13.4	13.2	13.4
1600EXW3	14.0	14.1	14.0	14.1
1000EXW4	10.0	10.1	10.0	10.1
1120EXW4	11.3	11.3	11.3	11.3
1250EXW4	12.2	12.3	12.2	12.3
1400EXW4	13.3	13.4	13.3	13.4
1500EXW4	14.1	14.2	14.1	14.2
1600EXW4	14.9	15.0	14.9	15.0
1680EXW4	15.3	15.4	15.3	15.4
1800EXW4	16.1	16.2	16.1	16.2
1900EXW4	17.0	17.1	17.0	17.1
2000EXW4	17.8	17.9	17.8	17.9

TABLE 12 - LOAD POINTS FOR DOUBLE-EFFECT EX & EXW UNITS - STANDARD EFFICIENCY

	LOAD POINT 1	LOAD POINT 2	LOAD POINT 3	LOAD POINT 4
150EXS	1.71	1.85	1.51	1.63
180EXS	1.90	2.19	1.77	2.04
240EXS	2.17	2.51	2.10	2.42
300EXS	2.49	2.88	2.47	2.86
360EXS	3.78	3.78	3.78	3.78
400EXS	4.23	4.23	4.23	4.23
450EXS	4.24	3.96	4.24	3.96
500EXS	4.81	4.50	4.81	4.50
560EXS	5.37	5.03	5.37	5.03
600EXS	5.97	5.58	5.97	5.58
700EXS	6.61	6.19	6.61	6.19
800EXS	7.36	6.89	7.36	6.89
900EXWS	7.98	7.98	7.98	7.98
1000EXWS	8.63	8.63	8.63	8.63
1100EXWS	9.35	9.35	9.35	9.35
1200EXW3S	10.4	10.5	10.4	10.5
1300EXW3S	11.2	11.2	11.2	11.2
1400EXW3S	11.9	12.0	11.9	12.0
1500EXW3S	12.6	12.7	12.6	12.7
1600EXW3S	13.3	13.4	13.3	13.4
1000EXW4S	9.64	9.71	9.64	9.71
1120EXW4S	10.8	10.8	10.8	10.8
1250EXW4S	11.7	11.8	11.7	11.8
1400EXW4S	12.7	12.8	12.7	12.8
1500EXW4S	13.5	13.6	13.5	13.6
1600EXW4S	14.3	14.4	14.3	14.4
1680EXW4S	14.6	14.7	14.6	14.7
1800EXW4S	15.4	15.5	15.4	15.5
1900EXW4S	16.2	16.3	16.2	16.3
2000EXW4S	16.9	17.0	16.9	17.0

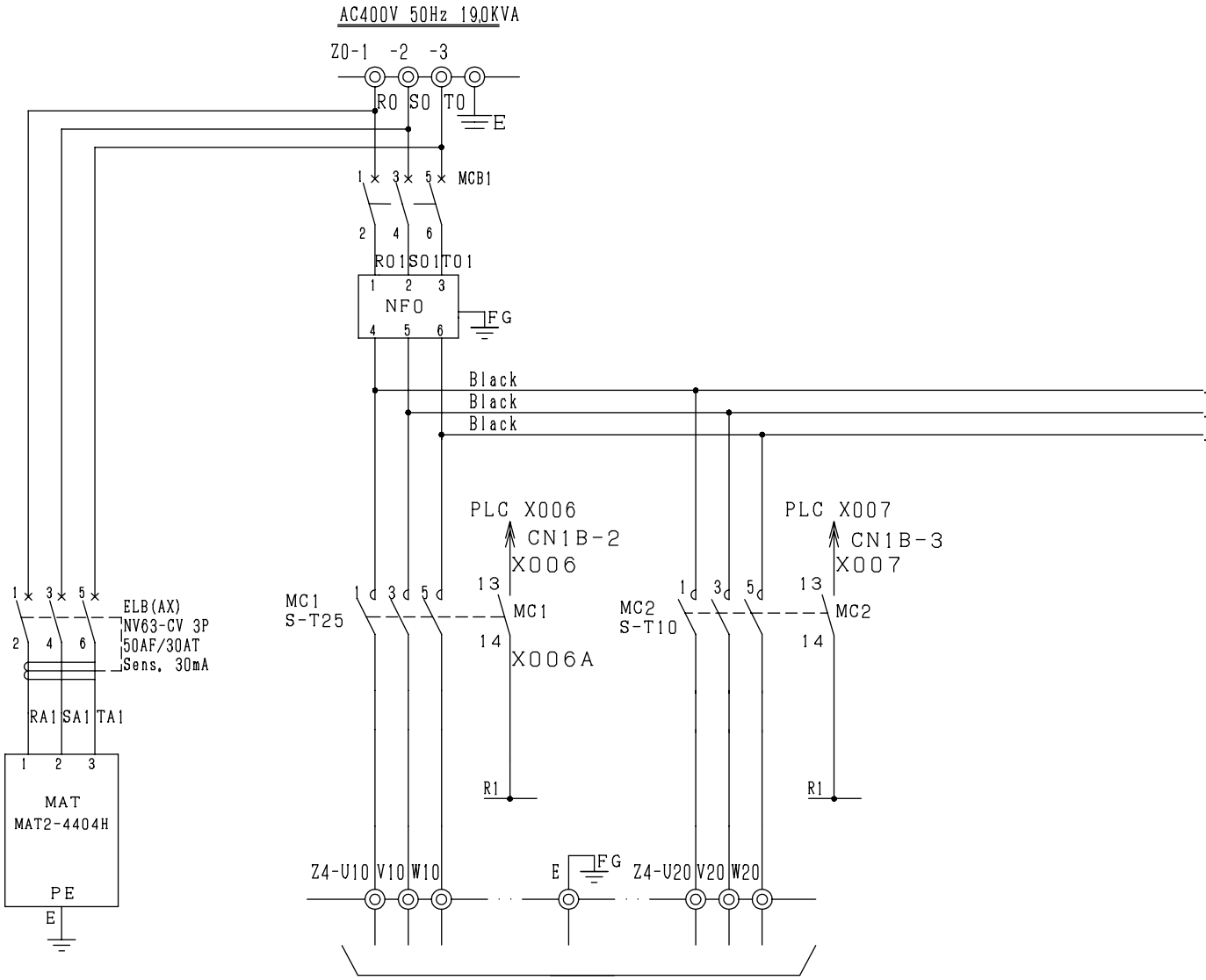
TABLE 13 - ELECTRICAL DATA

YHAU-CW	POWER SOURCE (VOLTAGE-PH-HZ)	MAIN BREAKER		SOLUTION CIRCULATION PUMP			SOLUTION SPRAY PUMP		
		RATED CURRENT	FRAME SIZE	KW	FLA	LRA	KW	FLA	LRA
150EX(S)	AC380V-3Ph-50Hz	32A	63A	2.2	6.1	23.0	1.1	3.4	12.1
	AC400V-3Ph-50Hz				5.8	24.0		3.45	12.6
180EX(S)	AC380V-3Ph-50Hz	32A	63A	2.2	6.1	23.0	2.2	6.1	23.0
	AC400V-3Ph-50Hz				5.8	24.0		5.8	24.0
240EX(S)	AC380V-3Ph-50Hz	32A	63A	2.2	6.1	23.0	2.2	6.1	23.0
	AC400V-3Ph-50Hz				5.8	24.0		5.8	24.0
300EX(S)	AC380V-3Ph-50Hz	32A	63A	3.0	8.1	29.0	2.2	6.1	23.0
	AC400V-3Ph-50Hz				7.8	30.0		5.8	24.0
360EX(S)	AC380V-3Ph-50Hz	32A	63A	3.0	8.1	29.0	2.2	6.1	23.0
	AC400V-3Ph-50Hz				7.8	30.0		5.8	24.0
400EX(S)	AC380V-3Ph-50Hz	32A	63A	3.0	8.1	29.0	2.2	6.1	23.0
	AC400V-3Ph-50Hz				7.8	30.0		5.8	24.0
450EX(S)	AC380V-3Ph-50Hz	32A	63A	5.5	14.2	60.0	2.2	6.1	23.0
	AC400V-3Ph-50Hz				13.5	63.0		5.8	24.0
500EX(S)	AC380V-3Ph-50Hz	32A	63A	5.5	14.2	60.0	2.2	6.1	23.0
	AC400V-3Ph-50Hz				13.5	63.0		5.8	24.0
560EX (S)	AC380V-3Ph-50Hz	32A	63A	5.5	14.2	60.0	2.2	6.1	23.0
	AC400V-3Ph-50Hz				13.5	63.0		5.8	24.0
600EX(S)	AC380V-3Ph-50Hz	32A	63A	5.5	14.2	60.0	2.2	6.1	23.0
	AC400V-3Ph-50Hz				13.5	63.0		5.8	24.0
700EX(S)	AC380V-3Ph-50Hz	32A	63A	5.5	14.2	60.0	2.2	6.1	23.0
	AC400V-3Ph-50Hz				13.5	63.0		5.8	24.0
800EX(S)	AC380V-3Ph-50Hz	32A	63A	5.5	14.2	60.0	2.2	6.5	20.3
	AC400V-3Ph-50Hz				13.5	63.0		6.2	21.0
900EXW(S)	AC380V-3Ph-50Hz	32A	63A	5.5	14.2	60.0	2.2	6.5	20.3
	AC400V-3Ph-50Hz				13.5	63.0		6.2	21.0
1000EXW(S)	AC380V-3Ph-50Hz	40A	63A	7.5	19.8	68.6	2.2	6.5	20.3
	AC400V-3Ph-50Hz				19.2	72.0		6.2	21.0
1100EXW(S)	AC380V-3Ph-50Hz	50A	63A	7.5	19.8	68.6	3.7	10.6	34.0
	AC400V-3Ph-50Hz				19.2	72.0		10.1	36.0
1200EXW3(S)	AC380V-3Ph-50Hz	50A	63A	7.5	19.8	68.6	3.7	10.6	34.0
	AC400V-3Ph-50Hz				19.2	72.0		10.1	36.0
1300EXW3(S)	AC380V-3Ph-50Hz	50A	63A	7.5	19.8	68.6	3.7	10.6	34.0
	AC400V-3Ph-50Hz				19.2	72.0		10.1	36.0
1400EXW3(S)	AC380V-3Ph-50Hz	50A	63A	7.5	19.8	68.6	3.7	10.6	34.0
	AC400V-3Ph-50Hz				19.2	72.0		10.1	36.0
1500EXW3(S)	AC380V-3Ph-50Hz	50A	63A	7.5	19.8	68.6	3.7	10.6	34.0
	AC400V-3Ph-50Hz				19.2	72.0		10.1	36.0
1600EXW3(S)	AC380V-3Ph-50Hz	50A	63A	7.5	19.8	68.6	3.7	10.6	34.0
	AC400V-3Ph-50Hz				19.2	72.0		10.1	36.0
1000EXW4(S)	AC380V-3Ph-50Hz	50	63A	7.5	19.8	68.6	3.7	10.6	34.0
	AC400V-3Ph-50Hz				19.2	72.0		10.1	36.0
1120EXW4(S)	AC380V-3Ph-50Hz	50	63A	7.5	19.8	68.6	3.7	10.6	34.0
	AC400V-3Ph-50Hz				19.2	72.0		10.1	36.0
1250EXW4(S)	AC380V-3Ph-50Hz	50	63A	7.5	19.8	68.6	3.7	10.6	34.0
	AC400V-3Ph-50Hz				19.2	72.0		10.1	36.0

TABLE 13 - ELECTRICAL DATA (CONT'D)

YHAU-CW	REFRIGERANT PUMP			VACUUM PUMP WITH CE			CAPACITY KVA	CONSUMPTION KW	SCCR KA
	KW	FLA	LRA	KW	FLA	LRA			
150EX(S)	0.2	1.1	3.0	0.75	1.8	9.0	8.5	6.8	6
		1.12	3.3		1.8	9.0	8.7	7.0	
180EX(S)	0.4	1.6	4.2	0.75	1.8	9.0	10.6	8.5	6
		1.65	4.4		1.8	9.0	10.7	8.6	
240EX(S)	0.4	1.6	4.2	0.75	1.8	9.0	10.6	8.5	6
		1.65	4.4		1.8	9.0	10.7	8.6	
300EX(S)	0.4	1.6	4.2	0.75	1.8	9.0	11.9	9.5	6
		1.65	4.4		1.8	9.0	12.1	9.7	
360EX(S)	0.4	1.6	4.2	0.75	1.8	9.0	11.9	9.5	6
		1.65	4.4		1.8	9.0	12.1	9.7	
400EX(S)	0.4	1.6	4.2	0.75	1.8	9.0	11.9	9.5	6
		1.65	4.4		1.8	9.0	12.1	9.7	
450EX(S)	0.4	1.6	4.2	0.75	1.8	9.0	15.9	12.7	6
		1.65	4.4		1.8	9.0	16.1	12.8	
500EX(S)	0.4	1.6	4.2	0.75	1.8	9.0	15.9	12.7	6
		1.65	4.4		1.8	9.0	16.1	12.8	
560EX (S)	0.4	1.6	4.2	0.75	1.8	9.0	15.9	12.7	6
		1.65	4.4		1.8	9.0	16.1	12.8	
600EX(S)	0.4	1.6	4.2	0.75	1.8	9.0	15.9	12.7	6
		1.65	4.4		1.8	9.0	16.1	12.8	
700EX(S)	0.4	1.6	4.2	0.75	1.8	9.0	15.9	12.7	6
		1.65	4.4		1.8	9.0	16.1	12.8	
800EX(S)	0.4	1.6	4.2	0.75	1.8	9.0	16.2	12.9	6
		1.65	4.4		1.8	9.0	16.3	13.1	
900EXW(S)	1.3	3.9	11.9	0.75	1.8	9.0	17.7	14.1	6
		3.8	12.8		1.8	9.0	17.8	14.3	
1000EXW(S)	1.3	3.9	11.9	0.75	1.8	9.0	21.4	17.1	6
		3.8	12.8		1.8	9.0	21.8	17.4	
1100EXW(S)	1.5	4.7	12.5	0.75	1.8	9.0	24.6	19.7	6
		4.5	13.0		1.8	9.0	25.0	20.0	
1200EXW3(S)	1.5	4.7	12.5	0.75	1.8	9.0	24.6	19.7	6
		4.5	13.0		1.8	9.0	25.0	20.0	
1300EXW3(S)	1.5	4.7	12.5	0.75	1.8	9.0	24.6	19.7	6
		4.5	13.0		1.8	9.0	25.0	20.0	
1400EXW3(S)	1.5	4.7	12.5	0.75	1.8	9.0	24.6	19.7	6
		4.5	13.0		1.8	9.0	25.2	20.0	
1500EXW3(S)	1.5	4.7	12.5	0.75	1.8	9.0	24.6	19.7	6
		4.5	13.0		1.8	9.0	25.0	20.0	
1600EXW3(S)	1.5	4.7	12.5	0.75	1.8	9.0	24.6	19.7	6
		4.5	13.0		1.8	9.0	25.0	20.0	
1000EXW4(S)	1.5	4.7	12.5	0.75	1.8	9.0	24.6	19.7	6
		4.5	13.0		1.8	9.0	25.0	20.0	
1120EXW4(S)	1.5	4.7	12.5	0.75	1.8	9.0	24.6	19.7	6
		4.5	13.0		1.8	9.0	25.0	20.0	
1250EXW4(S)	1.5	4.7	12.5	0.75	1.8	9.0	24.6	19.7	6
		4.5	13.0		1.8	9.0	25.0	20.0	

Electrical Diagram for Europe

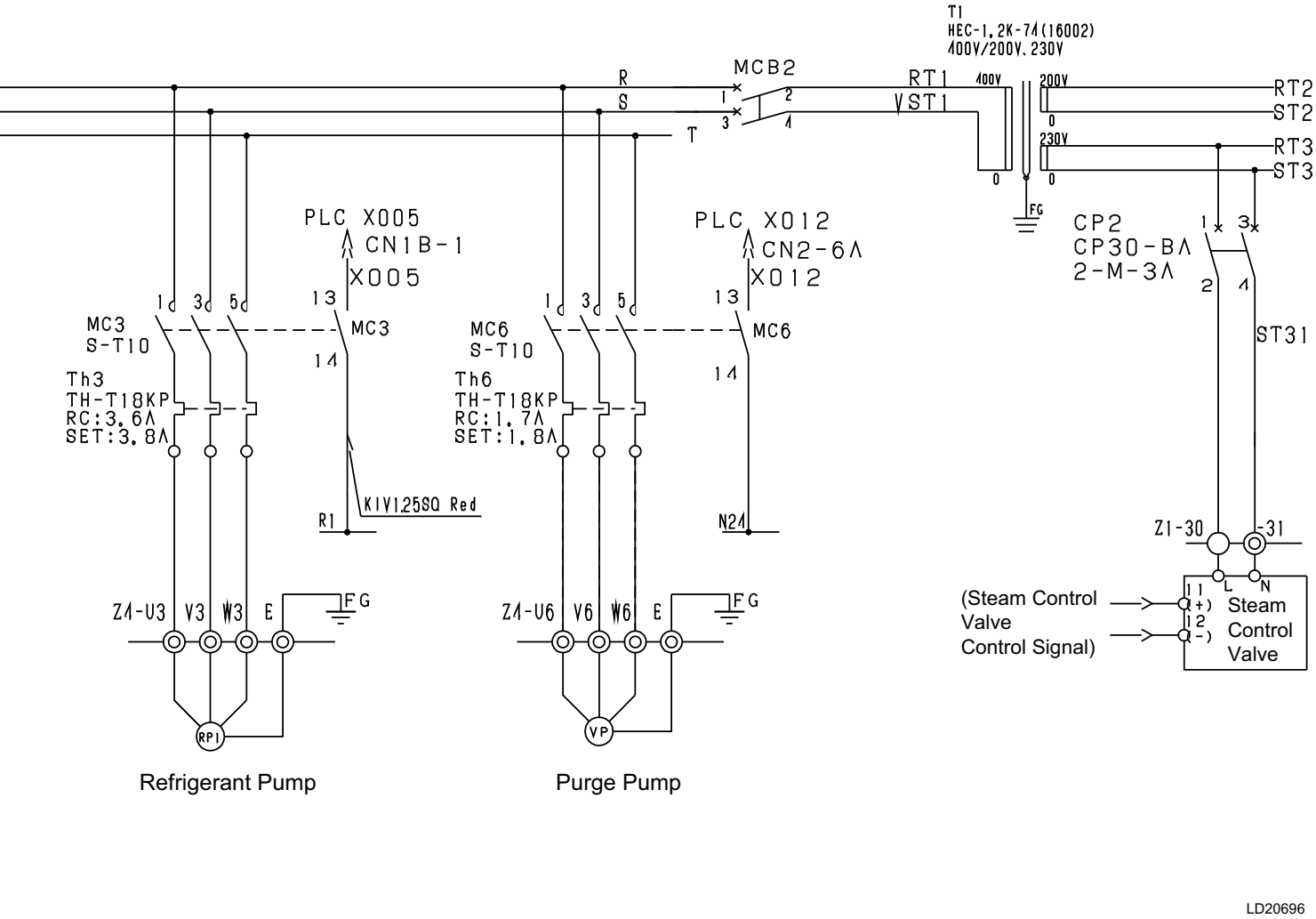


Model of electromagnetic switch and thermal switch are dependent on pump power.

LD20695

FIGURE 15 - POWER WIRING FOR EUROPE

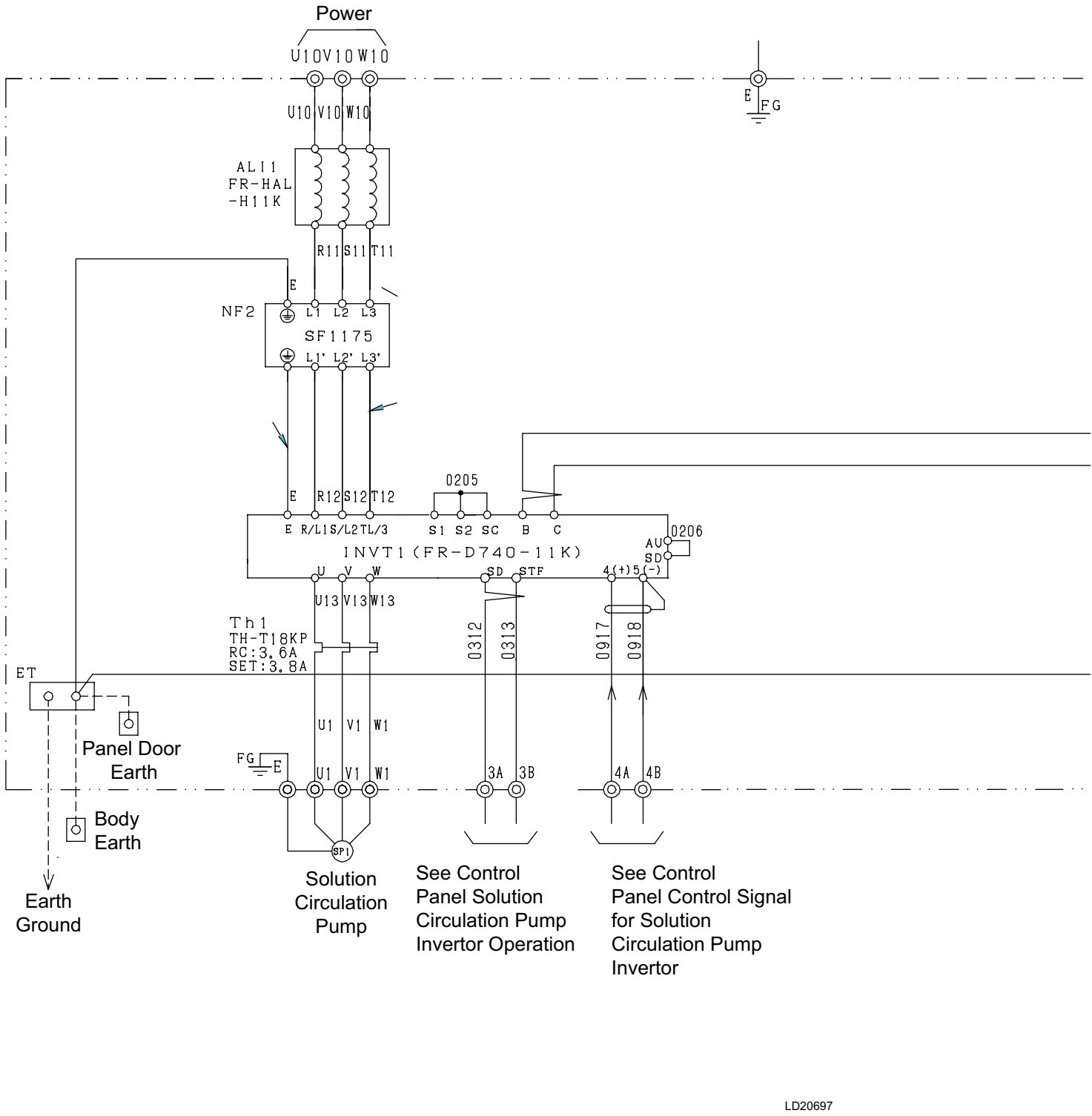
Electrical Diagram for Europe



LD20696

FIGURE 15 - POWER WIRING FOR EUROPE (CONT'D)

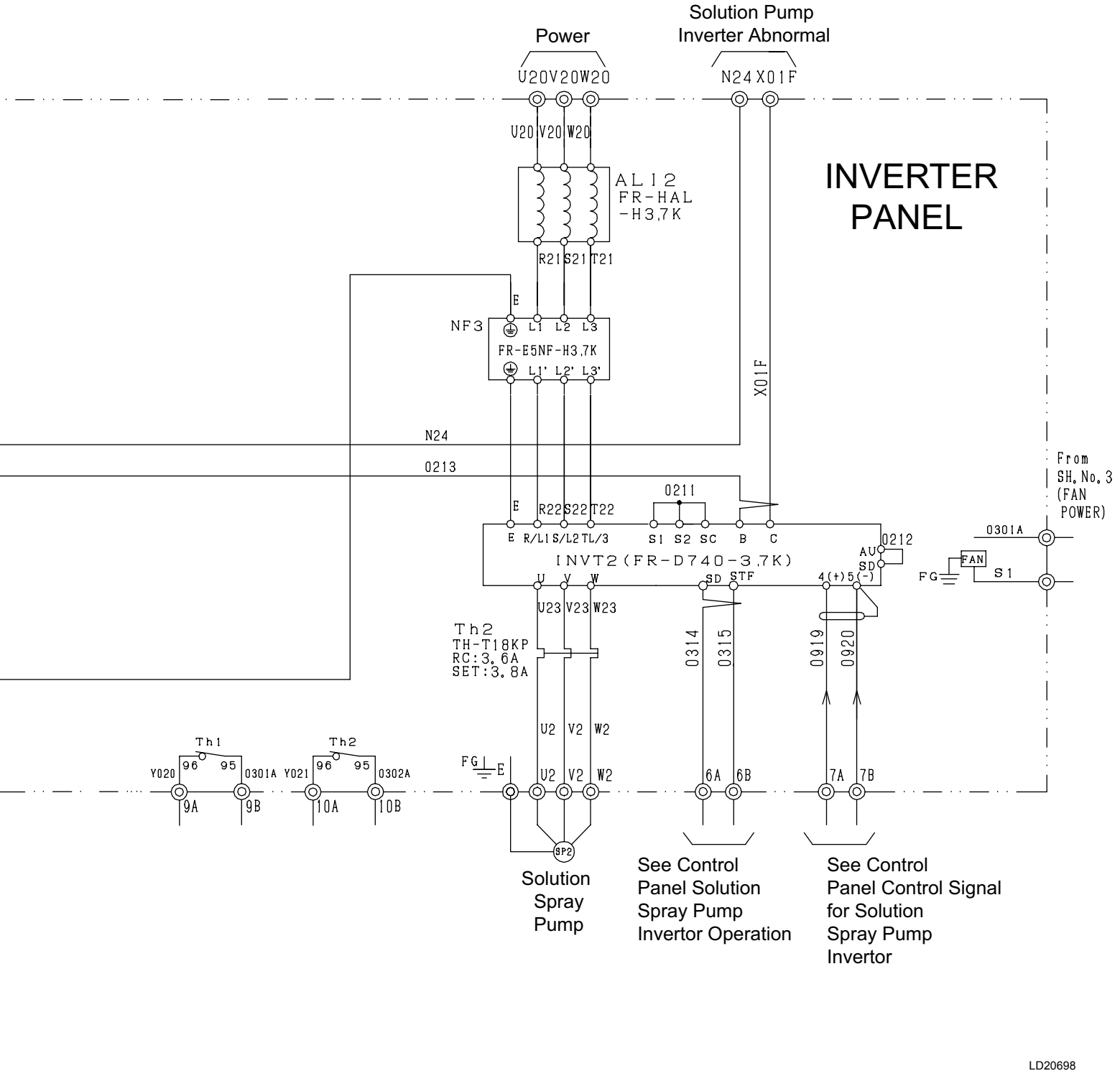
Electrical Diagram for Europe



LD20697

FIGURE 16 - INVERTER WIRING - OPTIONAL FOR EUROPE

Electrical Diagram for Europe



LD20698

FIGURE 16 - INVERTER WIRING - OPTIONAL FOR EUROPE (CONT'D)

Electrical Diagram for Europe

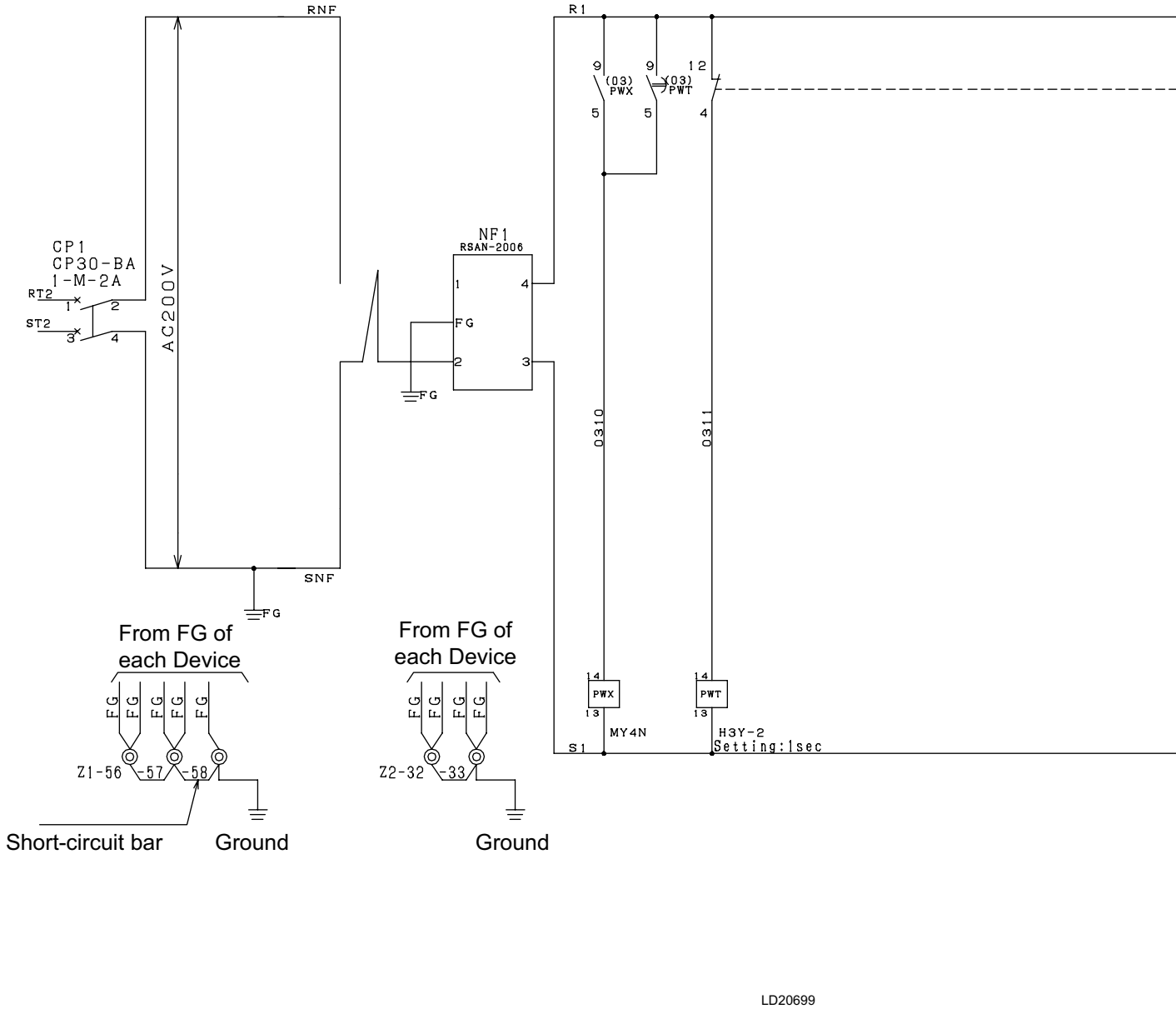


FIGURE 17 - POWER SUPPLY WIRING FOR EUROPE

Electrical Diagram for Europe

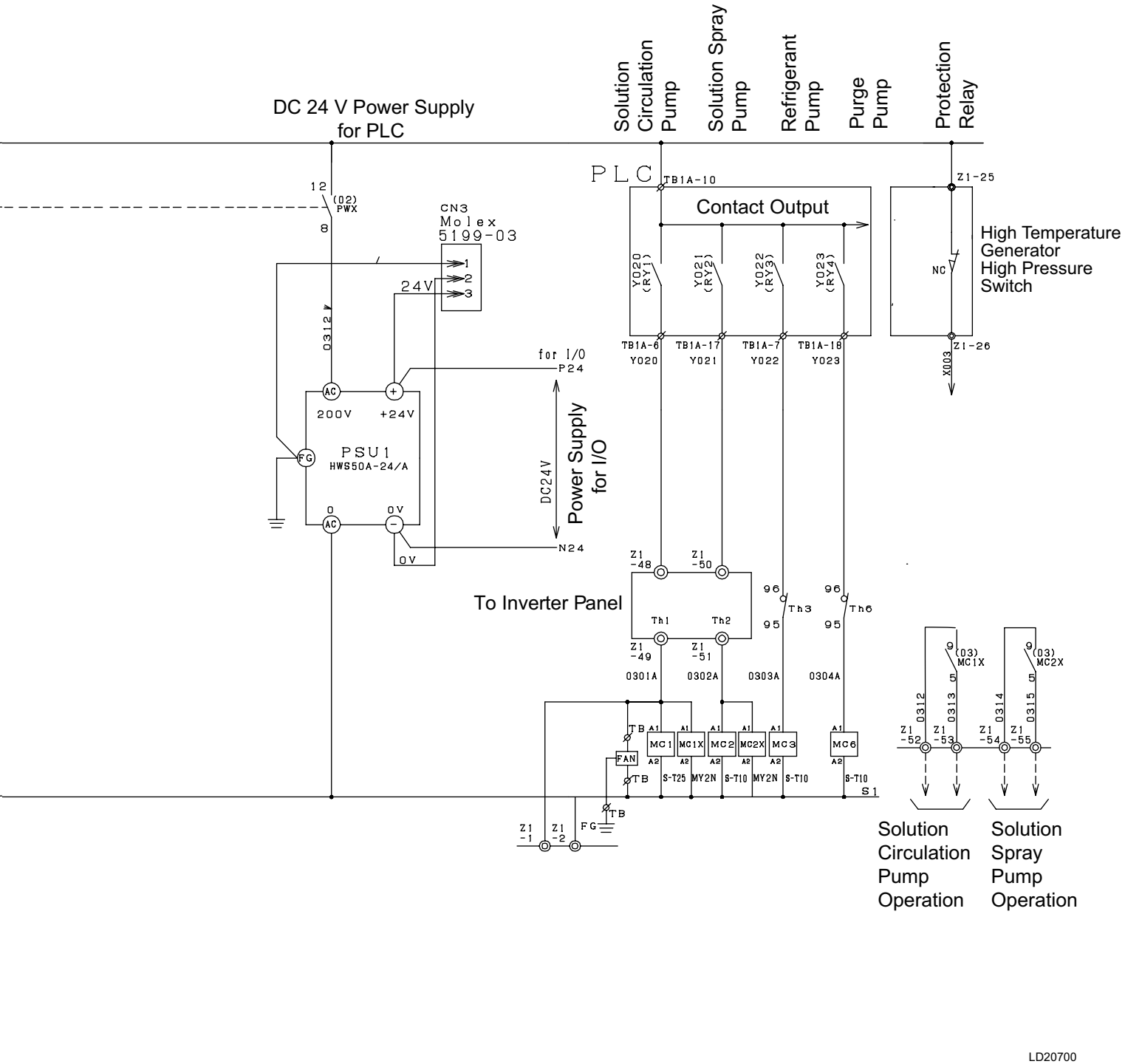


FIGURE 17 - POWER SUPPLY WIRING FOR EUROPE (CONT'D)

Electrical Diagram for Europe

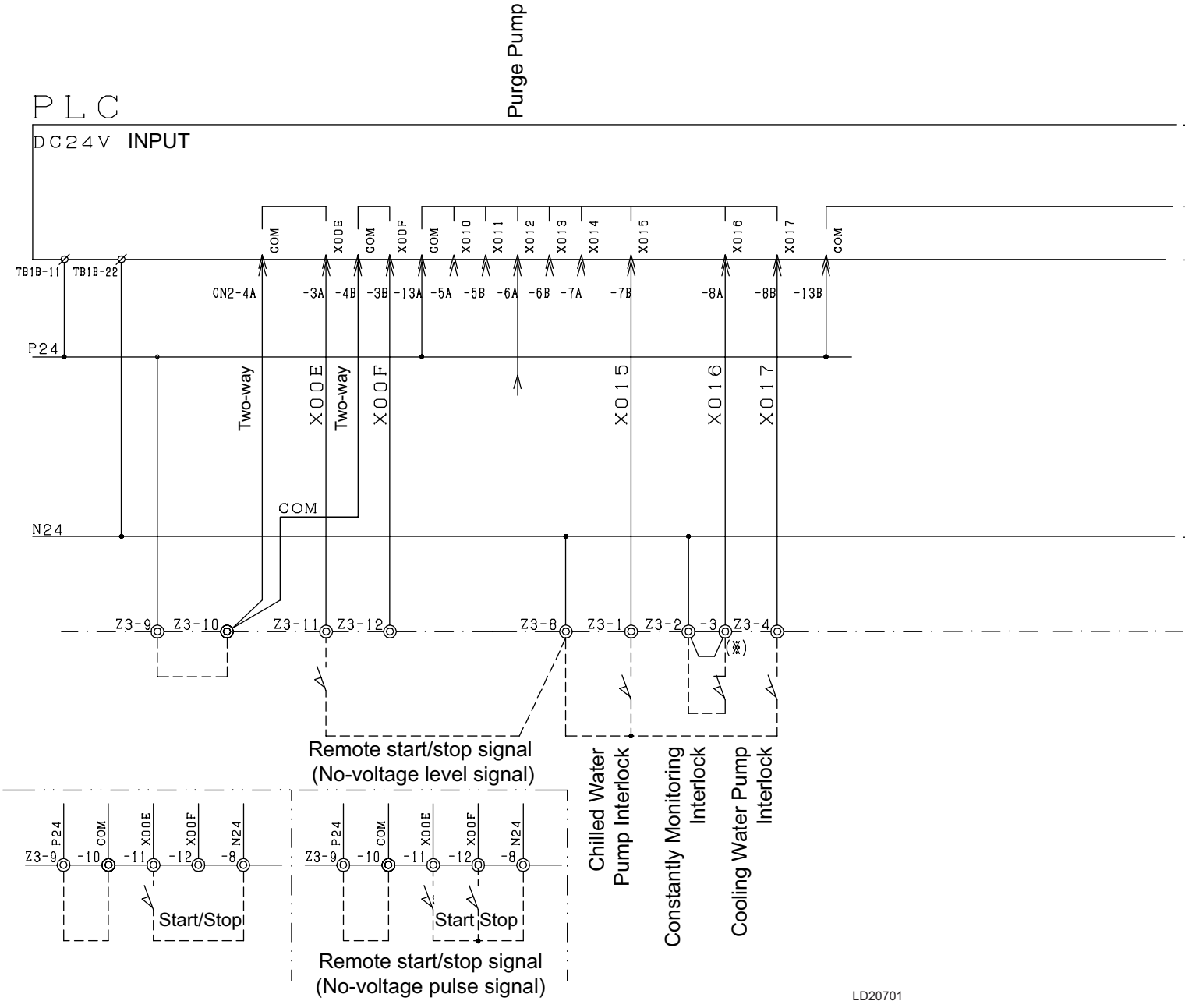
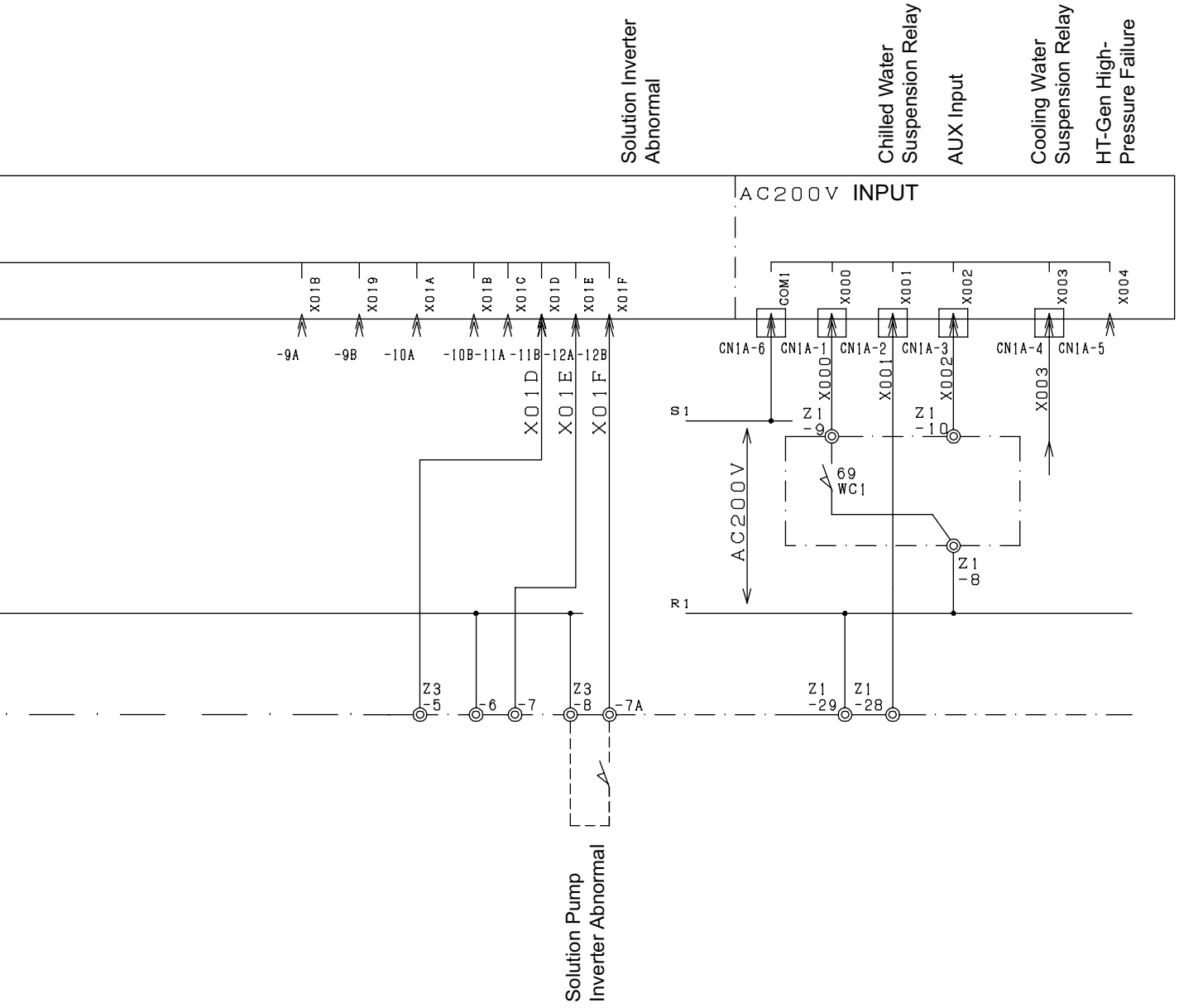


FIGURE 18 - PLC INPUT WIRING FOR EUROPE

Electrical Diagram for Europe



If a constantly monitoring cable is used, remove the jumper cable.

LD20702

FIGURE 18 - PLC INPUT WIRING FOR EUROPE (CONT'D)

Electrical Diagram for Europe

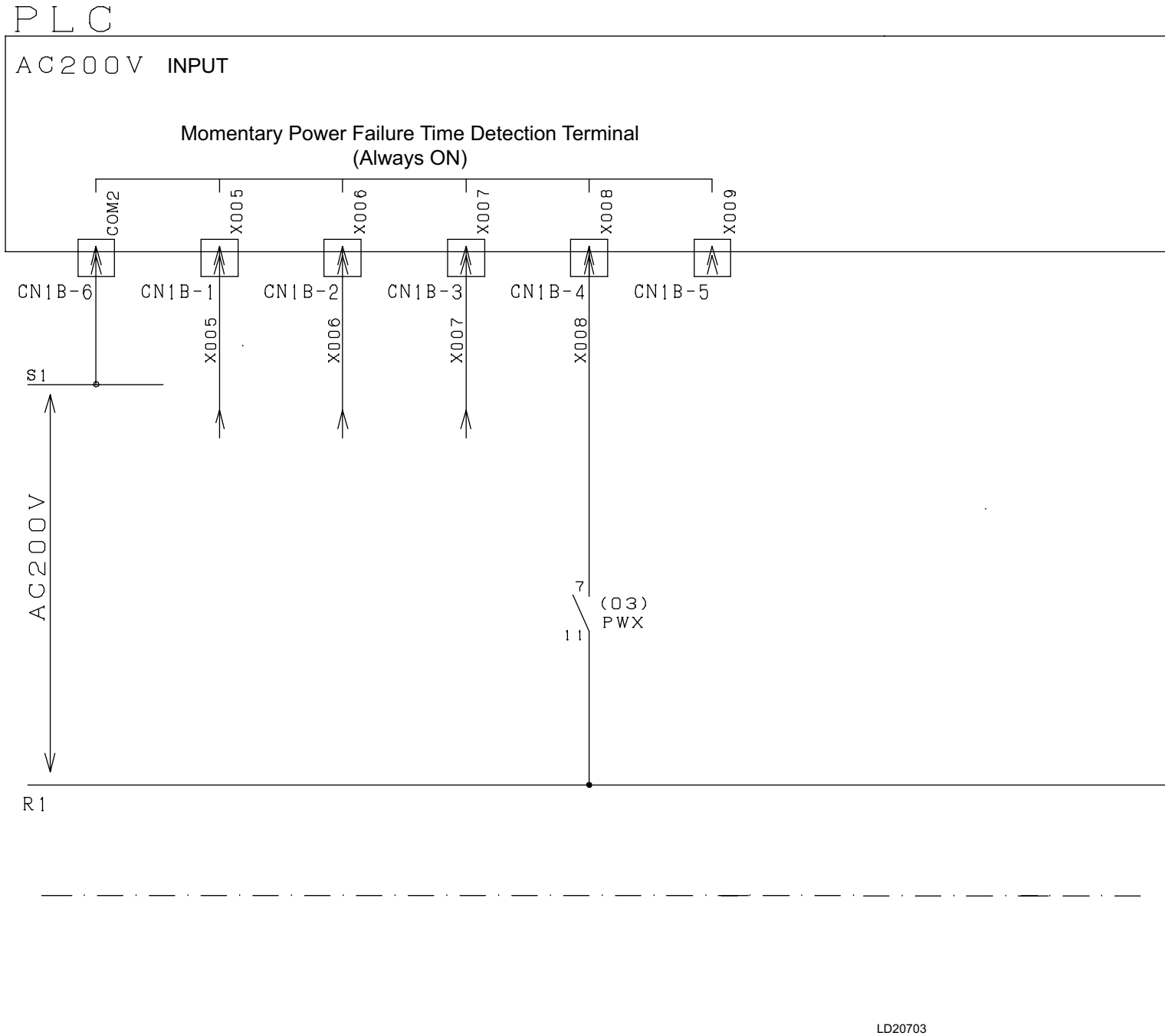


FIGURE 18 - PLC INPUT WIRING FOR EUROPE (CONT'D)

Electrical Diagram for Europe

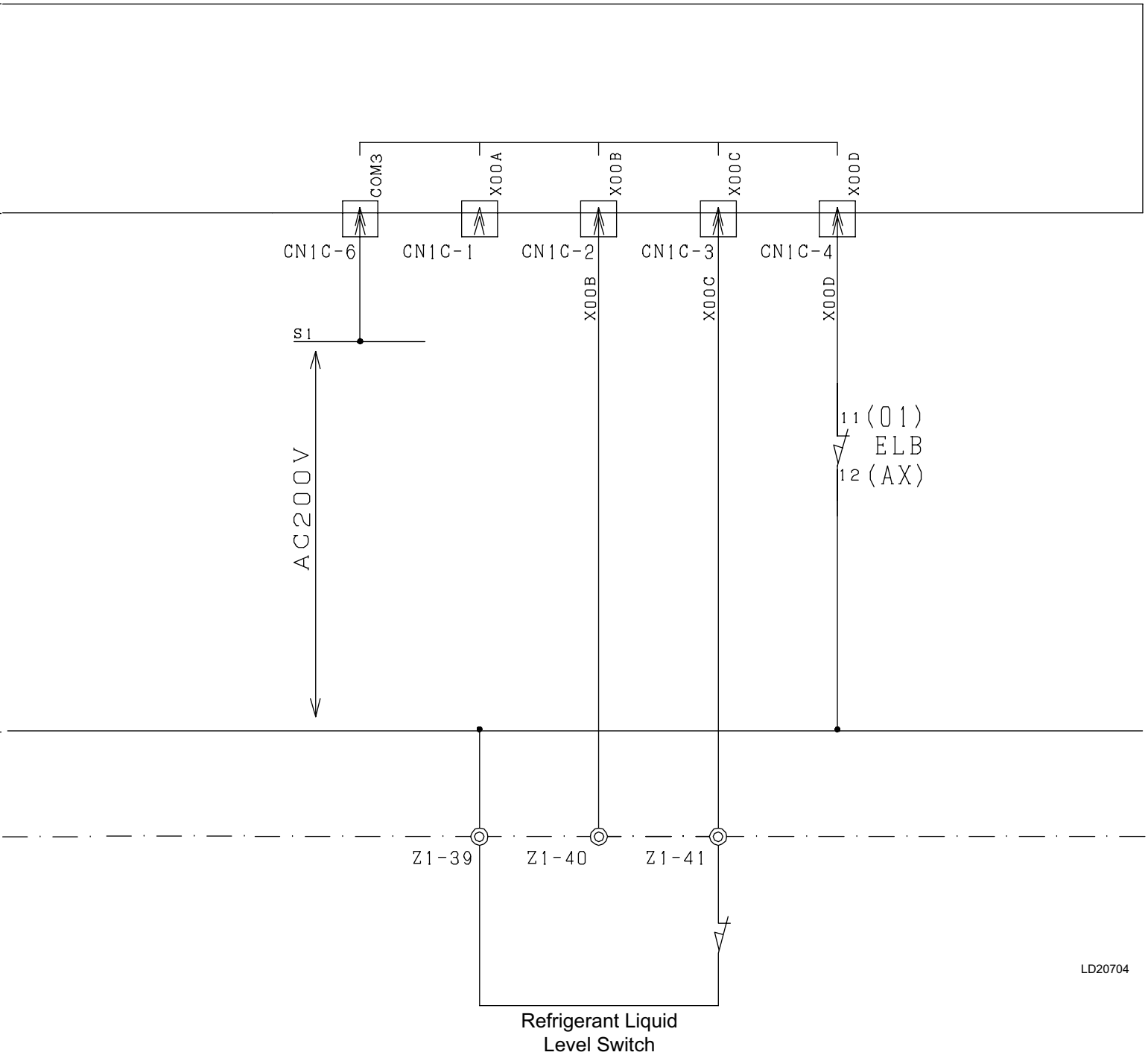


FIGURE 18 - PLC INPUT WIRING FOR EUROPE (CONT'D)

Electrical Diagram for Europe

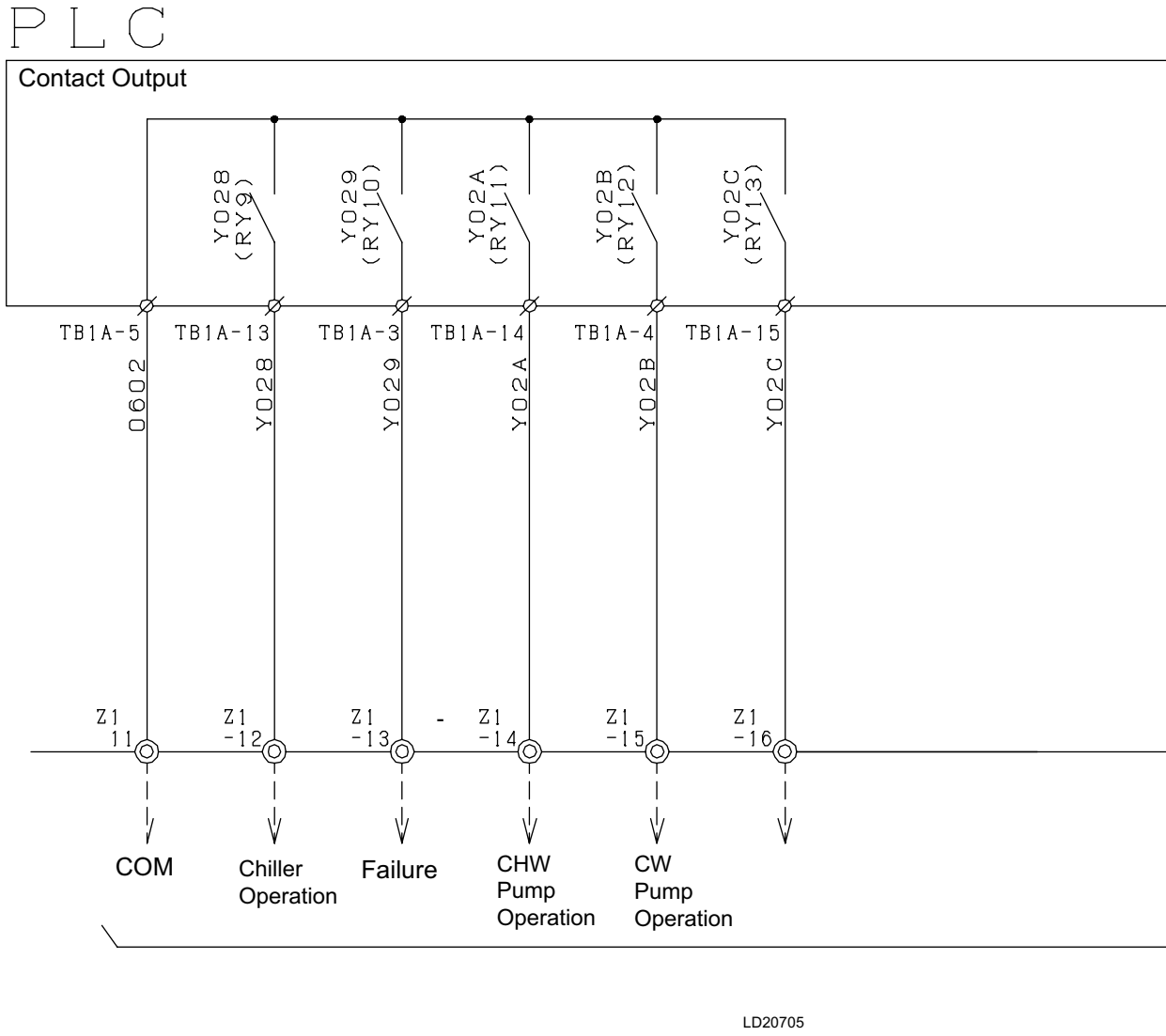


FIGURE 18 - PLC INPUT WIRING FOR EUROPE (CONT'D)

Electrical Diagram for Europe

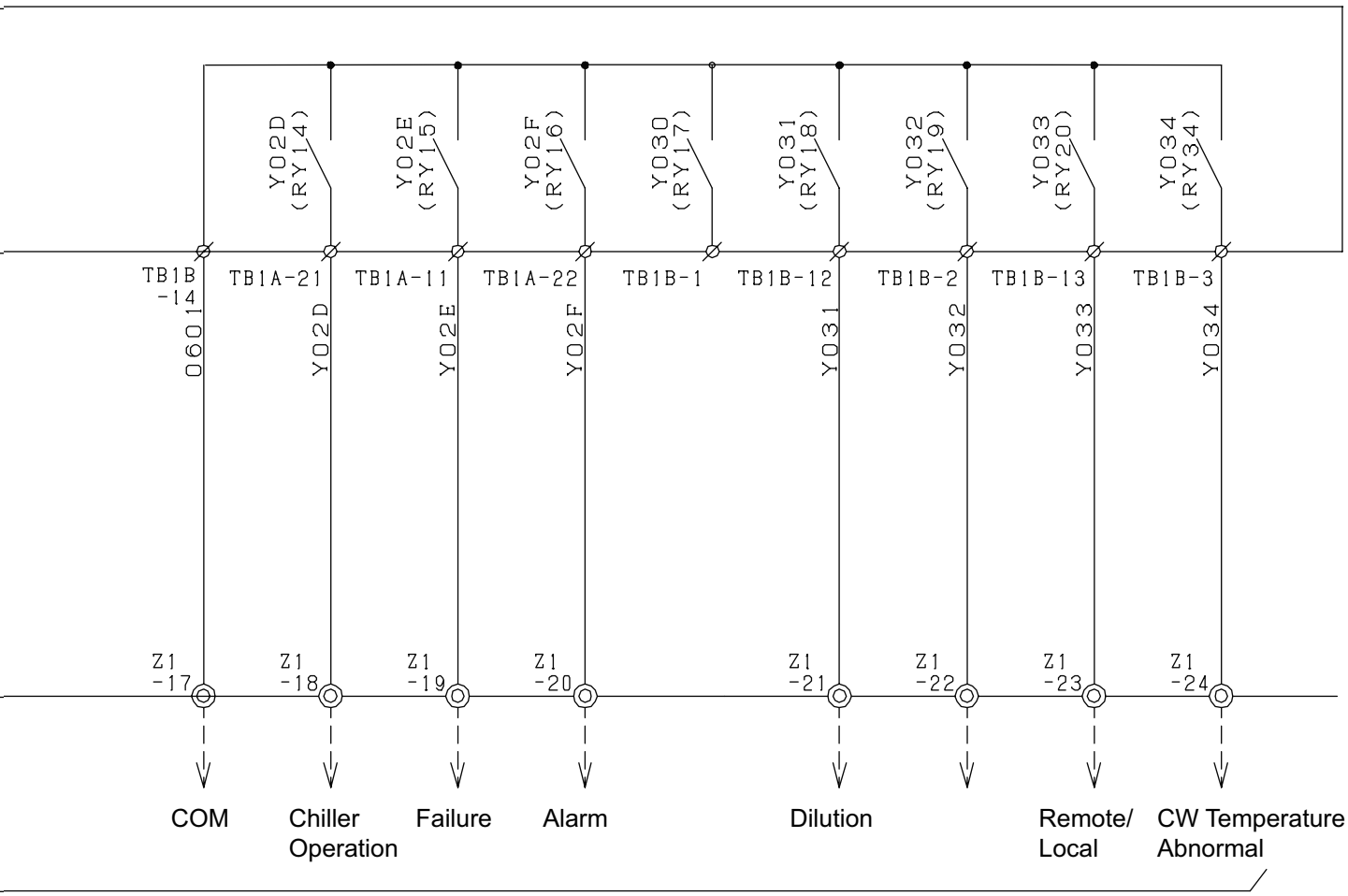


FIGURE 18 - PLC INPUT WIRING FOR EUROPE (CONT'D)

Electrical Diagram for Europe

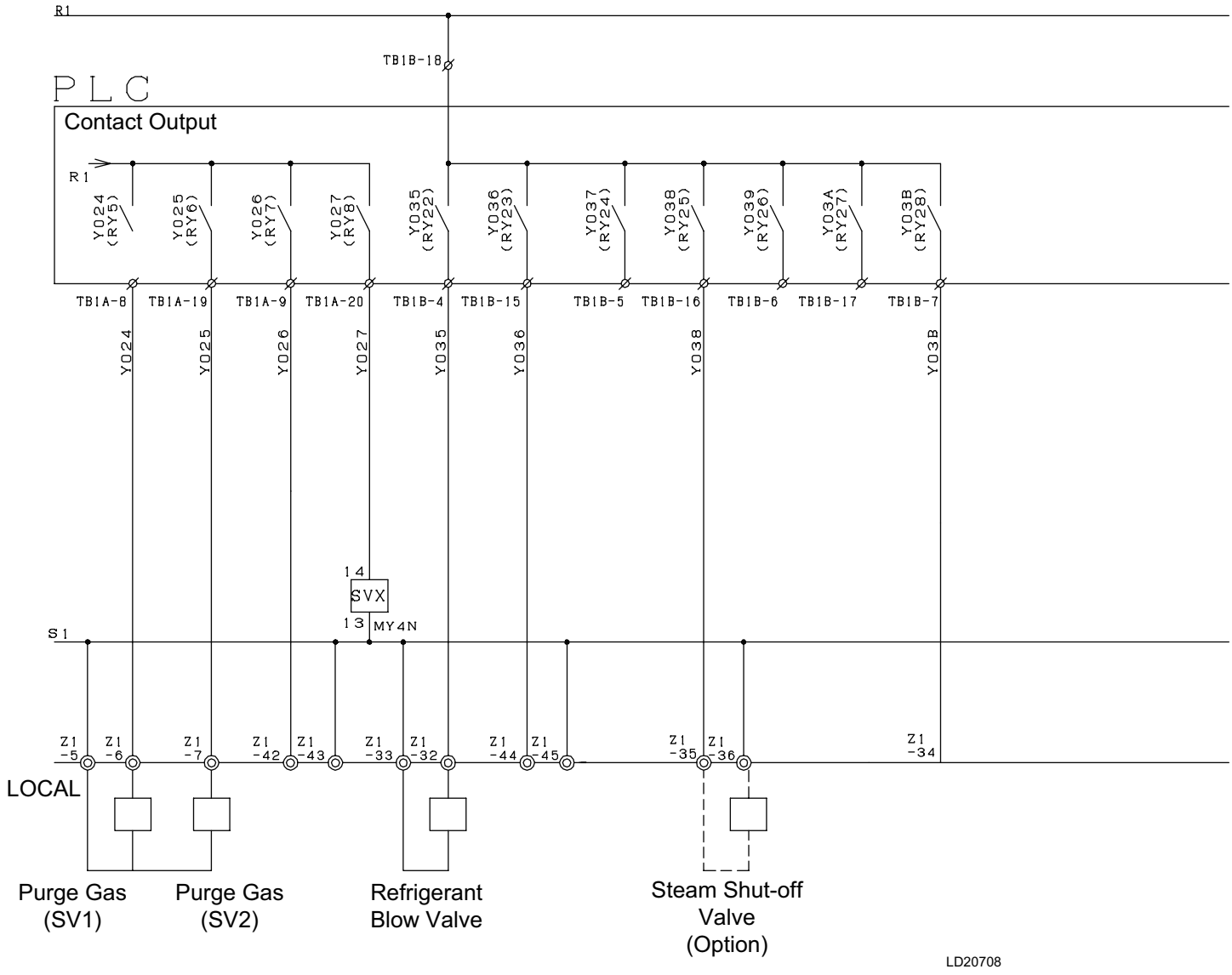


FIGURE 19 - PLC OUTPUT WIRING FOR EUROPE

Electrical Diagram for Europe

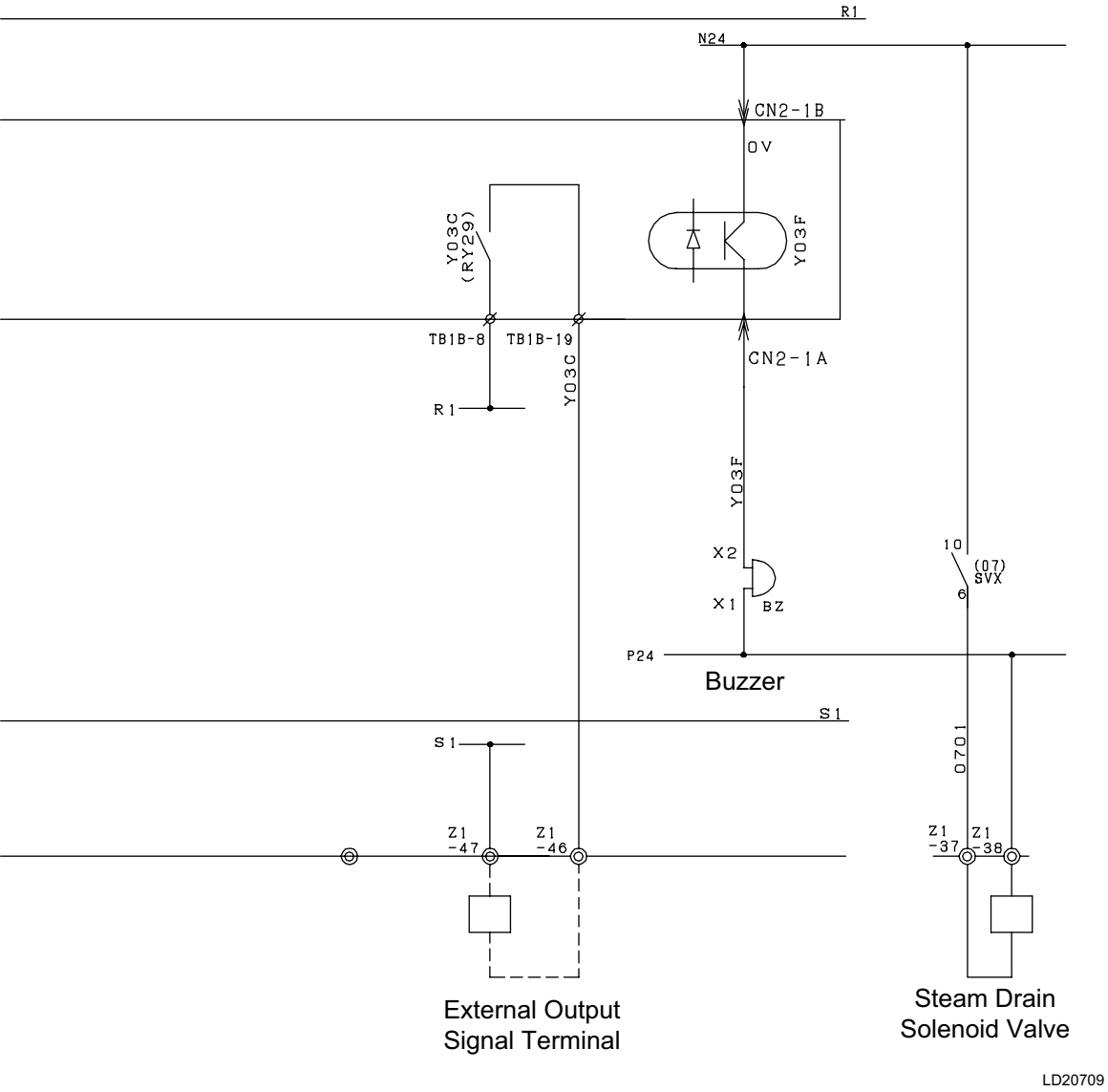
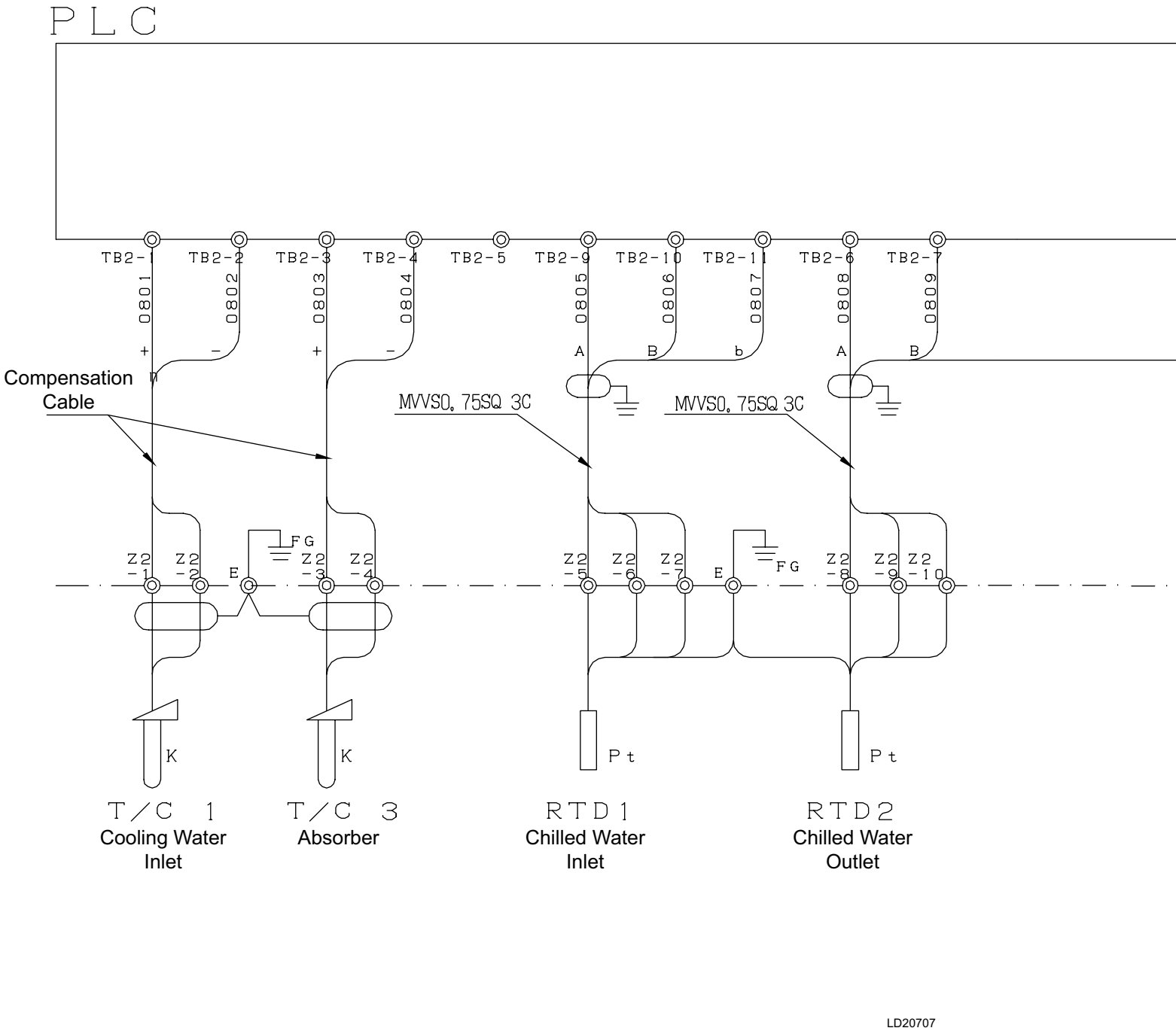


FIGURE 19 - PLC OUTPUT WIRING FOR EUROPE

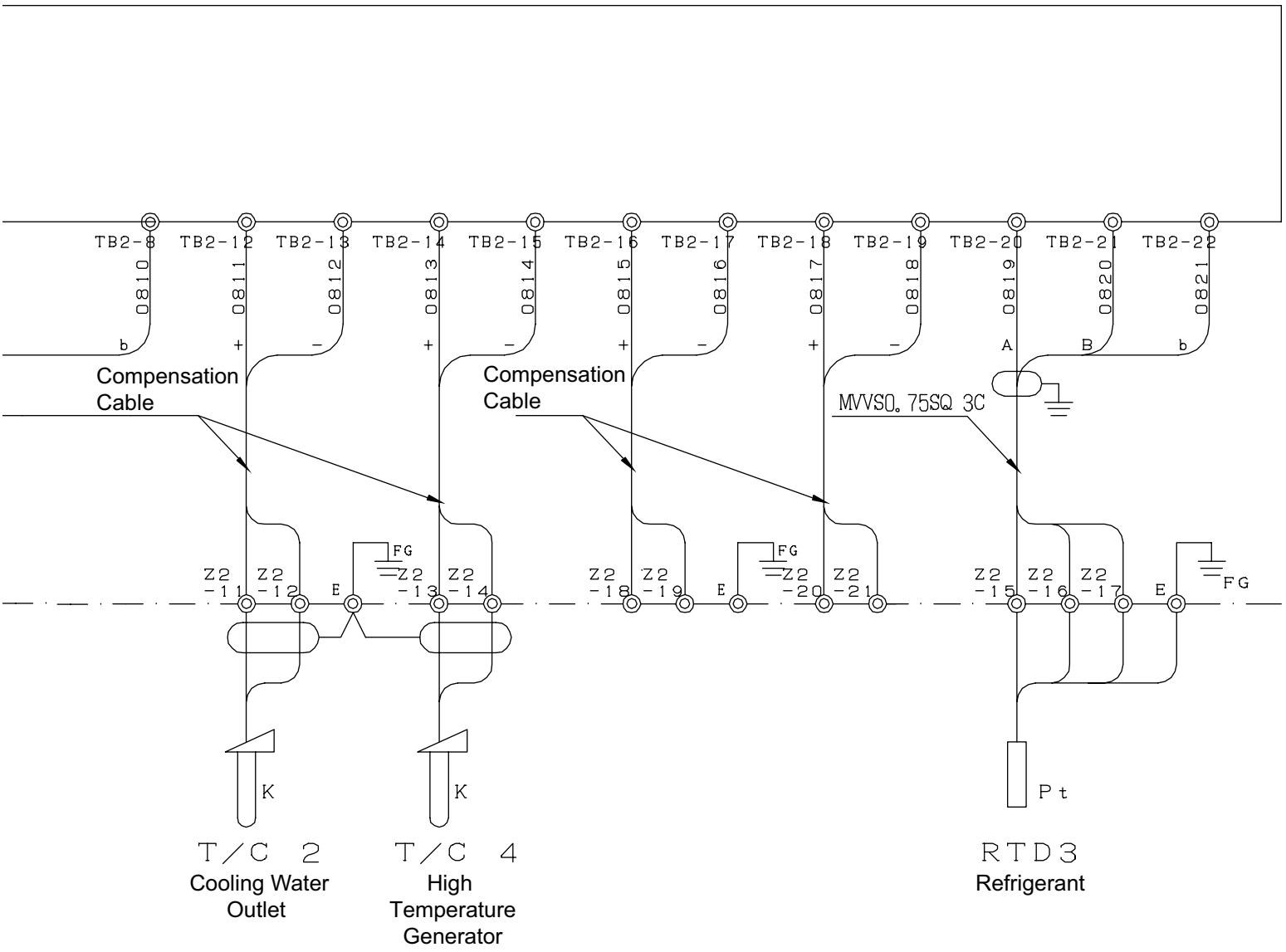
Electrical Diagram for Europe



LD20707

FIGURE 20 - PLC ANALOG INPUT WIRING FOR EUROPE

Electrical Diagram for Europe



LD20710

FIGURE 20 - PLC ANALOG INPUT WIRING FOR EUROPE (CONT'D)

Electrical Diagram for Europe

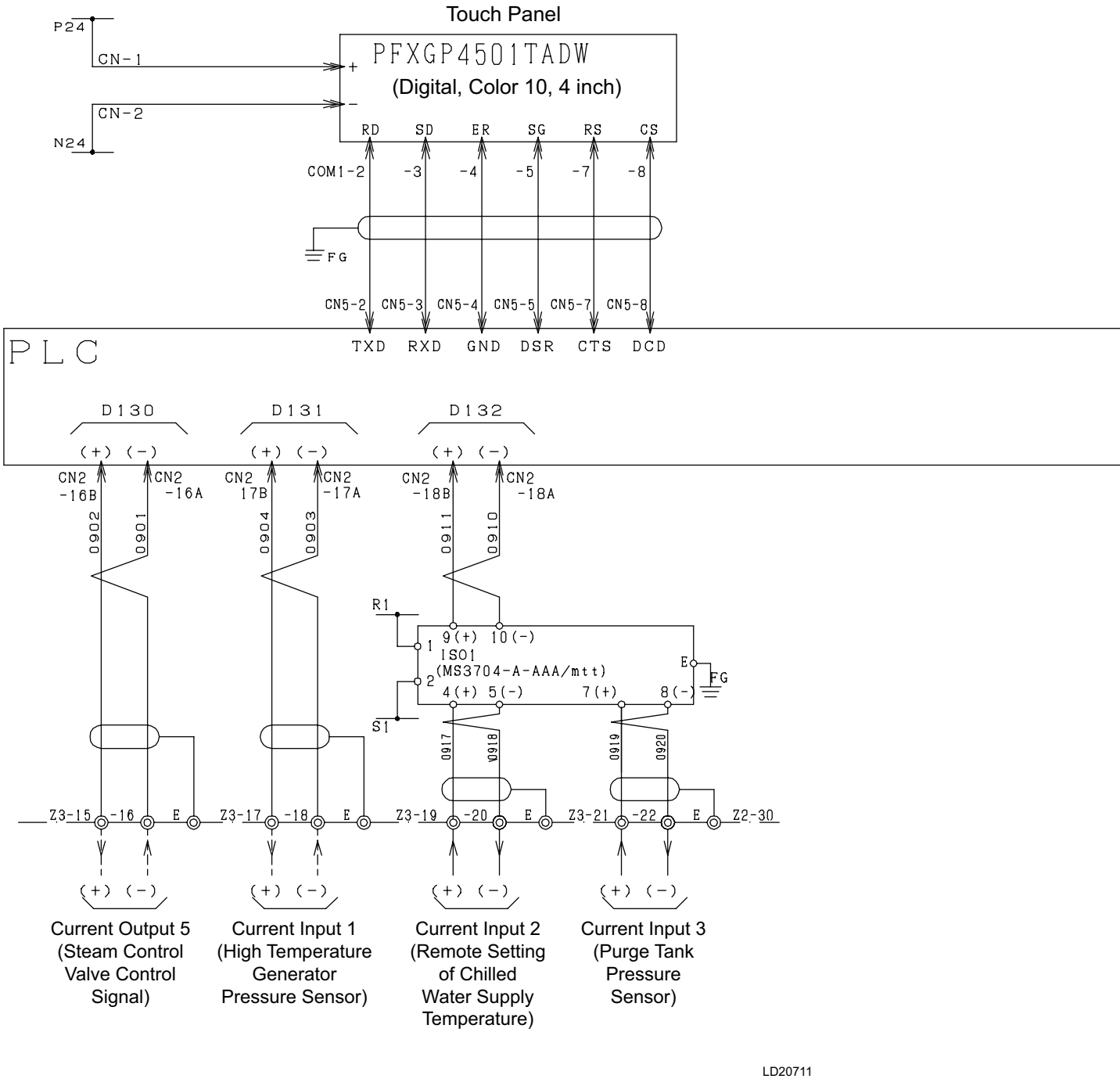


FIGURE 21 - DISPLAY/ANALOG INPUT WIRING FOR EUROPE

Electrical Diagram for Europe

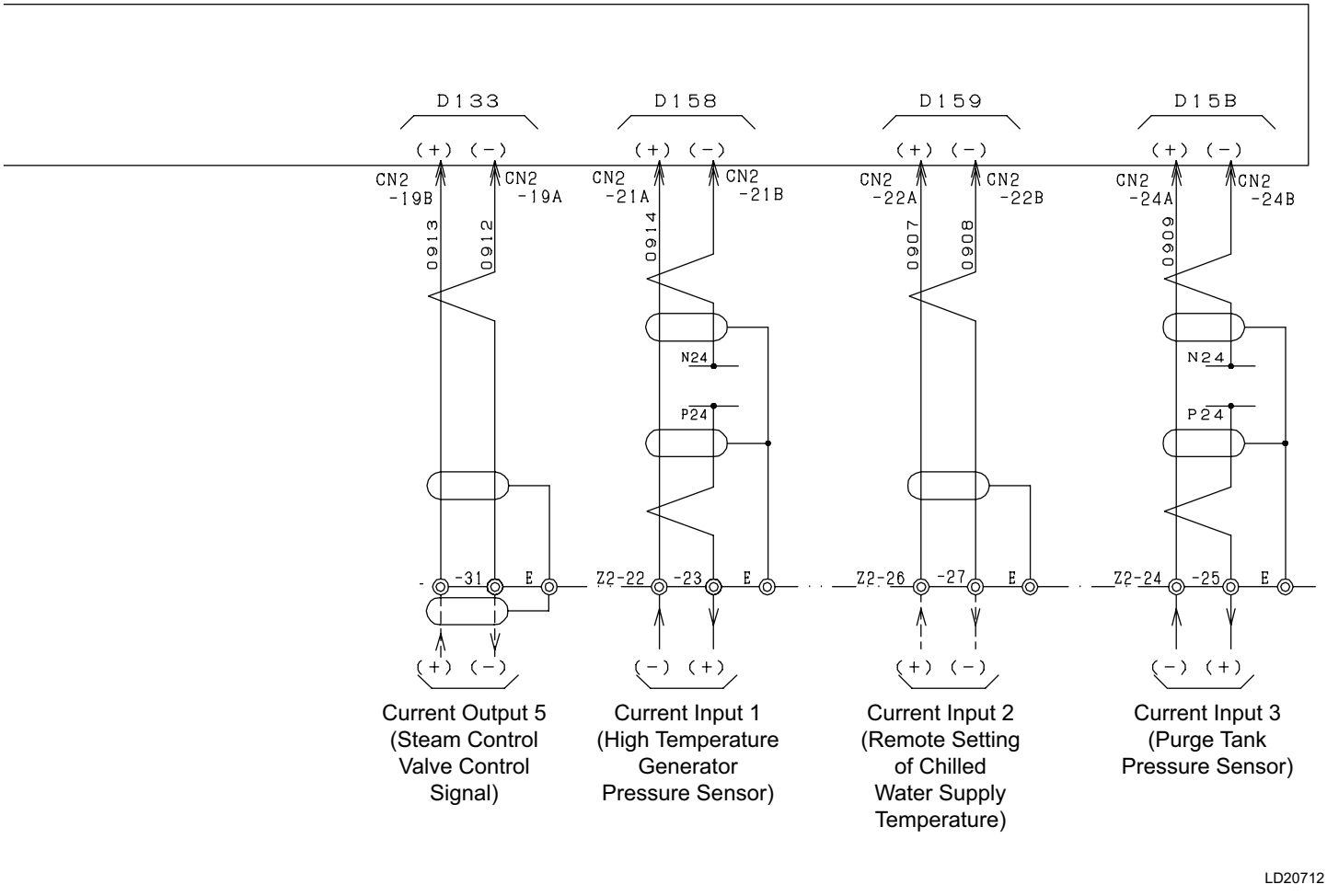


FIGURE 21 - DISPLAY/ANALOG INPUT WIRING FOR EUROPE (CONT'D)

Electrical Diagram for UL AND GB

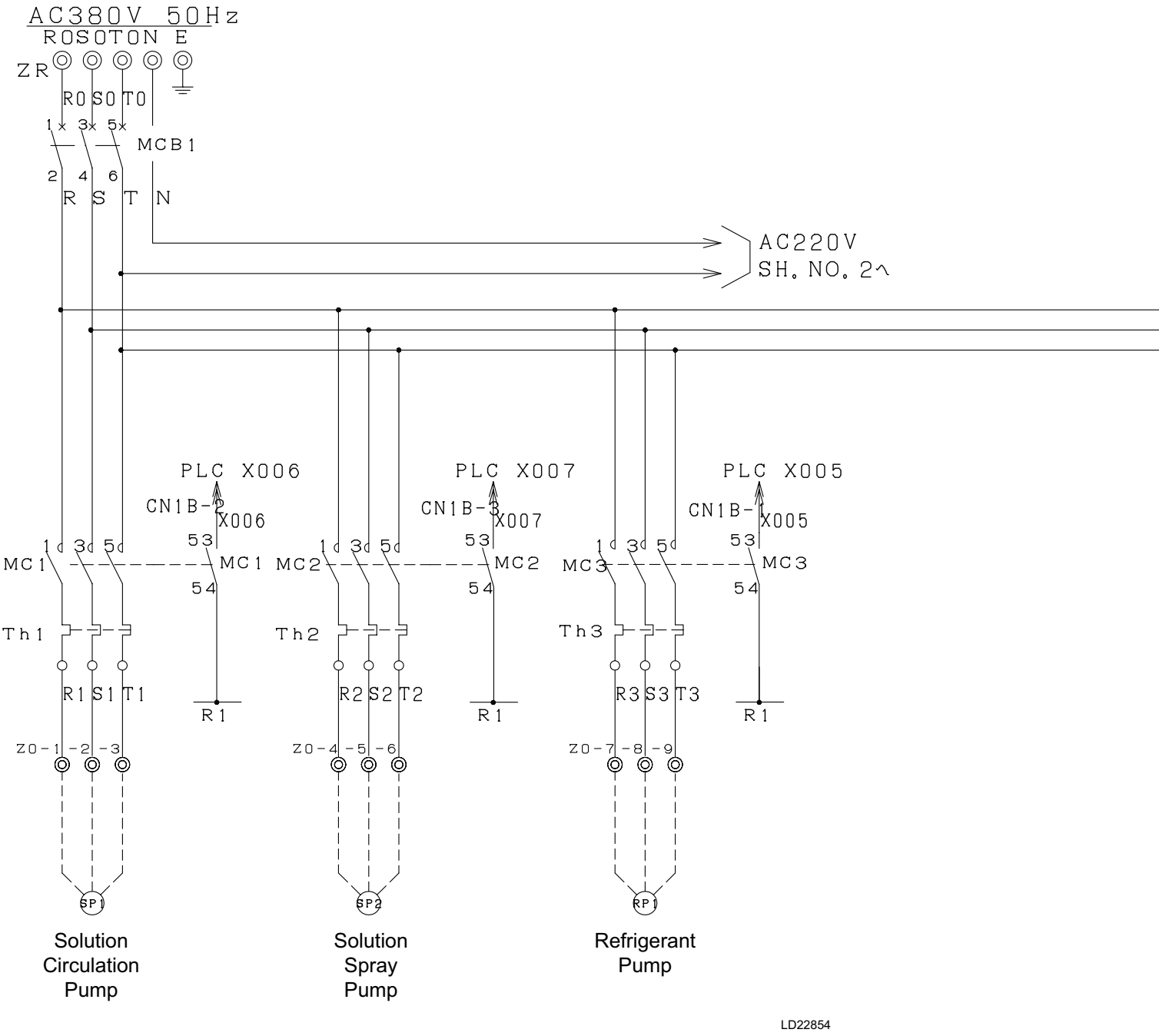
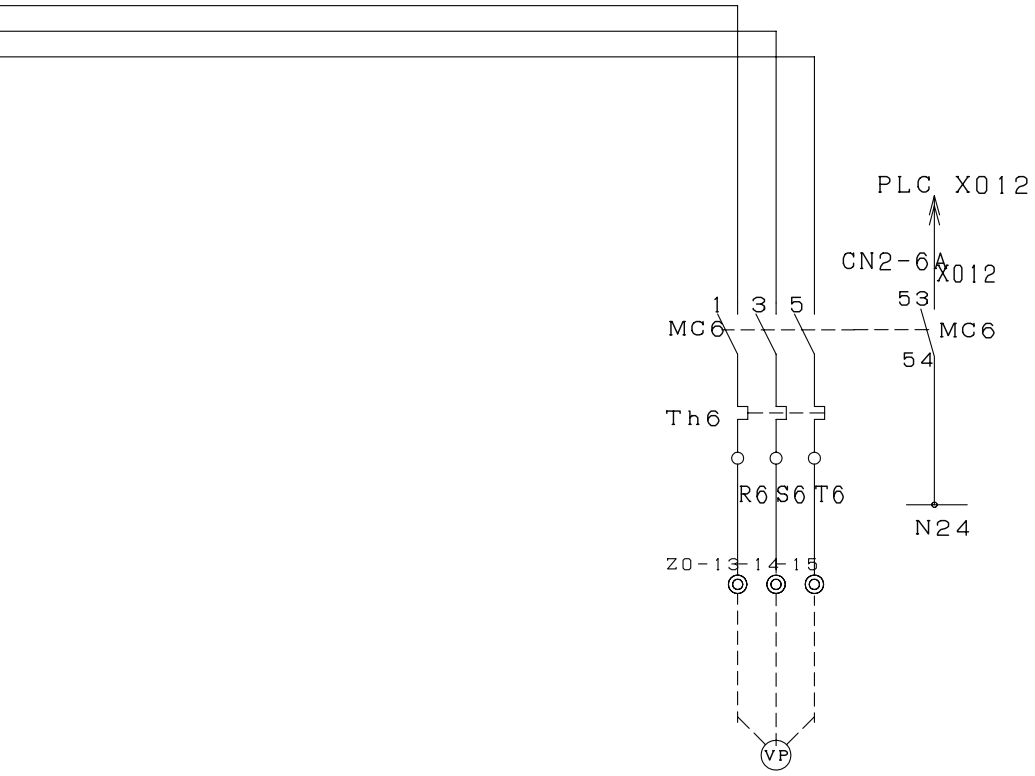


FIGURE 22 - POWER WIRING FOR UL AND GB

Electrical Diagram for UL AND GB

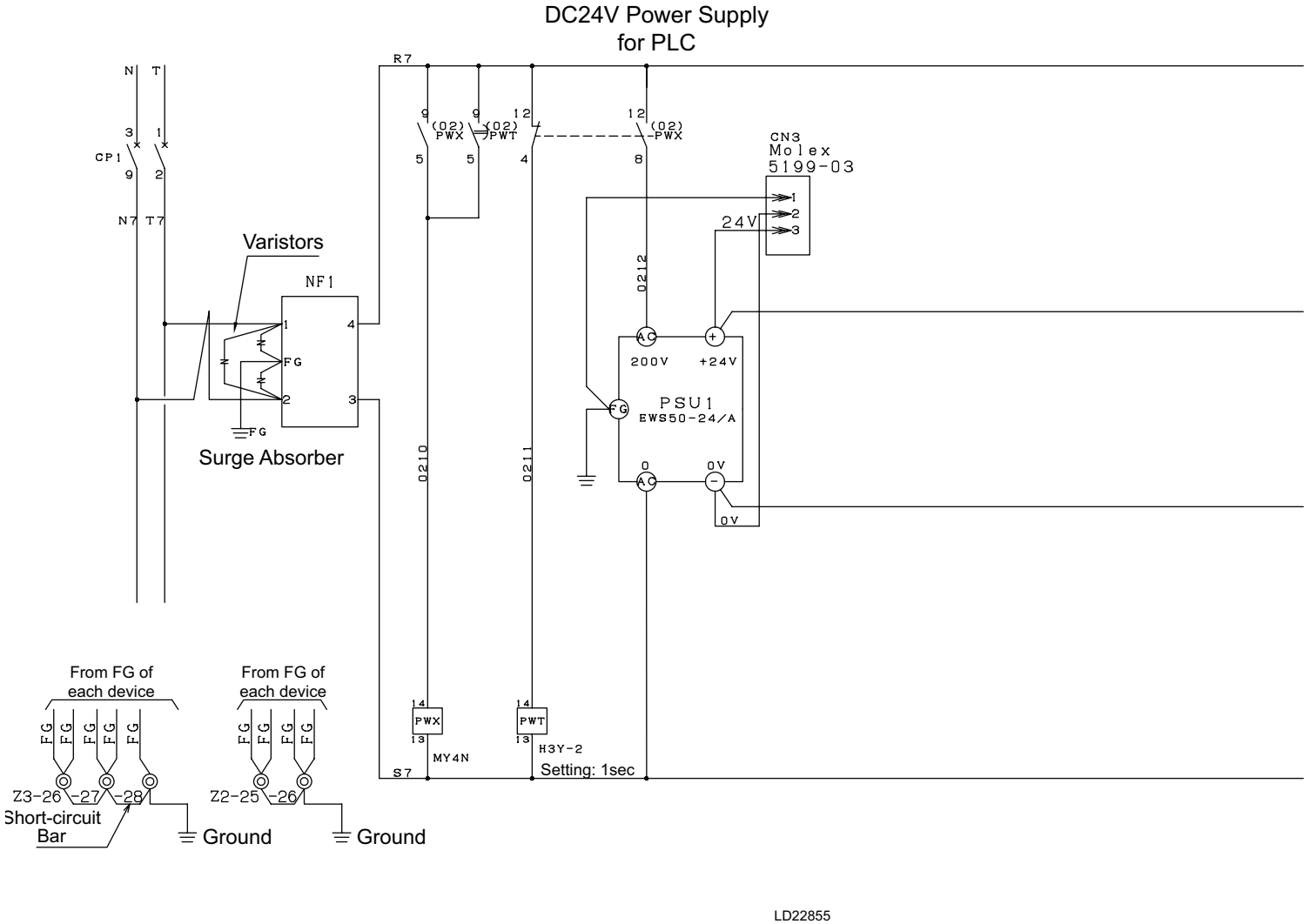


Purge Pump

LD22854a

FIGURE 22- POWER WIRING FOR UL AND GB (CONT'D)

Electrical Diagram for UL AND GB



LD22855

FIGURE 23 - PLC POWER SUPPLY FOR UL AND GB

Electrical Diagram UL AND GB

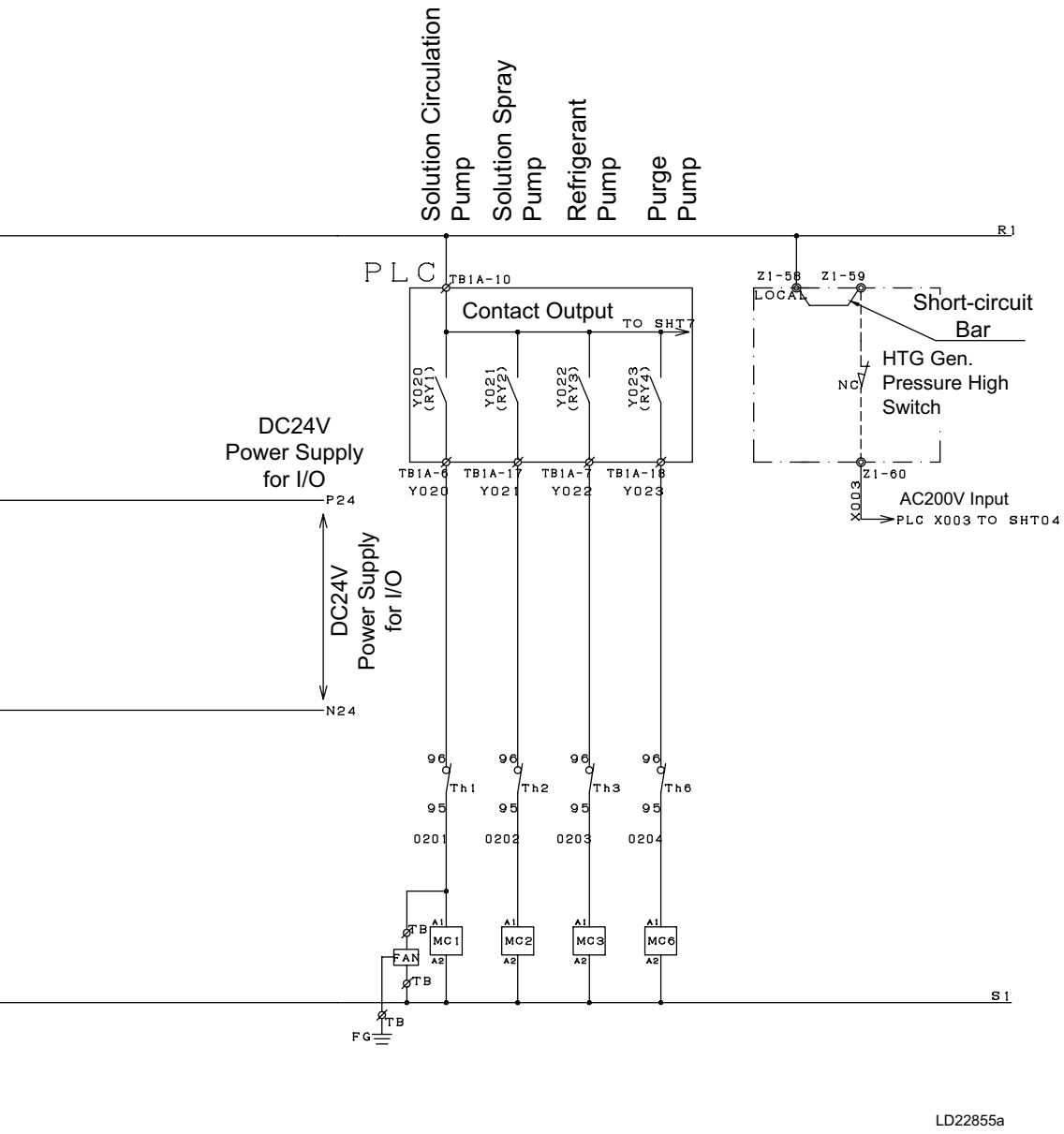


FIGURE 23 - PLC POWER SUPPLY FOR UL AND GB (CONT'D)

Electrical Diagram for Other Countries

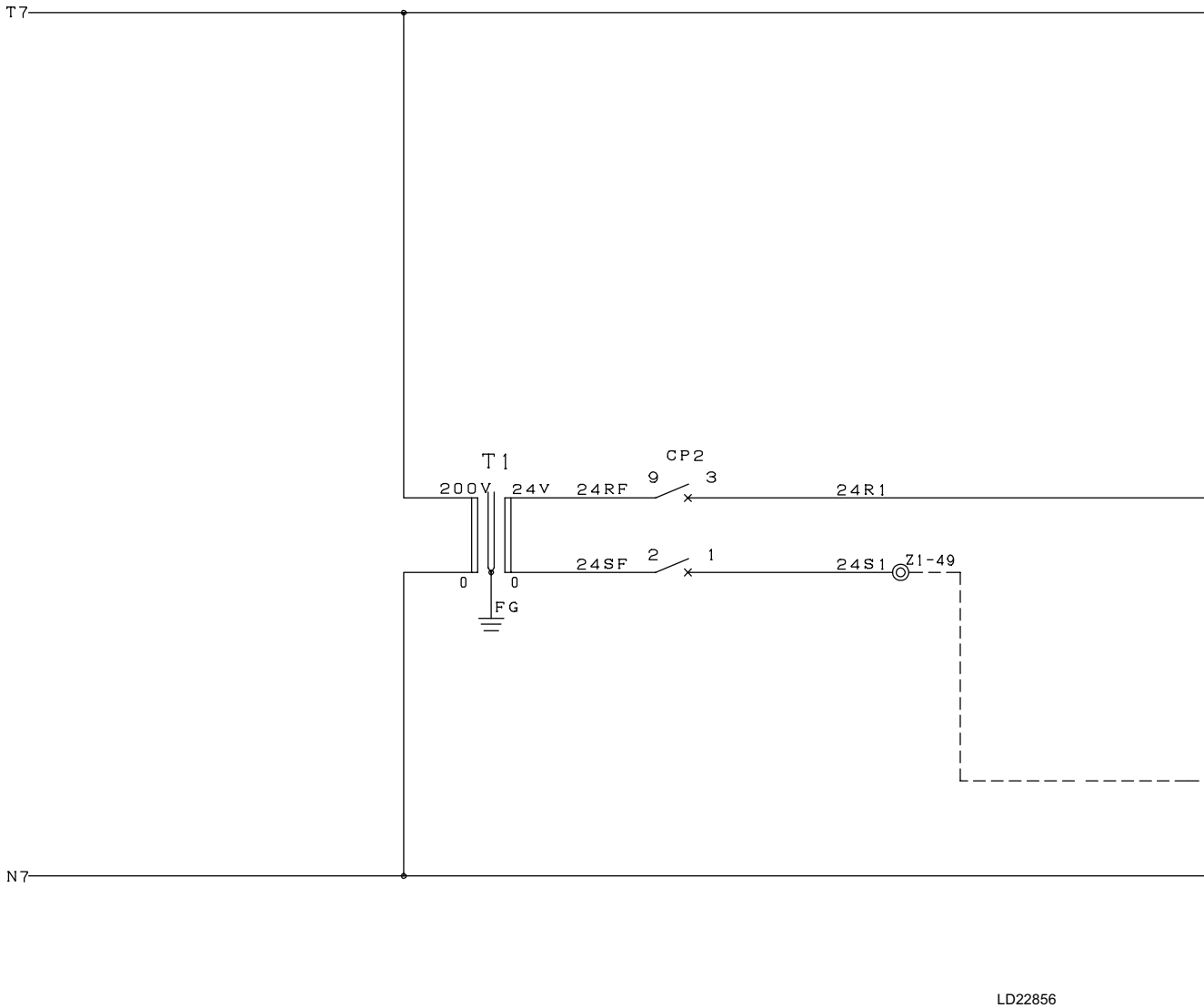


FIGURE 24 - PLC POWER SUPPLY FOR UL AND GB

Electrical Diagram for Other Countries

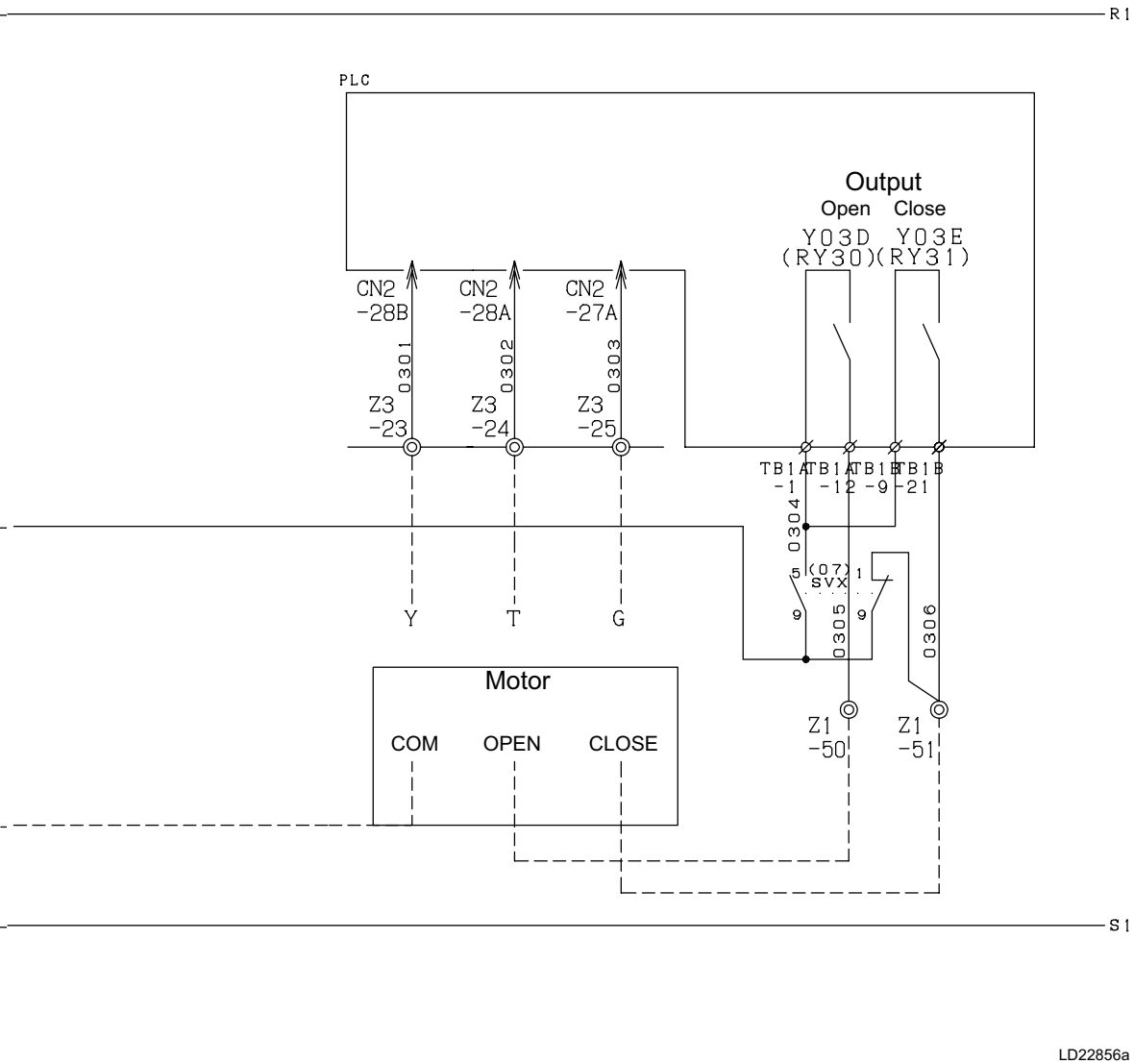


FIGURE 24 - PLC POWER SUPPLY FOR UL AND GB (CONT'D)

Electrical Diagram for UL AND GB

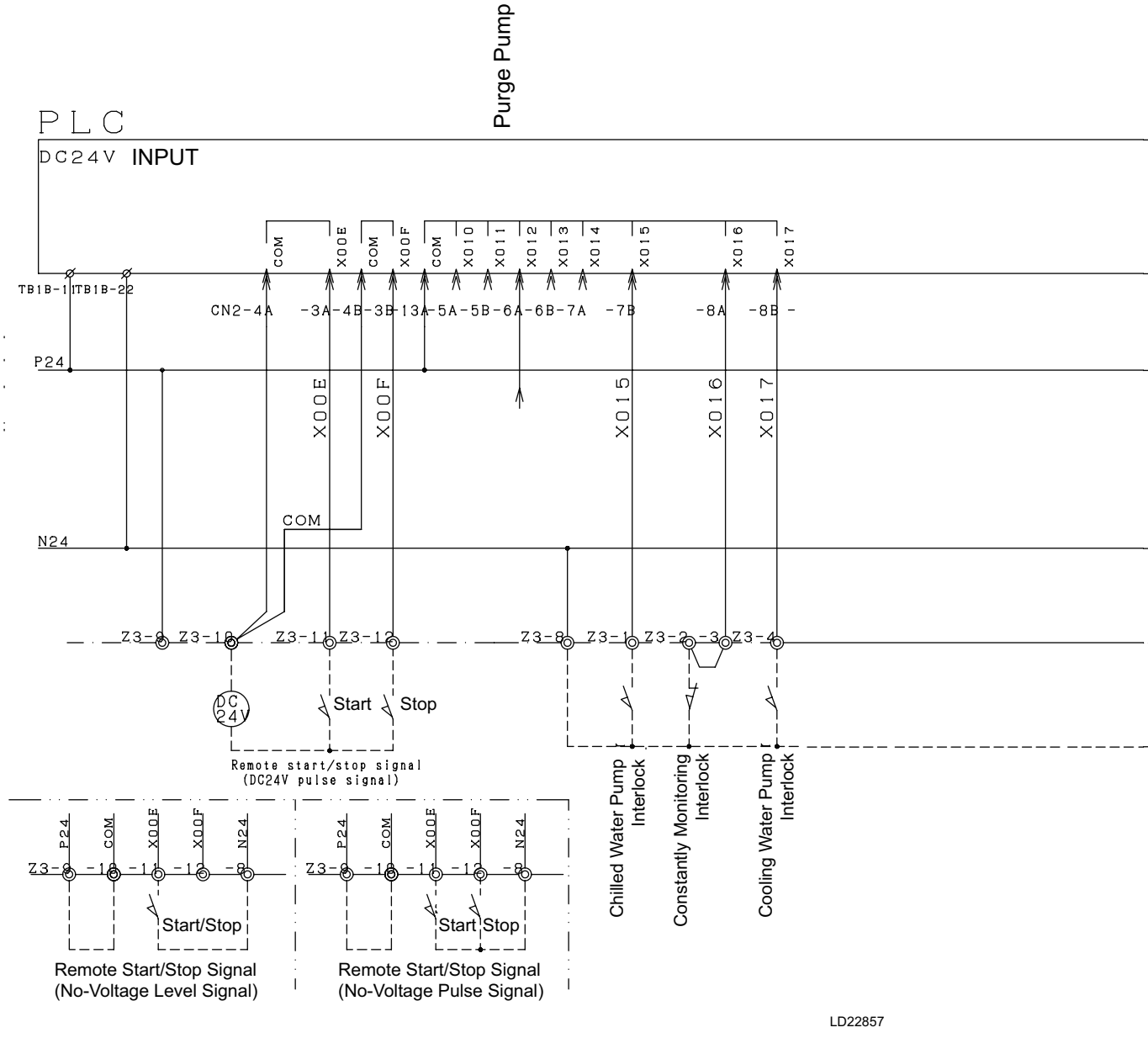


FIGURE 25 - PLC INPUT WIRING FOR UL AND GB

Electrical Diagram for UL AND GB

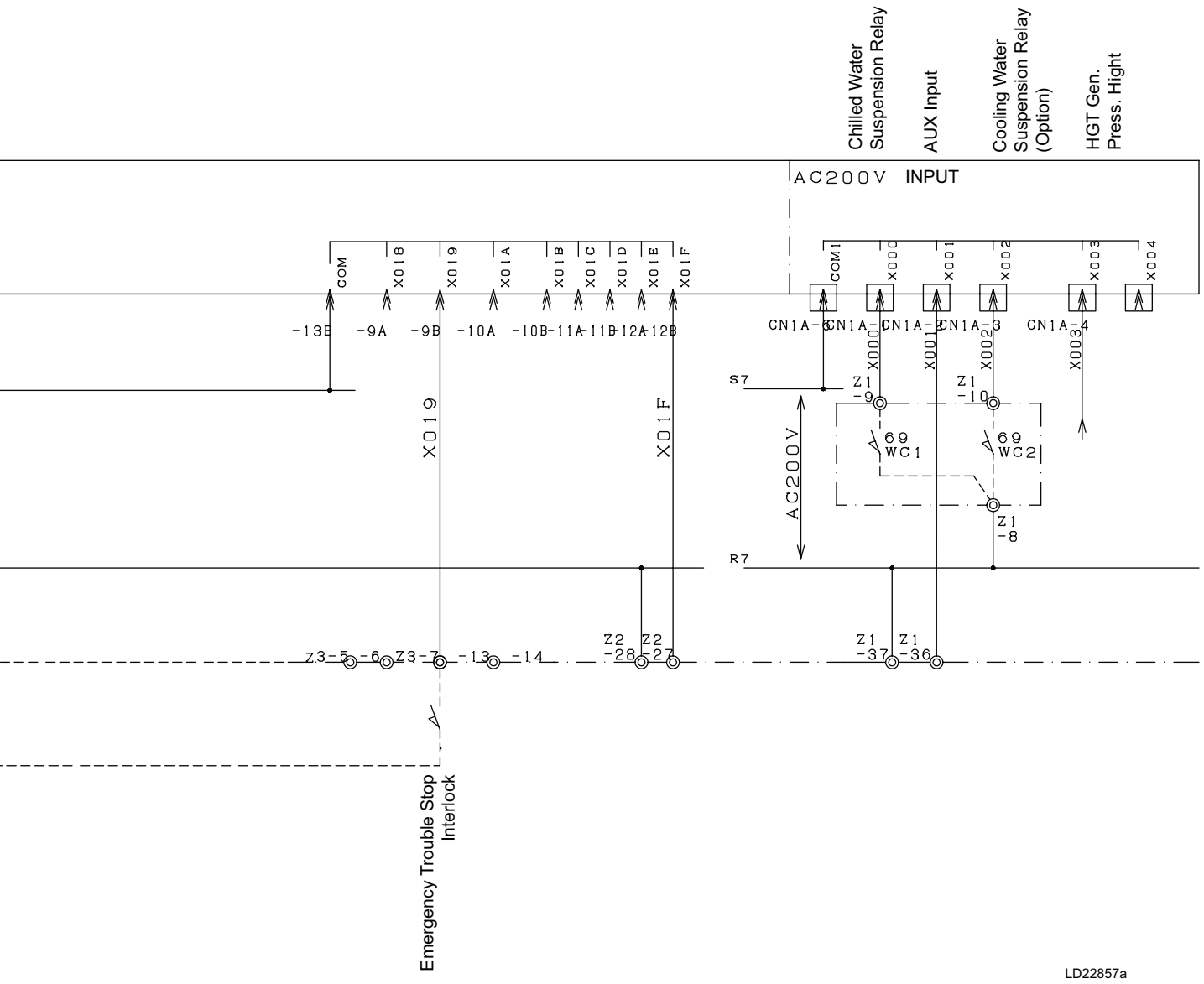


FIGURE 25 - PLC INPUT WIRING FOR UL AND GB (CONT'D)

Electrical Diagram for UL AND GB

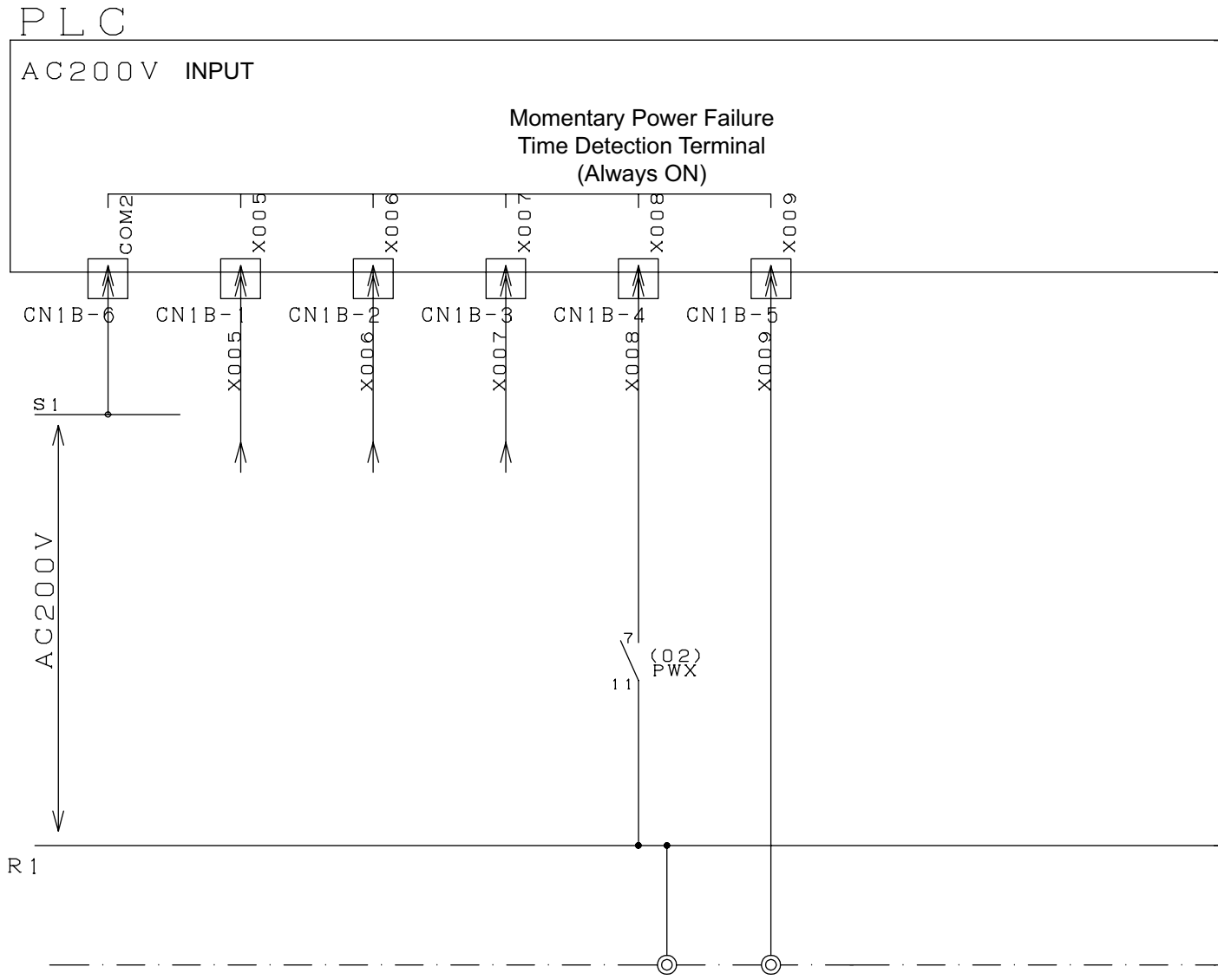


FIGURE 26 - PLC INPUT WIRING FOR UL AND GB

Electrical Diagram for UL AND GB

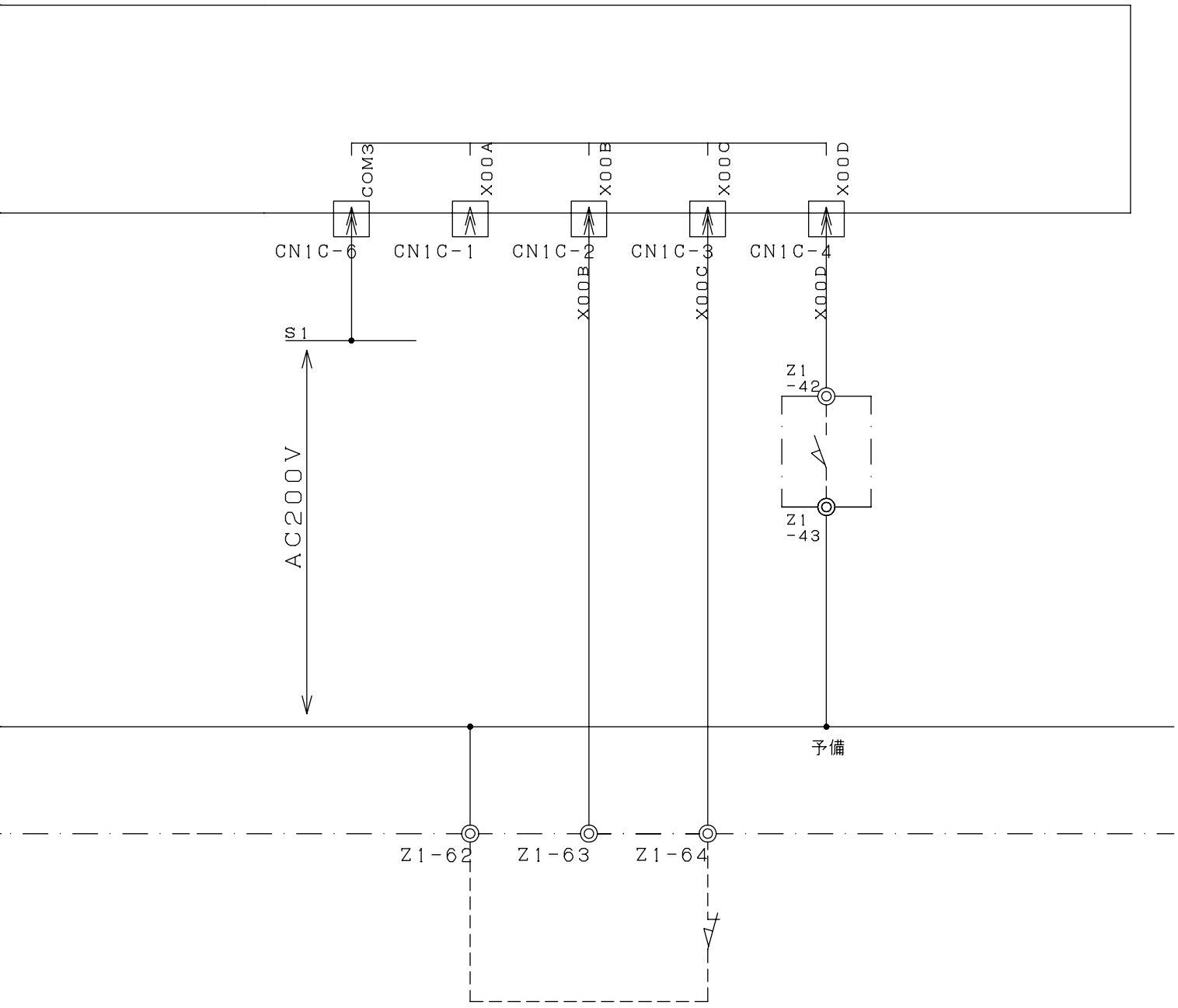


FIGURE 26 - PLC INPUT WIRING FOR UL AND GB (CONT'D)

Electrical Diagram for UL AND GB

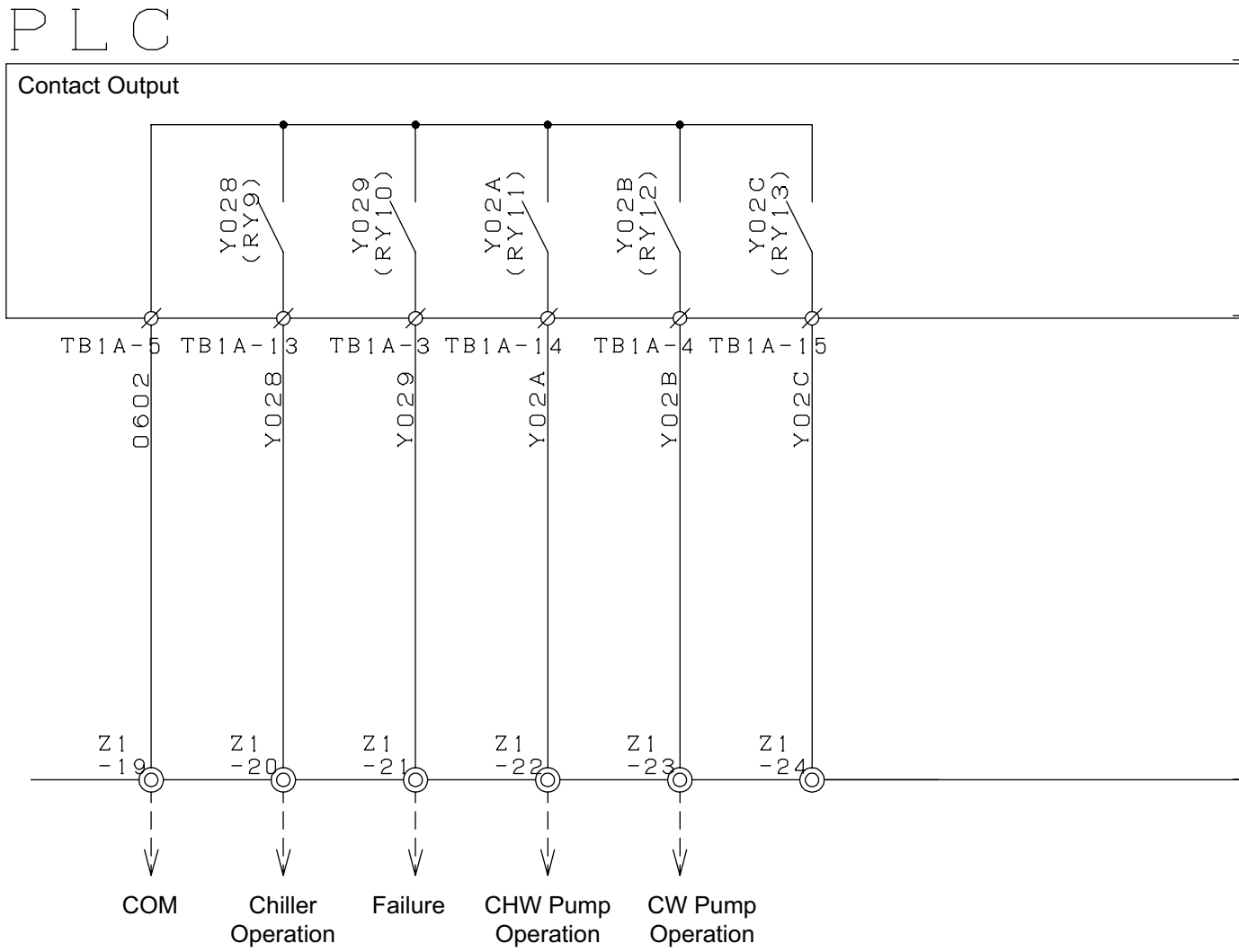
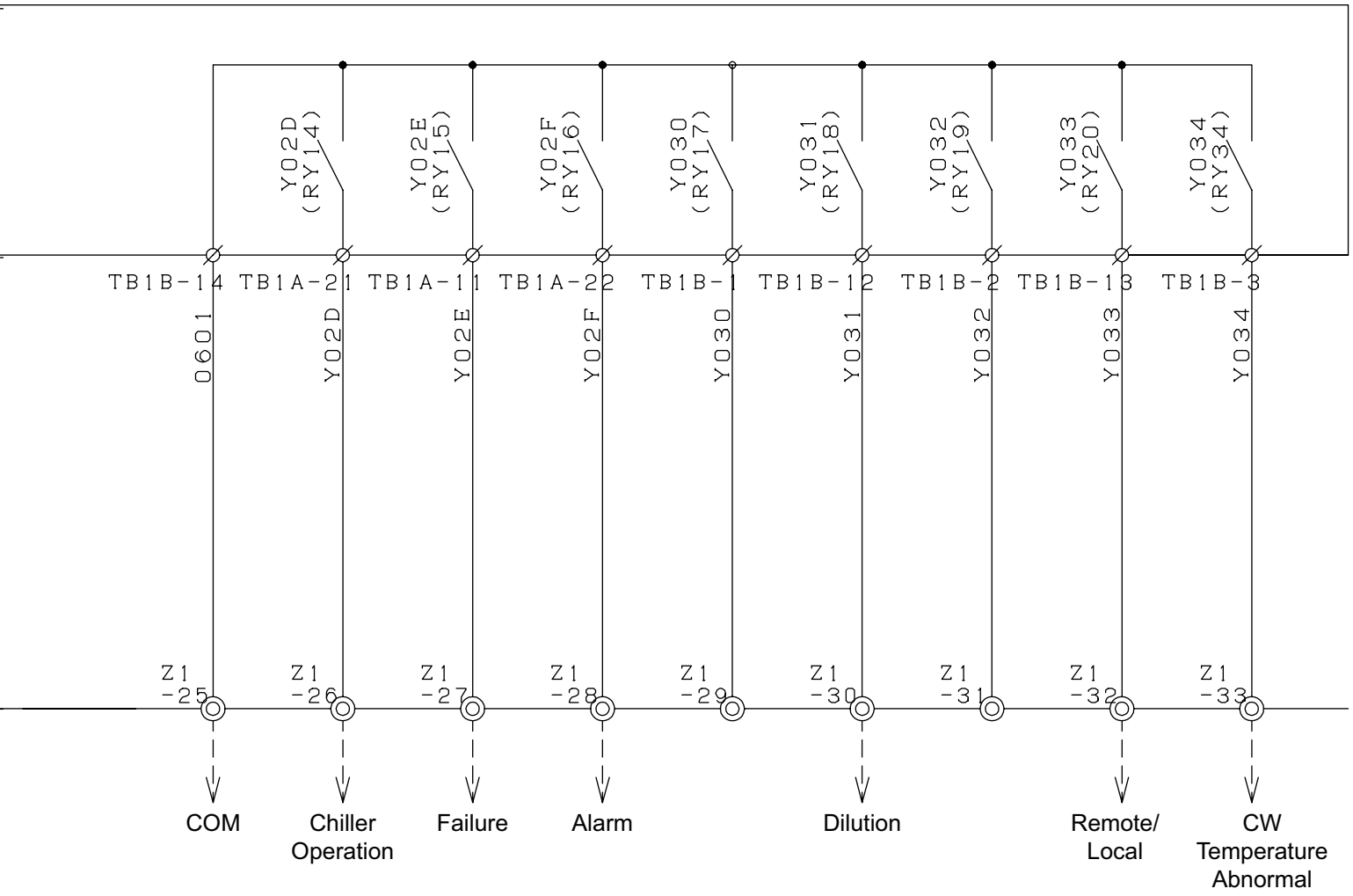


FIGURE 27 - PLC OUTPUT WIRING FOR UL AND GB

Electrical Diagram for UL AND GB



LD22859a

FIGURE 27 - PLC OUTPUT WIRING FOR UL AND GB (CONT'D)

Electrical Diagram for UL and GB

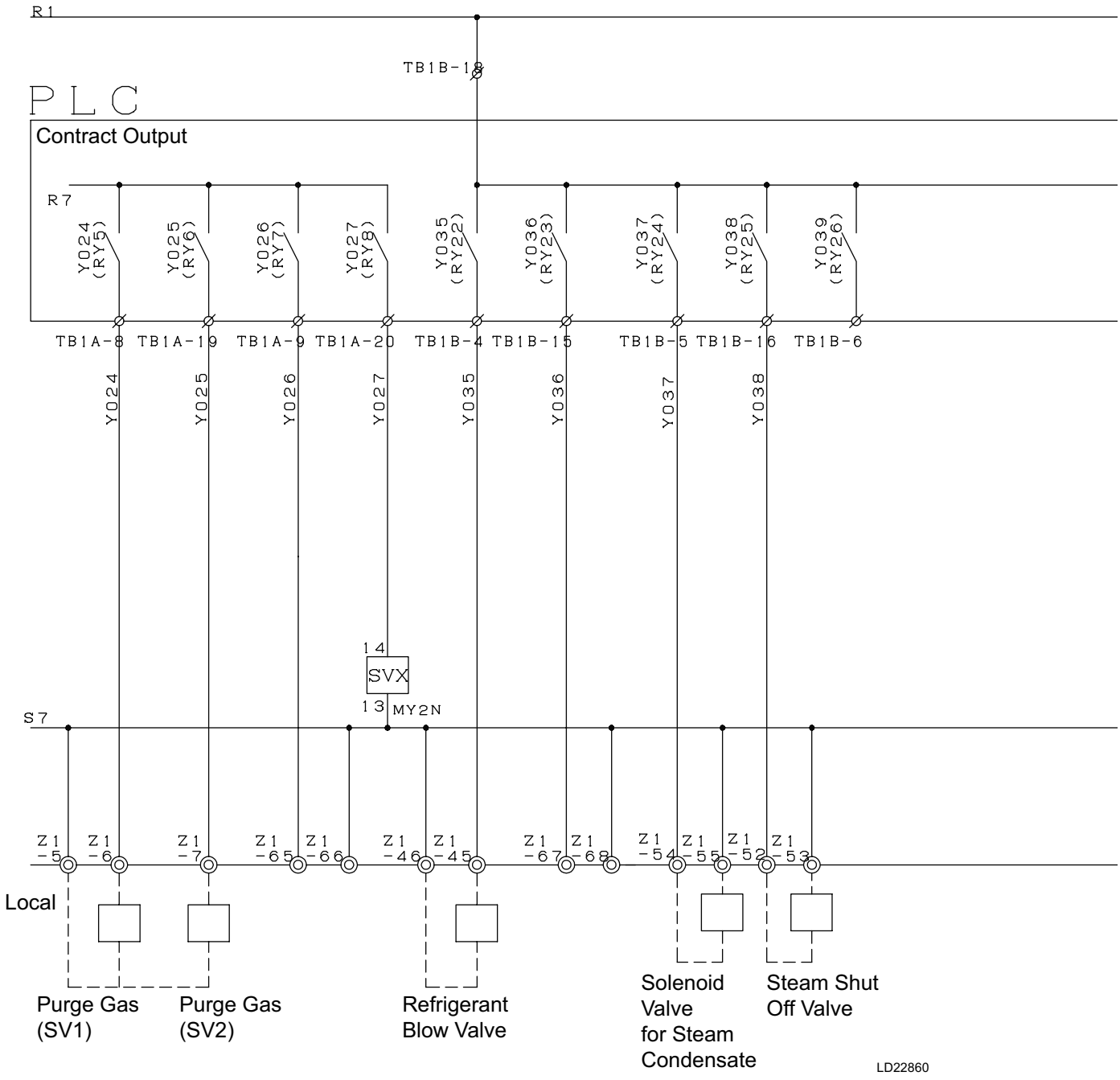


FIGURE 28 - PLC OUTPUT WIRING FOR UL AND GB

Electrical Diagram for UL and GB

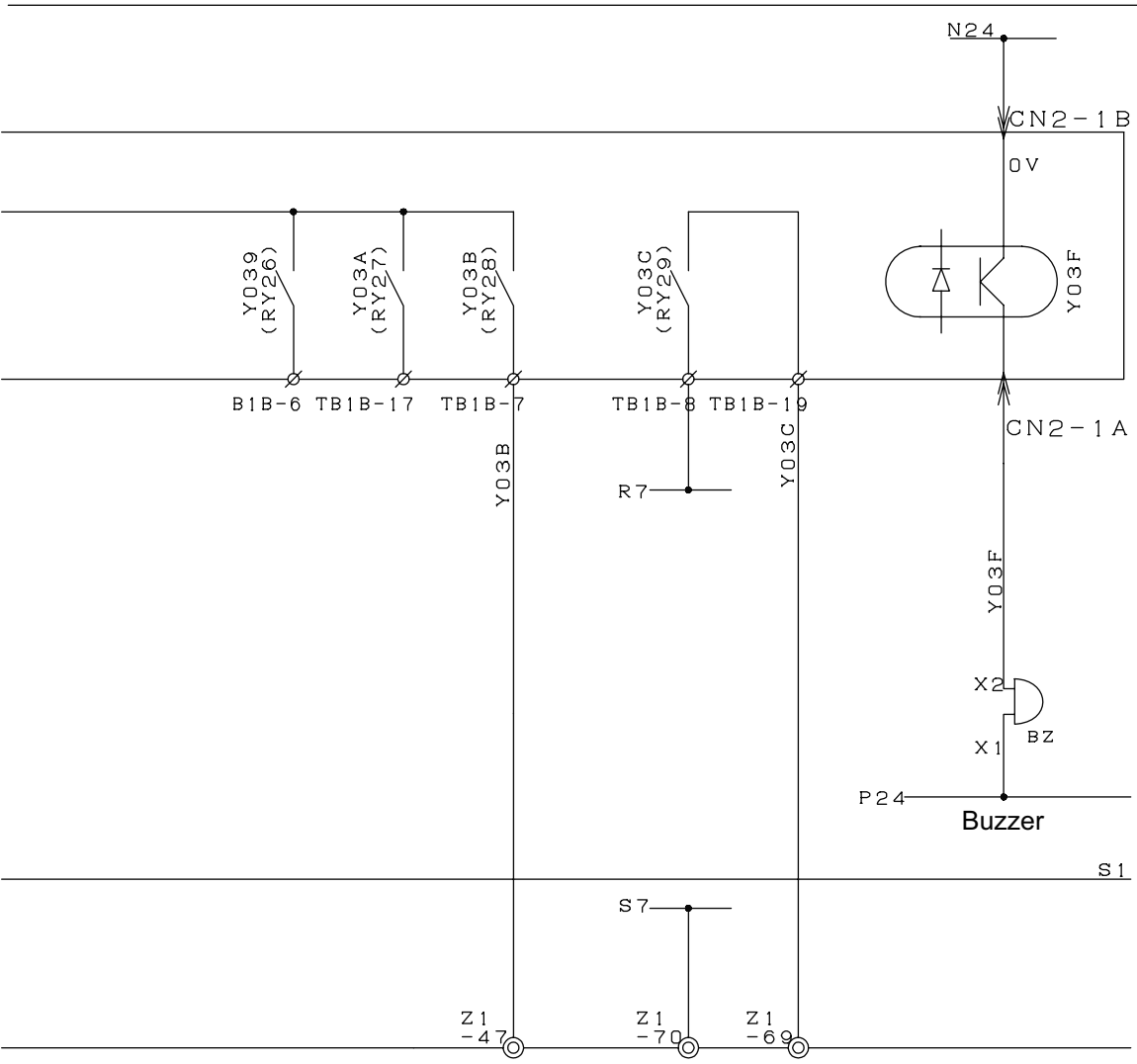


FIGURE 28- PLC OUTPUT WIRING FOR UL AND GB (CONT'D)

Electrical Diagram for UL AND GB

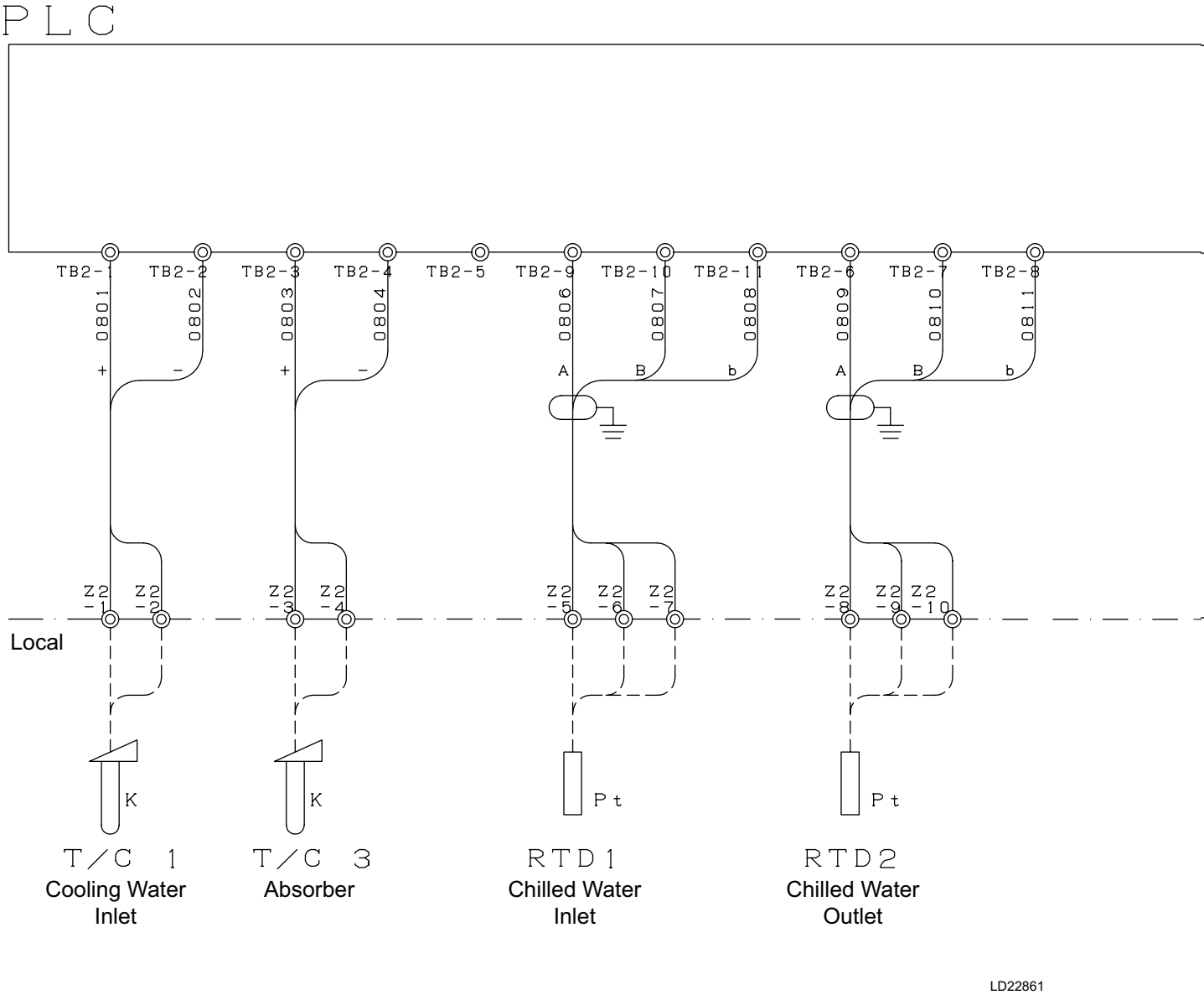


FIGURE 29 - PLC ANALOG INPUT WIRING DIAGRAM FOR UL AND GB

Electrical Diagram for UL AND GBs

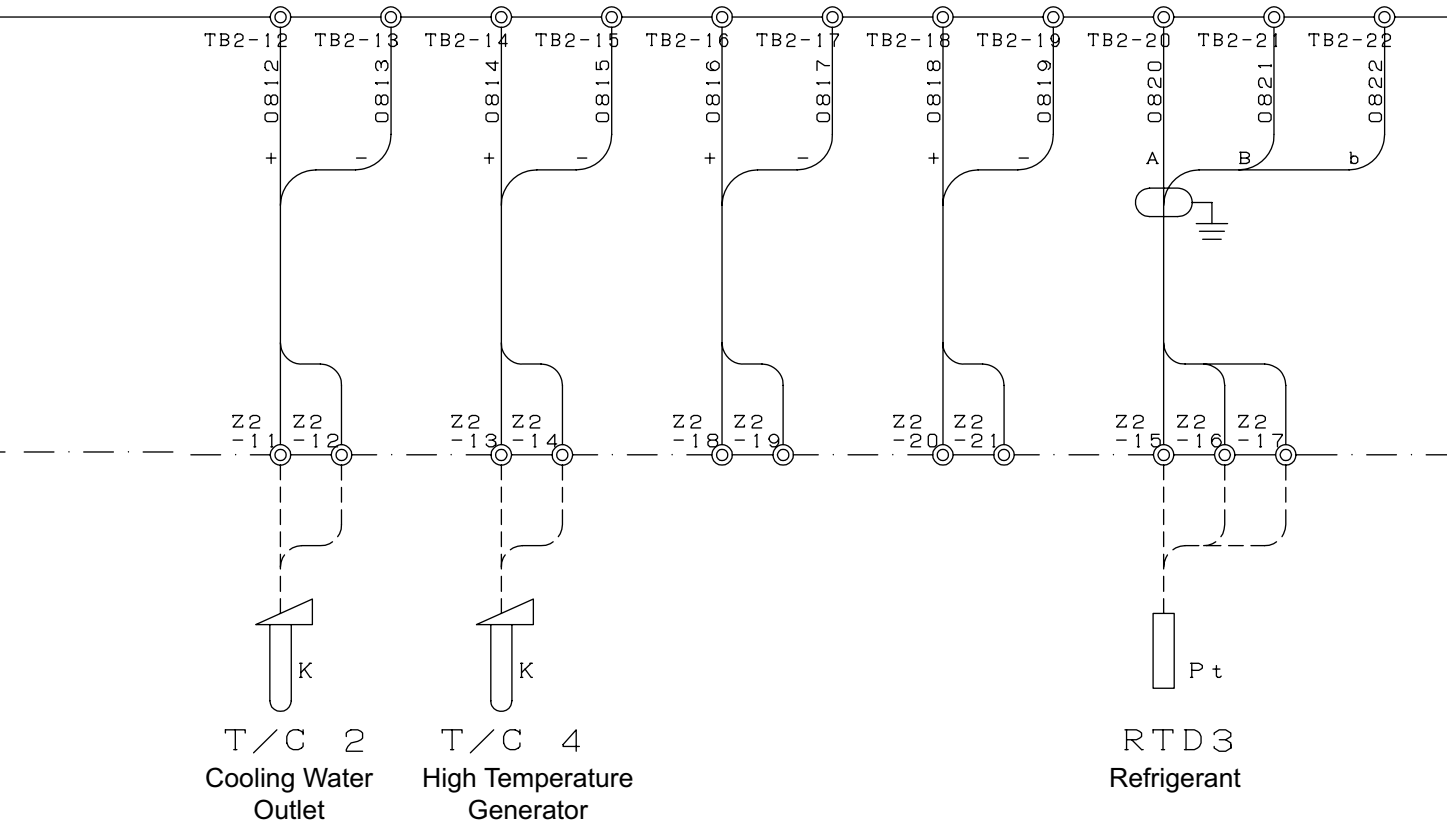
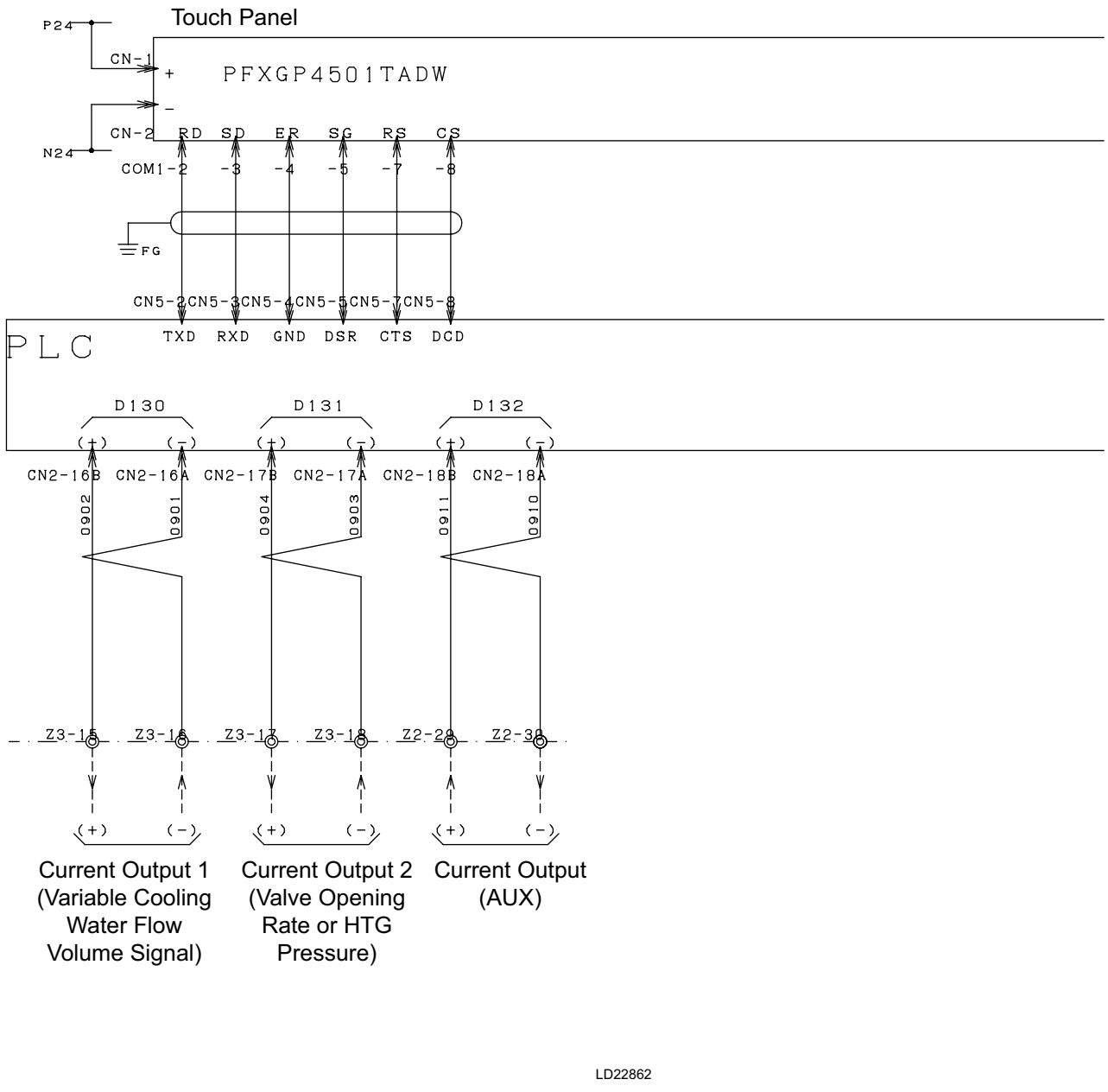


FIGURE 29 - PLC ANALOG INPUT WIRING DIAGRAM FOR UL AND GB (CONT'D)

Electrical Diagram for UL AND GB

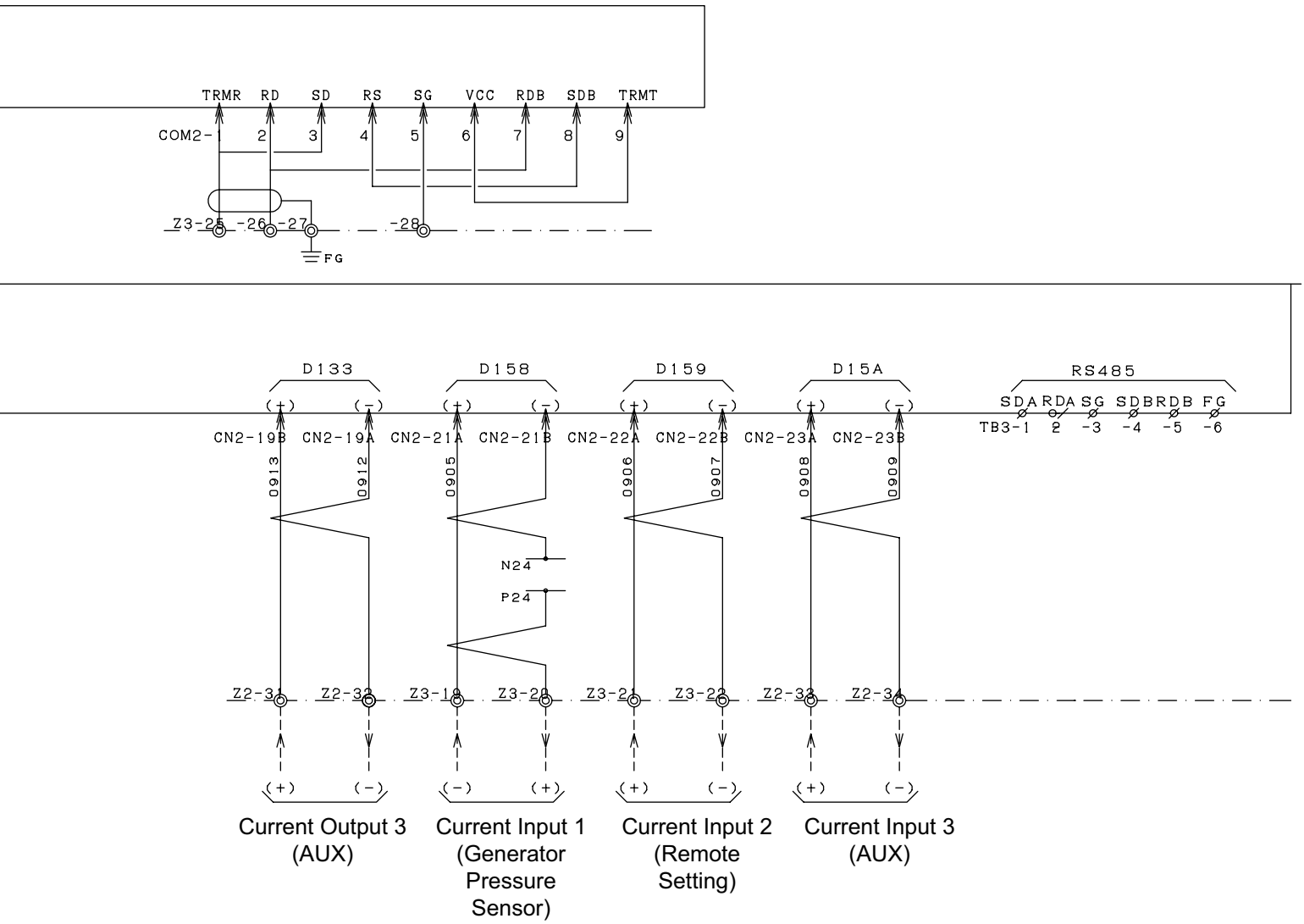


LD22862

FIGURE 30 - DISPLAY / ANALOG INPUT WIRING DIAGRAM FOR UL AND GB

Electrical Diagram for UL AND GB

4



LD22862a

FIGURE 30 - DISPLAY / ANALOG INPUT WIRING DIAGRAM FOR UL AND GB

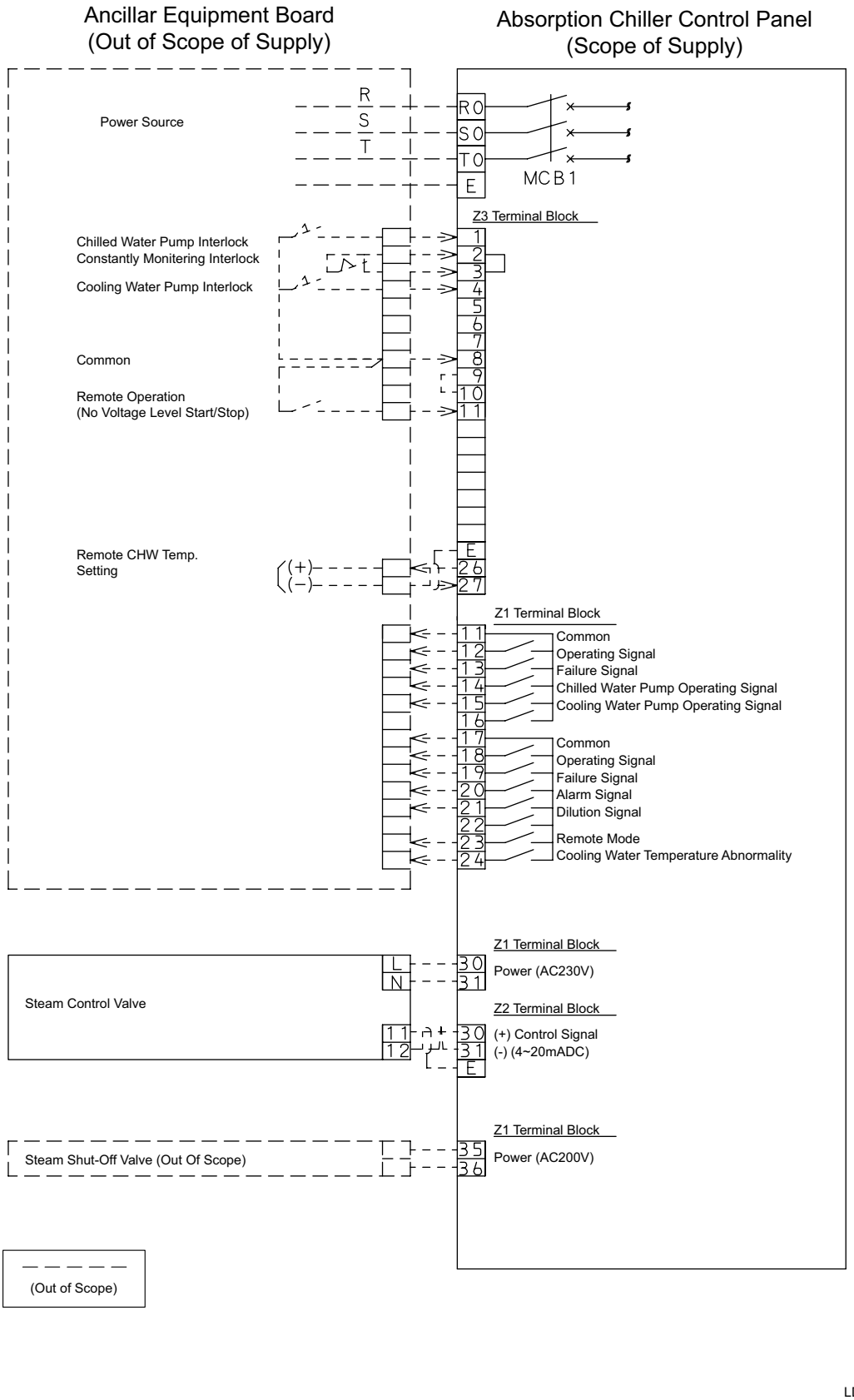


FIGURE 31 - EXTERNAL CONNECTION TERMINAL DETAILS FOR CE

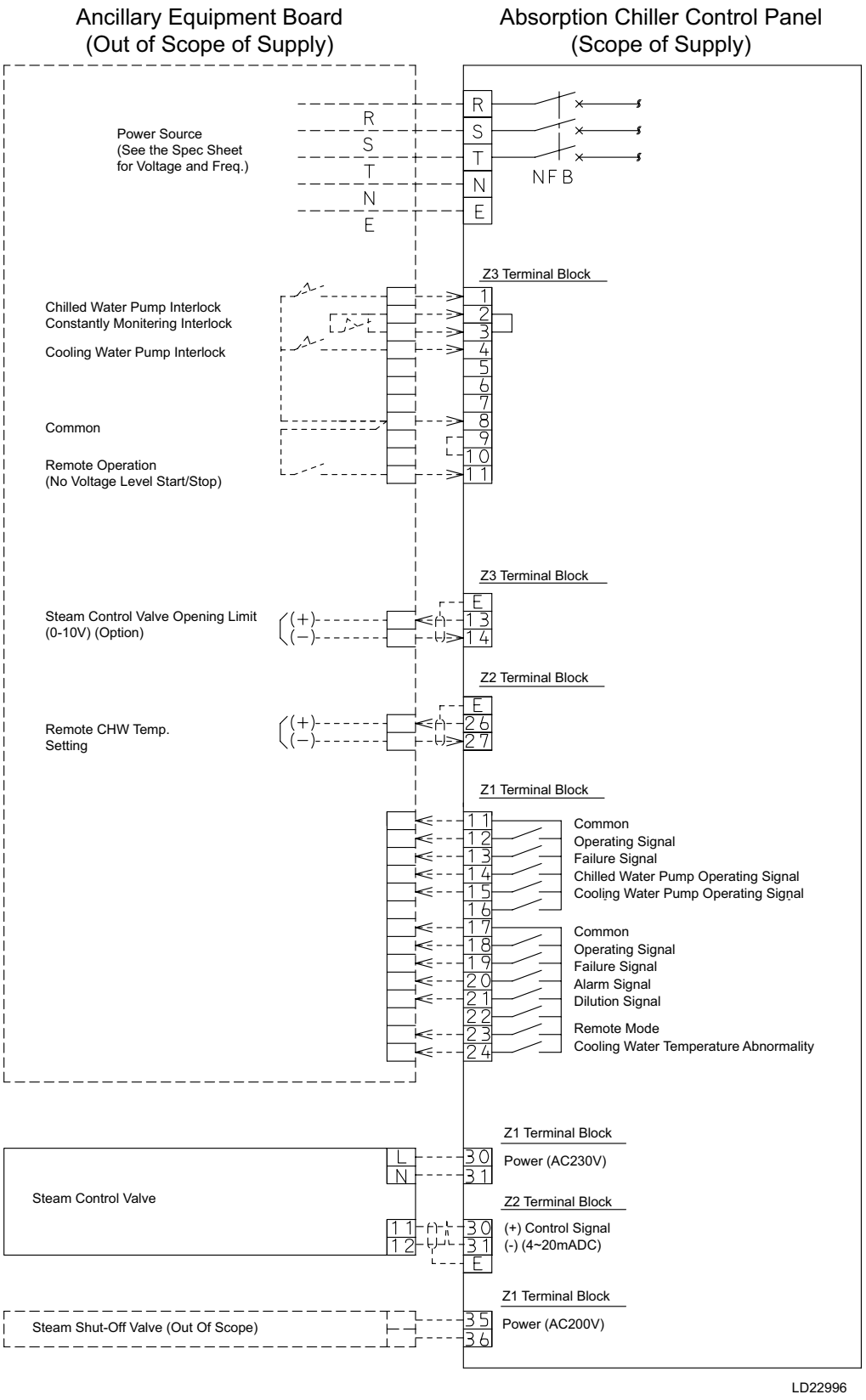


FIGURE 32 - EXTERNAL CONNECTION TERMINAL DETAILS FOR UL AND GB

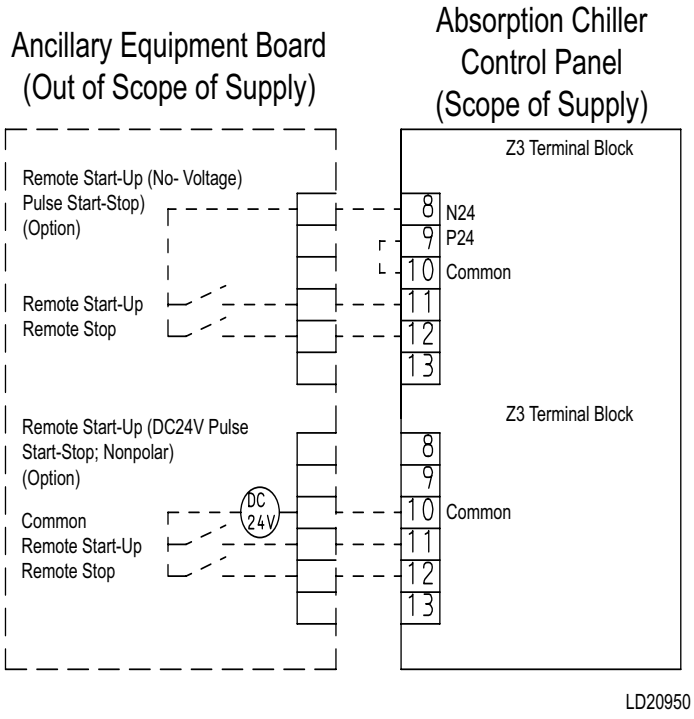
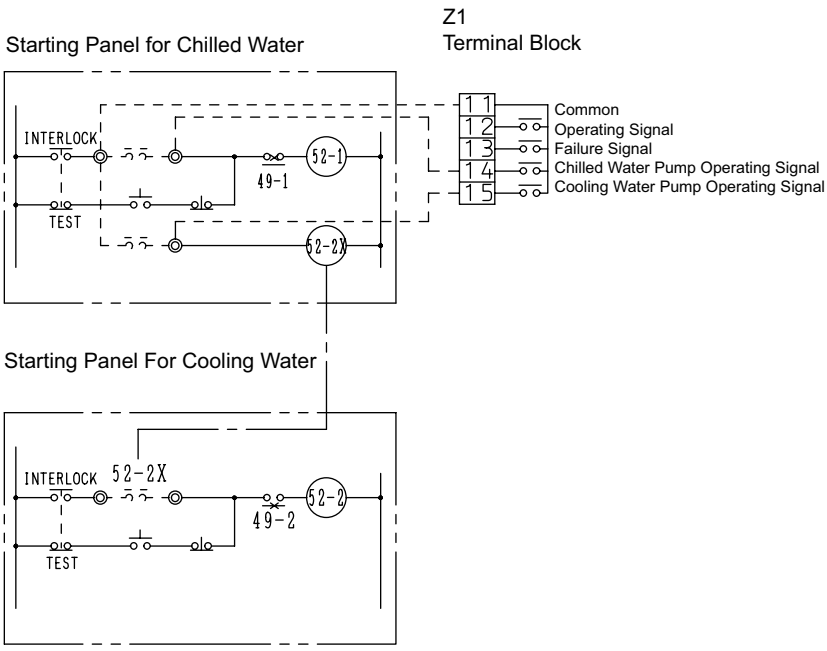


FIGURE 33 - REMOTE TRANSMISSION SIGNAL

4



Example Diagram of Starting Panel if Chilled/Hot Water Pump and Cooling Water Pump are Separately Equipped.

FIGURE 34 - SIGNAL TERMINAL TRANSITION WIRING

TABLE 14 - BREAKER CAPACITY

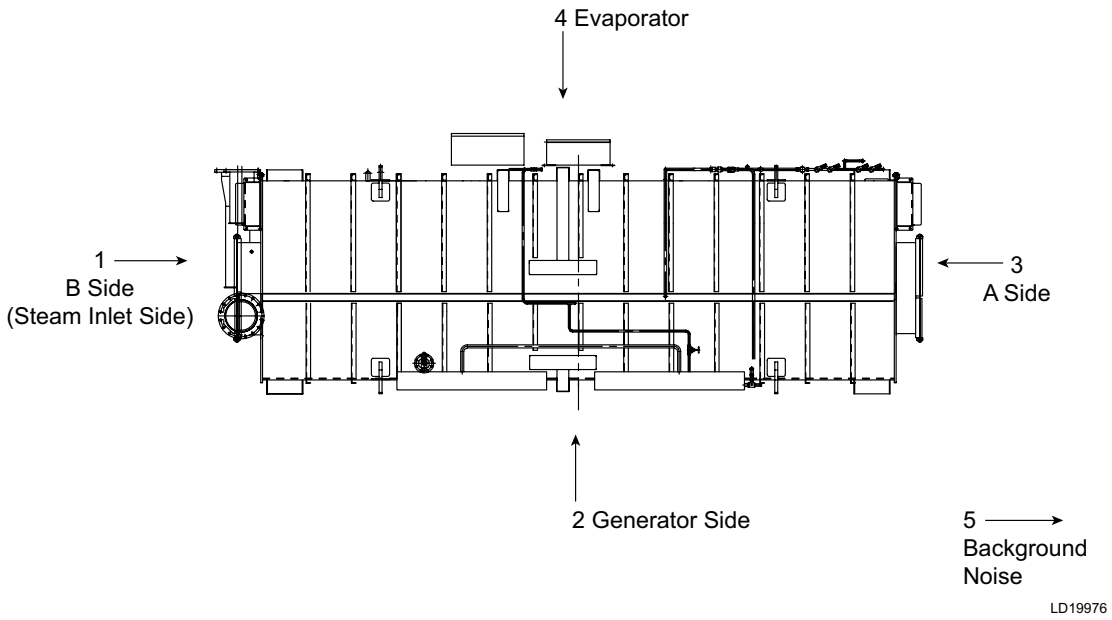
MODEL	POWER 380 V/400 V(A) CURRENT RATING (FLAME)
150EX(S) - 900EX(S)	32 (63 AF)
1000EXW(S)	40 (63 AF)
1100EXW(S) - 1600EXW3(S)	50 (63 AF)
11200EXW4(S) - 1680EXW4(S)	50 (63 AF)
1800EXW4(S) - 2000EXW4(S)	80 (125 AF)

TABLE 15 - CONTACT SPECIFICATIONS

		CONTACT SPECIFICATION
ABSORPTION CHILLER CONTROL PANEL -> EXTERNAL OUTPUT TERMINAL	DIGITAL SIGNAL	MAX. OPEN/CLOSE VOLTAGE: AC 250 V/DC 30 V MAX. OPEN/CLOSE CURRENT: 2 A/1 POINT (RESISTANCE LOAD) MAX. COMMON CURRENT: 8 A (RESISTANCE LOAD)
	ANALOG SIGNAL	ALLOWED RESISTANCE LOAD: 550 Ω
EXTERNAL -> ABSORPTION CHILLER CONTROL PANEL	DIGITAL SIGNAL	RATING VOLTAGE/CURRENT: DC 24 V/7 mA

Additional Information

1. Supply power source to absorption chiller is designed as 3 phase 3 wire for CE, and 3 phase 4 wire for the UL and GB as standard.
2. If you need information about breaker capacity, see *Table 14 on page 86*.
3. If you need information about the contact specifications, see *Table 14 on page 86*.
4. Connect the following absorption chiller interlocks. If it is marked with an "*", be sure the connection is made.
   d. Operating interlock
   * Chilled water operation interlock
   • Air handling unit interlock
   e. Cooling water pump interlock
   * Cooling water pump interlock
   f. Normally monitoring interlock
   • Seismoscope relay
   • Abnormal room temperature sensor
5. For terminal base position information, see *Figure 33 on page 84*.
6. Use a shield wire which has a maximum extension of 200 m and more than 0.8 mm.
7. Terminals that are not shown in the figures have already been connected in the factory.



LOCATION*	OVERALL	OCTAVE BAND									
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	16 kHz
1	80/ 83	37 / 76	48 / 74	57 / 73	64 / 73	69 / 72	73 / 73	75 / 74	75 / 74	70 / 71	56 / 63
2	77 / 83	40 / 79	49 / 75	56 / 72	62 / 71	68 / 71	70 / 70	71 / 70	70 / 69	70 / 71	53 / 60
3	75 / 83	41 / 80	49 / 75	59 / 75	62 / 71	65 / 68	69 / 69	71 / 70	67 / 66	58 /59	44 / 51
4	78 / 84	40 / 79	50 / 76	61 / 77	64 / 73	71 / 74	71 / 71	74 / 73	71 / 70	65 / 66	50 / 57
5	64 / 80	37 / 76	44 / 70	60 / 76	56 / 65	54 / 57	57 / 57	56 / 55	50 / 49	36 / 37	26 / 33

* Position of Measuring instrument
Height:1.5 m, Horizon:1.0 m (from chiller surface)

NOTE: These data are reference values, as the chiller unit was not covered with the thermal insulation materials and the water pipes (for chilled water, cooling water, and steam) were temporary during the measurement.

FIGURE 35 - SAMPLE SOUND TESTING FOR YHAU-CW CHILLER

UPPER COMMUNICATION SPECIFICATION

The information in this section applies to both the CW-EX Series and the CW-EXW series of steam absorption chillers.

Upper Communication System Configuration

The configuration of the upper communication system is shown in the figure below.

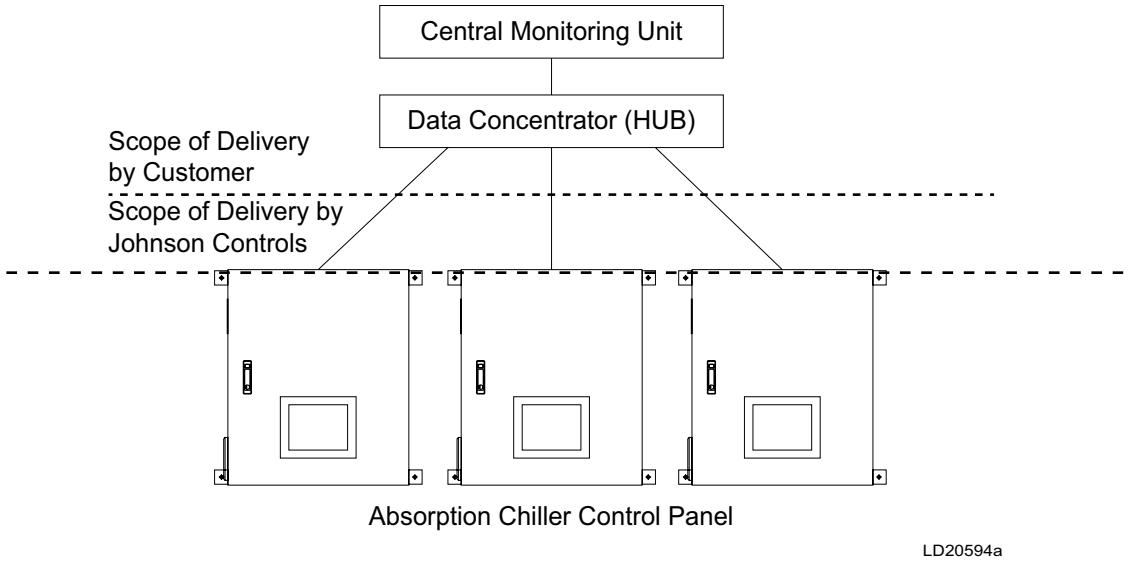


FIGURE 36 - UPPER COMMUNICATION SYSTEM CONFIGURATION

Scope of Delivery

Johnson Controls scope of delivery for the upper communication system covers the control panels for the upper communication function. The customer is responsible to deliver all other related equipment: concentrator (HUB), installation, wiring, communication program for the central monitoring unit, and other relevant communication modes. See *Table 16 on page 89*.

TABLE 16 - SCOPE OF DELIVERY

ITEM	CUSTOMER	JCI	REMARKS
Control panel with upper communication function		X	Communication protocol: Modbus TCP
Data concentrator (HUB)	X		Installation and wiring are included
Wiring work for Ethernet connection	X		Apply twisted pair cable
Communication program for central monitoring unit	X		See *Table 17 on page 89* and *Table 18 on page 90* for the details of the IP address, function code, communication data address, or other applicable communication addresses.

Connection Port for Ethernet Communication

Make sure that the Ethernet cable is plugged into the correct port on the Control Panel. The ethernet connection port is located at the bottom left on the back of the Control Panel.

TABLE 17 - ETHERNET INTERFACE SPECIFICATION

ITEM		SPECIFICATION	
Communication format		10BASE-T/100BASE-TX	
Connector shape		RJ-45 type modular jack connector	
LED function 	Active (Green)	Blink	Data sending/receiving
		No light	No data sending/receiving
	Link (Green)	Blink	Data sending/receiving via 10BASE-T/100BASE-TX
		No light	No connection or successor job failure

Communication Specification

TABLE 18 - COMMUNICATION SPECIFICATIONS

Communication Protocol	Modbus TCP
Communication Path Type	10BASE-T/100BASE-TX
IP Address	(No. 1) 192.168.1.1, (No. 2) 192.168.1.2, (No. 3) 192.168.1.3
Subnet Mask	255.255.255.0
Function Code	Read Command (Digital Signal) 0.1/Read Coil (Analog Signal) 0.3/Read Holding Register
	Write Command (Digital Signal) 0.5/Force Single Coil

Communication Data

TABLE 19 - COMMUNICATION DATA/READ COMMAND

ITEM			DISPLAY	UNIT	ADDRESS	CONTENT
SET VALUE	1	Set Point	7.0	°C	00001	0050~1000 unit, 1 unit=0.1 °C
	2	Automatic stop temp. (thermo-off temp)	5.0	°C	00003	0040~1000 unit, 1 unit=0.1 °C
	3	Temp. difference of Automatic stop/ start control	5.0	°C	00005	0001~1000 unit, 1 unit=0.1 °C
OPERATION CONDITION	4	Operation condition	0 or 1	-	00021	0:STOP, 1:COOLING OPERATION
	5	Local or remote mode condition	0 or 1	-	01001	0:LOCAL, 1:REMOTE
	6	Solution pump condition	0 or 1	-	01003	0:STOP, 1:OPERATION
	7	Refrigerant pump condition	0 or 1	-	01005	0:STOP, 1:OPERATION
	8	Load limit condition	0 or 1	-	01009	0:NORMALLY OPERATION 1:LOAD LIMIT OPERATION
	9	Control manipulated variable	100	%	00023	-0100~1100 unit, 1 unit=0.1%
	10	Failure signal	0 or 1	-	01011	0:NORMAL OPERATION 1:FAILURE OCCUR
	11	Alarm signal	0 or 1	-	01013	0:NORMAL OPERATION 1:ALARM OCCUR
MEASUREMENT VALUE	12	Chilled water inlet temp.	12.0	°C	00083	0001~4000 unit, 1 unit=0.1 °C
	13	Chilled water outlet temp.	7.0	°C	00085	0001~4000 unit, 1 unit=0.1 °C
	14	Refrigerant temp at evaporator	5.0	°C	00087	0001~4000 unit, 1 unit=0.1 °C
	15	Cooling water inlet temp.	32.0	°C	00089	0001~4000 unit, 1 unit=0.1 °C
	16	Cooling water outlet temp.	37.0	°C	00091	0001~4000 unit, 1 unit=0.1 °C
	17	Absorber solution temp.	38.0	°C	00093	0001~4000 unit, 1 unit=0.1 °C
	18	High temperature generator solution temp.	145.0	°C	00095	0001~4000 unit, 1 unit=0.1 °C
	19	High temperature generator pressure	70.0	kPa	00099	0001~1100 unit, 1 unit 1 kPa
	20	High temperature generator concentration	62.0	%	00101	0001~1100 unit, 1 unit = 0.1%
	21	Purge tank pressure	2.0	kPa	00103	0001~4000 unit, 1 unit 1 kPa

TABLE 20 - COMMUNICATION DATA/WRITE COMMAND

ITEM		ADDRESS	CONTENT
1	Chiller operation signal	02001	ON at CHILLER OPERATION, PULSE SIGNAL
2	Chiller stop signal	02002	ON at CHILLER STOP, PULSE SIGNAL
3	Steam control valve upper limit	00201	0000~1000 unit, 1 unit=0.1%
4	Set point	00203	0050~1000 unit, 1 unit=0.1°C

User-Created

The diagrams and tables that follow detail some of the work that must be performed by the customer to be sure that the communication systems work properly.

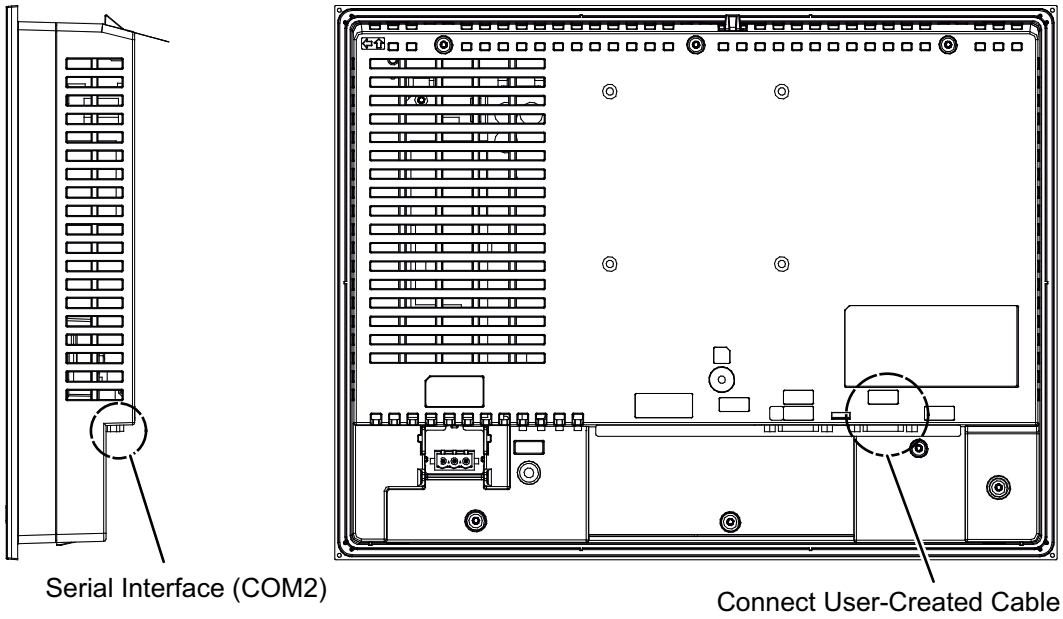
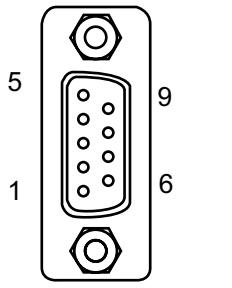


FIGURE 37 - CONNECTION DETAIL FOR D-SUB 9PIN

TABLE 21 - SCOPE OF DELIVERY OF UPPER COMMUNICATION SYSTEM

ITEM	CUSTOMER	JCI	REMARKS
Control panel with upper communication function		X	Communication protocol: Modbus RTU
Wiring work for Modbus RTU communication	X		Apply RS485 communication cable. See *Table 22 on page 92 .*
Communication program for central monitoring unit	X		See *Table 23 on page 95* for the details of the communication protocol, path type, function code, communication data address, and other applicable communication information not defined here.

TABLE 22 - CABLE DIAGRAM (RS422/RS485)

PIN CONNECTION	PIN. NO.	RS-422/RS-485		
		SIGNAL NAME	DIRECTION	MEANING
	1	RDA	Input	Receive Data A (+)
	2	RDB	Input	Receive Data B (-)
	3	SDA	Output	Send Data A (+)
	4	ERA	Output	Data Terminal Ready A (+)
	5	SG		Signal Ground
	6	CSB	Input	Send Possible B (-)
	7	SDB	Output	Send Data B (-)
	8	CSA	Input	Send Possible A (+)
	9	ERB	Output	Data Terminal Ready B (-)
	Shell	FG		Frame Ground (Common with SG)

2 Wire Type Cable Diagrams

The following are sample cable diagrams for a 2-wire type connection. They use a GP4000 series (COM2).

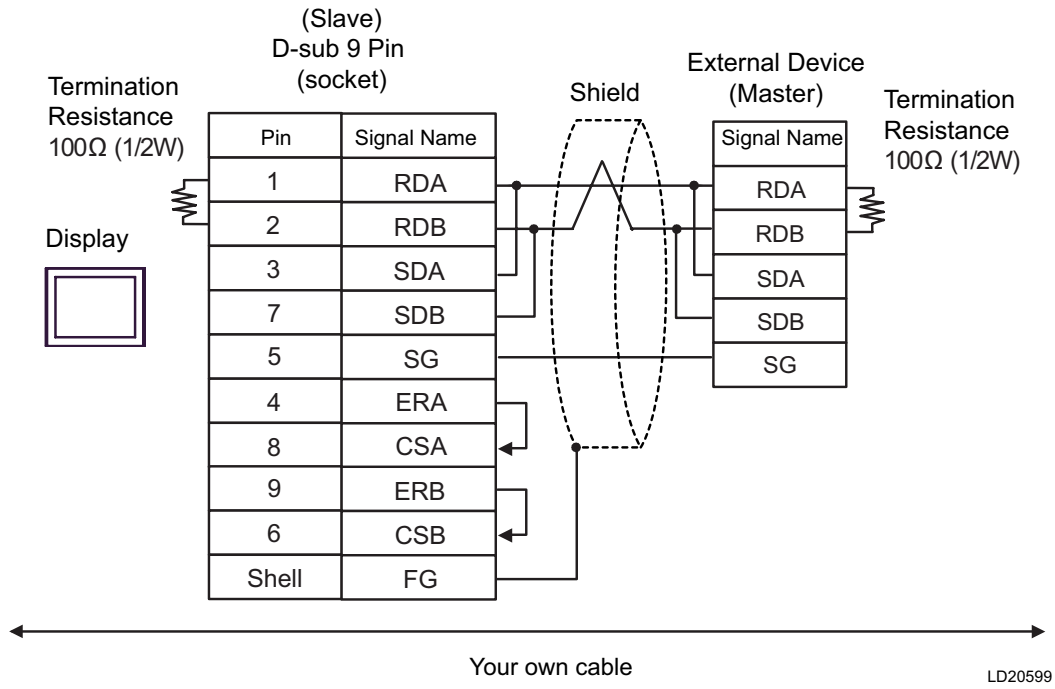


FIGURE 38 - 2 WIRE 1:1 CONNECTION WITH USER-CREATED CABLE

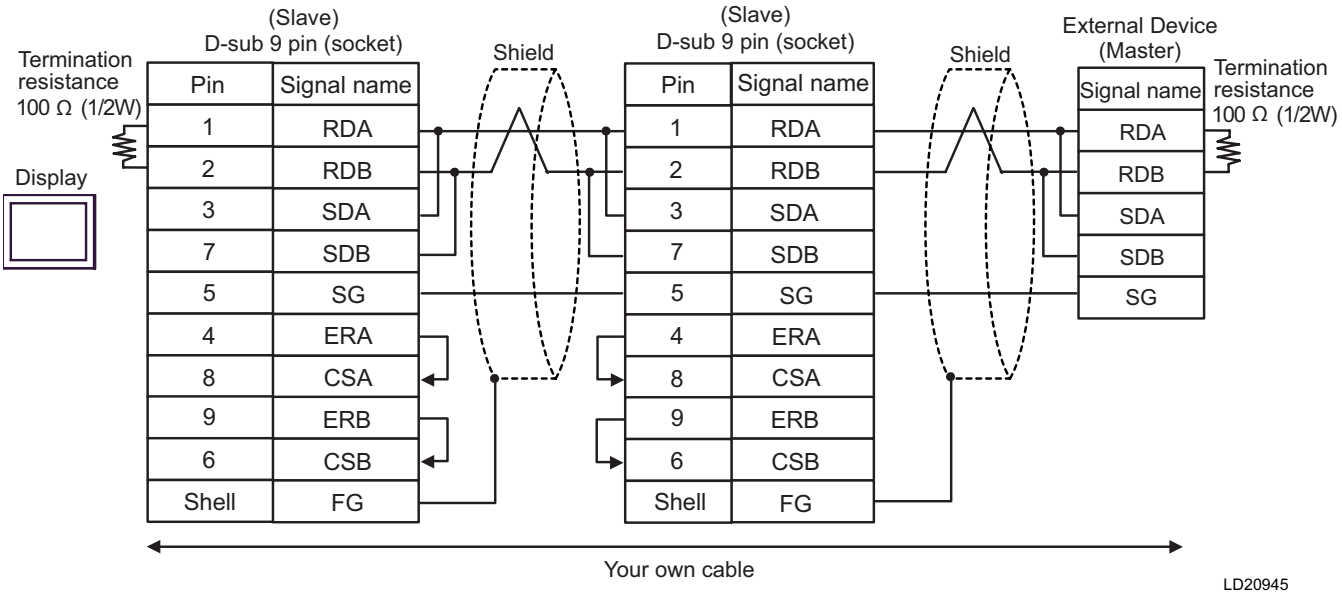


FIGURE 39 - 2 WIRE N:1 CONNECTION WITH USER-CREATED CABLE

4 Wire Type Cable Diagrams

The following are sample cable diagrams for 4-wire type connections. They use a GP4000 series (COM2).

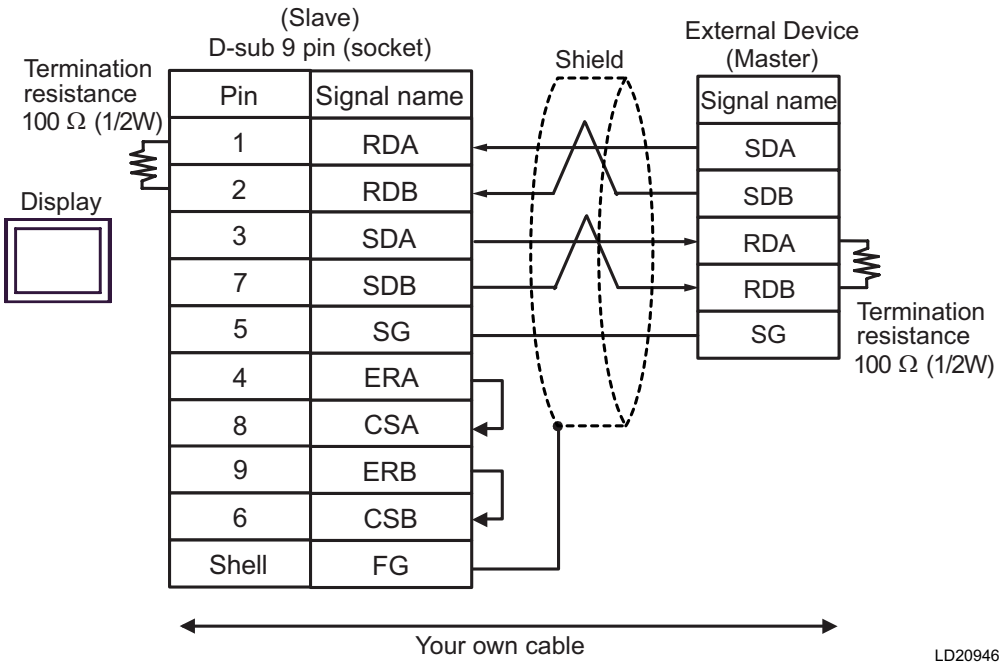


FIGURE 40 - 4 WIRE 1:1 CONNECTION WITH USER-CREATED CABLE

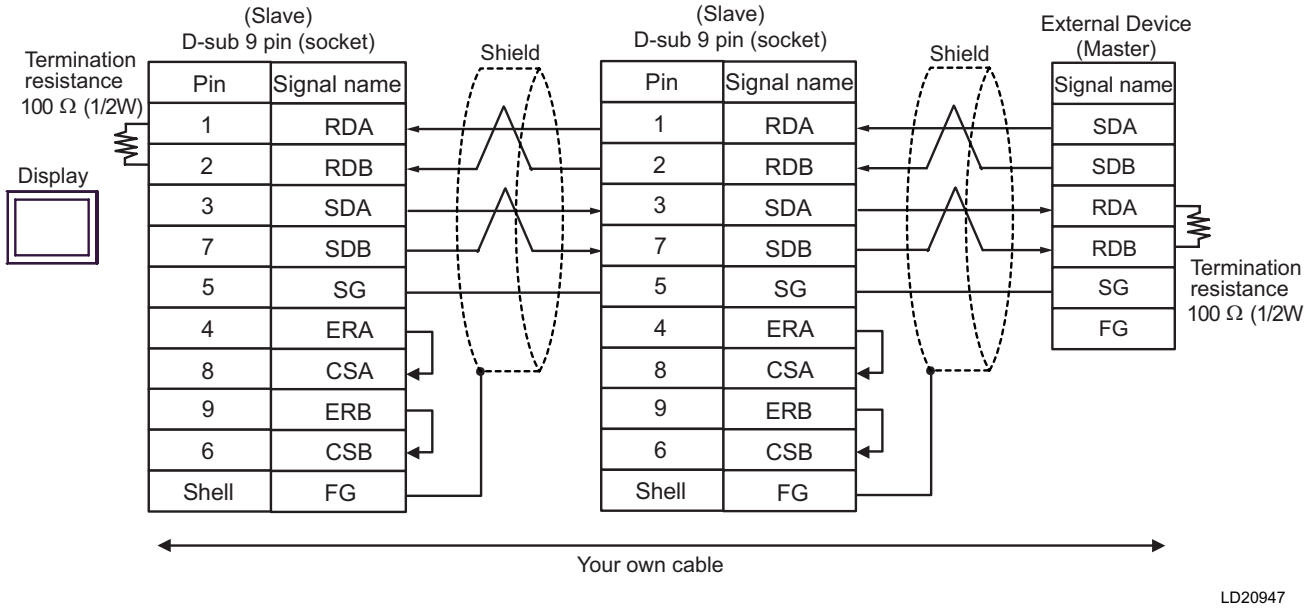


FIGURE 41 - 4 WIRE N:1 CONNECTION WITH USER-CREATED CABLE

The following table contains information about the communication specifications needed for the Modbus RTU. See *Table 19 on page 90* for more information about the Read Command or *Table 20 on page 91* for more information about the Write Command.

TABLE 23 - COMMUNICATION SPECIFICATIONS

Communication Protocol	Modbus/RTU
Communication Path Type	RS422/RS485 Data Length: 8 Bit Stop Bit: 1 Bit Parity: EVEN Speed: 9600 bps
Connector	D-Sub 9pin
Function Code	Read Coil Status:01 Read Holding Register:03
Device	Digital Signal: Coil Analog Signal: Holding Register
Slave Equipment Address	1

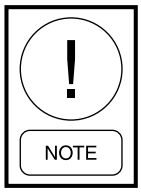
THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 5 - COMMISSIONING

GENERAL GUIDELINES FOR USE

Before Operation

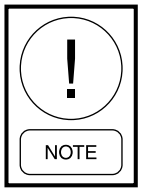
During commissioning, check the motor's rotating direction of the solution pump, refrigerant pump, and purge pump:



The flow of fluid cannot be seen because the solution and refrigerant pumps are hermetically sealed.

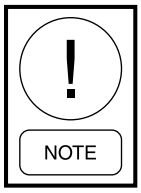
The rotation direction can be tested by using a rotation detector (Bell and Gosset or WILO DKG). If a rotation detector is not available, use the following procedure:

1. Remove the plugs at the solution and refrigerant sampling valves.
2. Make sure the valves are completely closed.
3. Confirm that the absorber and refrigerant tank contain enough solution and refrigerant.
4. Connect a compound gauge (NPT 1/2 inch) to the sampling valve with Teflon tape.



The gauge's scale must be -760 mm Hg. to 2 Kg / cm^{2}g, or -30 inches Hg. to 30 psig. To prevent corrosion of the gauge, clean it thoroughly and check for leaks after use.

5. Operate the pump.
6. Open the valve.
7. Read and record the delivery pressure of the solution pump and the refrigerant pump.
8. Close the valve.
9. Check the pressure readings. See *Table 24 on page 97* to see if your pump rotation is in the right direction. The correct direction shows a higher discharge pressure.



The delivery pressure reflects the high vacuum condition of the machine. If the inside pressure is atmospheric, add 1.0 kg / cm (14.3 psig) to the standards in the Rotary Pump Rotation table below.

10. Remove the compound gauge.
11. Put the plugs back on the valves.
12. Clean the gauge with water.
13. For refrigerant, confirm the correct rotation by viewing the refrigerant spray through the sight glass.

TABLE 24 - ROTARY PUMP ROTATION

	CORRECTION ROTATION PRESSURE
Solution Circulation Pump	0.10 to 0.20 MPa.G
Solution Spray Pump	-0.05 to 0.02 MPa.G
Refrigerant Pump	-0.08 to -0.02 MPa.G

After the completion of the equipment work (installation of the chiller, thermal insulation for cold or hot surfaces, and other relevant installation processes), operate the chiller and measure the noise around the chiller unit.

The noise data of the chiller unit was measured in decibels at the factory. See *Figure 35 on page 87*.

An Earth Leakage Breaker (ELB) is not installed on this chiller unit. You MUST install an adequate ground fault circuit breaker at the primary side of the chiller unit.

The Chiller Pre-Start Up and Commissioning Checklist contains specific information for the installation and start-up of the unit. The steps and procedures MUST be performed by a YORK/Johnson Controls Service person prior to customer use.

All items on the checklist MUST be completed prior to charging and initial operation. Failure to do this may result in machine malfunction, damage, and/or injury.

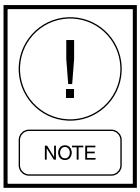
PRECAUTIONS FOR THE USE OF STEAM

Absorption chillers driven by steam use corrosion-resistant stainless steel (SUS) tubes in the High Temperature Generator.

Staining and corrosion of the tubes in the evaporator, absorber, and condenser largely depend on the quality of the water used as chilled water and cooling water. As a result, since the water is supplied from the boiler, observe the following precautions for control of the boiler water.

Water quality must be checked periodically for stain and corrosion to prevent problems. If water quality is not controlled and maintained properly, premature tube failure can result. Causes of bad quality water include:

- Polluted seawater
- Polluted underground water
- Cooling tower located near a chimney or in dirty air



Be sure to analyze the chilled water and the cooling water within one month after commissioning. See *Table 25 on page 99.*

Install strainers of 10 mesh and above to the chilled water and cooling water inlets.

Shut off valves are installed in the chilled water and cooling water inlets as well as the outlets. Be sure the valves are completely open when supplying water. If not, the water flow can become turbulent (at the shut off valves). If that happens, the water chamber case and tubes may be damaged. If you need to reduce the quantity of the chilled water and cooling water, use the valves to adjust the flow.

When the flow rate change of the chilled water is controlled, the load change speed is limited. (The flow rate change function must be installed first.)

- The load change condition to limit the chilled water temperature at the outlet is ~0.5 °C 1.5% minimum/maximum.
- The critical load change condition to prevent an overcooling trip of the chiller is 5% minimum/maximum.

Set the steam feed pressure at the inlet of the steam control valve to the specified level. If the pressure is lower than the specification, performance may be insufficient. Limit the steam pressure fluctuation in the range of the specification value +0.05/-0.1 MPa. If the pressure fluctuation is too big, control becomes unstable. The valve may start to hunt for the correct chilled water temperature at the outlet. As a result, performance suffers, and the operation may stop.

Be sure to install a strainer of 60 ~ 70 mesh before the steam control valve. If the steam control valve is clogged, the control valve has a problem and the steam flow rate cannot be controlled. If the system has a non-leak steam control valve, does not have a steam shut-off valve, and the control valve is clogged, the steam leaks while the chiller is stopped. The solution in the high temperature generator may crystallize.

Adjust the pressure at the steam drain outlet to the specified level at the specification point with the regulator valve on the facility side.

If steam drain or air may flow back while the chiller is stopped, install a check valve to the middle of the drain return piping. If two or more chillers are installed and their drain return pipes are joined together to return the drain to the hot well tank, install the check valve before the junction of the pipes.

Install a drain trap at the lowest place of the control valve before the steam control valve inlet side to prevent an inflow of drain to the high temperature generator. And install a mist separator if too much mist is contained in the steam.

A drain trap does not need to be installed in the steam drain line between the chiller and the hot well tank. The presence of a drain trap will cause the steam flow to become unstable. In this case, the condensed water draining from the chiller is sub-cooled enough so that a drain trap is unnecessary.

Isolate the main steam supply valve when servicing the chiller or during an extended shut down.

CHILLED WATER OUTLET TEMPERATURE CONTROLLER

The chilled water outlet temperature controller (23A) is located on the sequencer. It controls the chilled water outlet temperature.

Liquid Level Gauges

Liquid level gauges are used to check the condition of the chiller components.

TABLE 25 - LIQUID LEVEL GAUGES

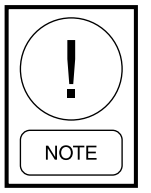
LIQUID LEVEL GAUGE NAME	SYMBOL	FUNCTION
Refrigerant overflow monitoring level gauge	G101	Checks refrigerant overflow level
Refrigerant tank level gauge	G102	Checks lower limit of refrigerant tank level
Absorber level gauge	G103	Checks lower limit of absorber
HT-GEN level gauge	G104	Checks condition of solution in high-temperature generator
LT-GEN level gauge	G105	Checks condition of solution in low-temperature generator

START THE CHILLER

Before starting the chiller, inspect the following items:

- Check that the steam supply valve is open.
- Check that the refrigerant blow valve V8 is closed.
- Open the steam shut off valve and keep the steam inlet pressure at specification.
- Check that the Refrigerant Pump **Auto** button is pressed.

After the review is complete, start the chiller.



The OPER. and STOP buttons are available on the Main, Data, and Setting screen. We recommend that you use these buttons on the Main screen whenever possible.

1. Navigate to the Main screen on the Control Panel.
2. Press the **OPER.** button on the Control Panel to start the chiller. To start the chiller from a remote location, enter the remote start signal.

When the chiller starts, the following occurs:

- The solution circulation pump, solution spray pump, and refrigerant pump start.
- The control valve, steam drain valve, and steam shut-off valve (option) open.
- The low drive source lamp lights and the low opening of the steam control valve is held for about 10 minutes.
- After 10 minutes, the steam volume is controlled automatically according to the cooling load and the Temp. Control lamp lights.

STOP THE CHILLER

1. Navigate to the Main screen on the Control Panel.
2. Press the **STOP** button on the Control Panel to stop the chiller. To stop the chiller from a remote location, enter the remote stop signal.

When the chiller stops, the following occurs:

- The steam control valve, steam drain valve, and steam shut-off valve (option) close.
- The dilution operation starts and continues for 7 - 30 minutes.
- During the dilution operation, the solution circulation pump, solution spray pump, and refrigerant pump operate.
- Once the dilution operation is complete, the solution circulation pump, solution spray pump, and refrigerant pump stop. Then the chiller water pump, cooling water pump, and cooling tower stop.

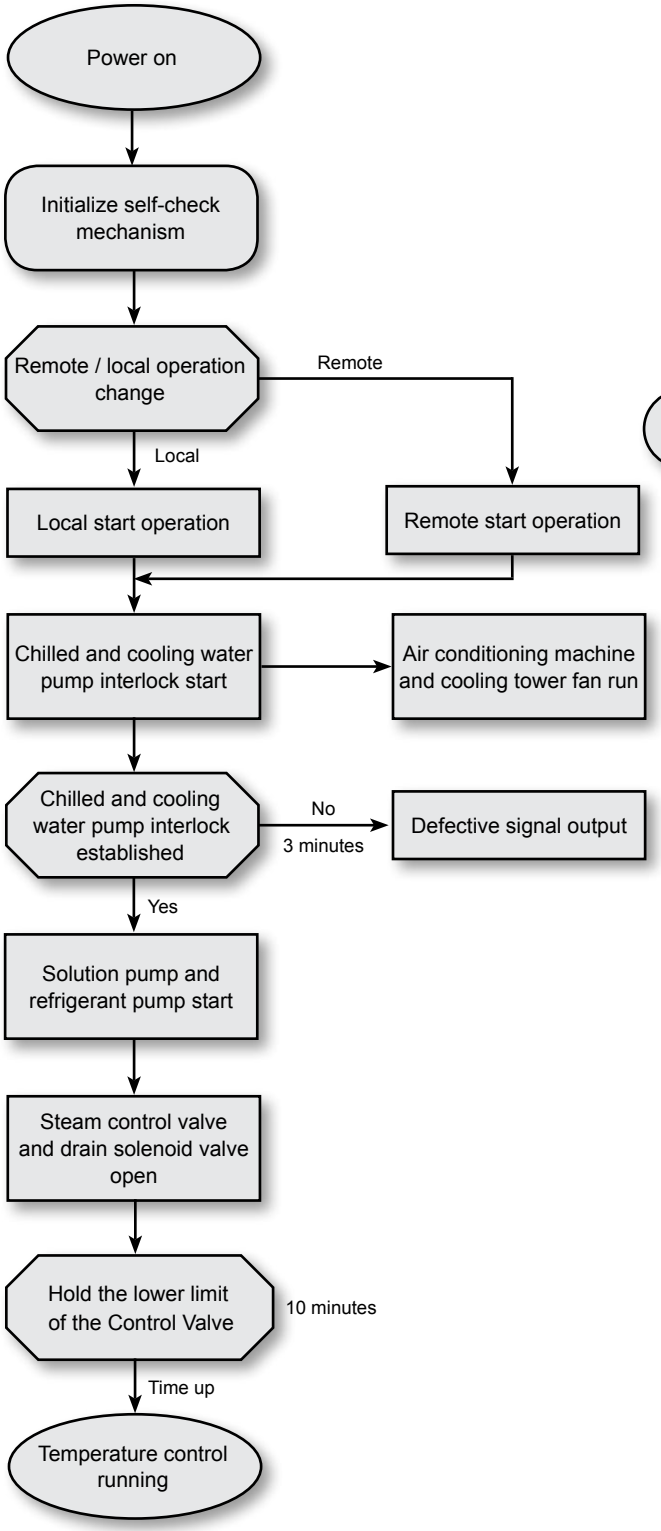


FIGURE 42 - COOLING START DIAGRAM

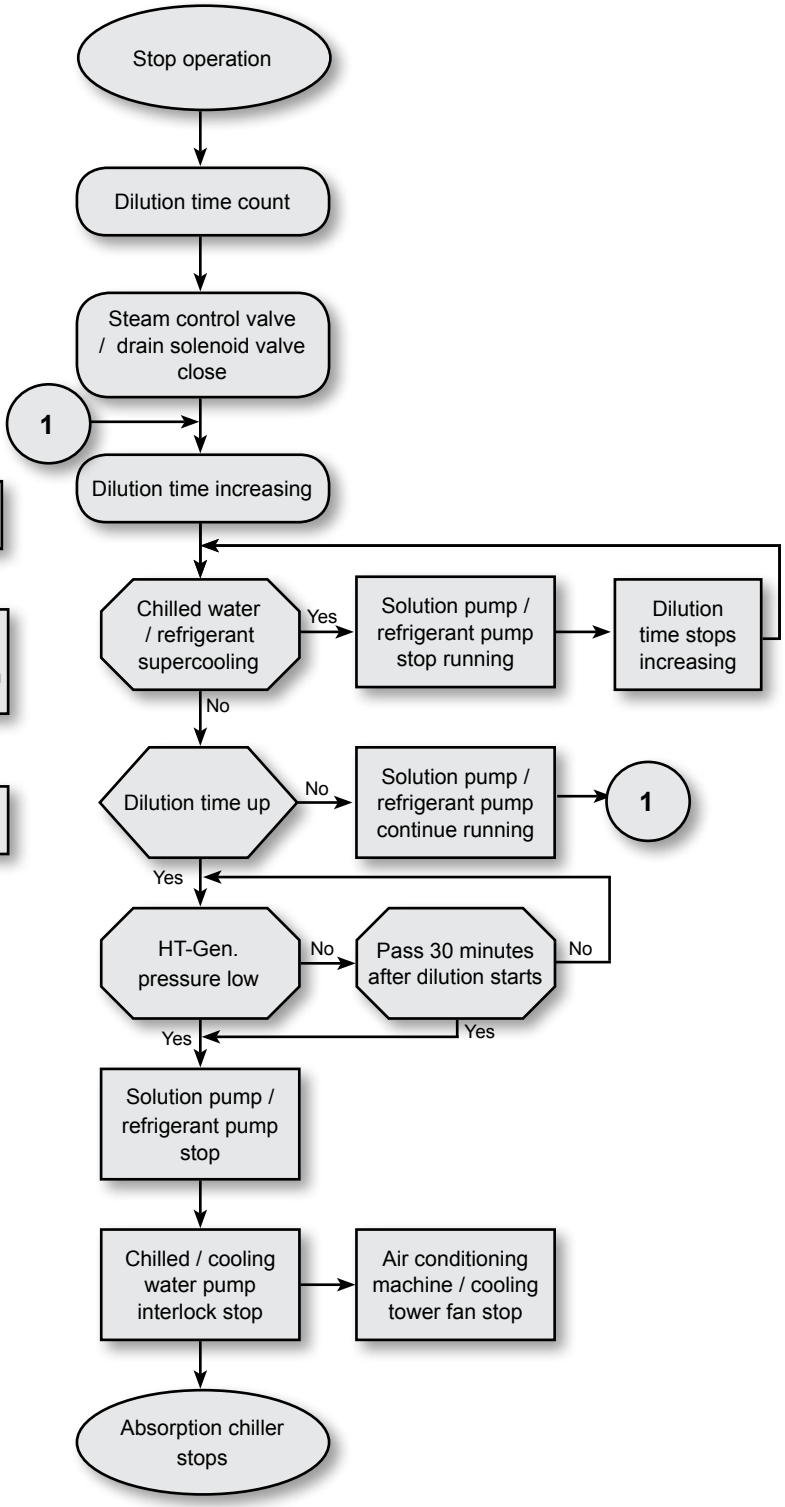
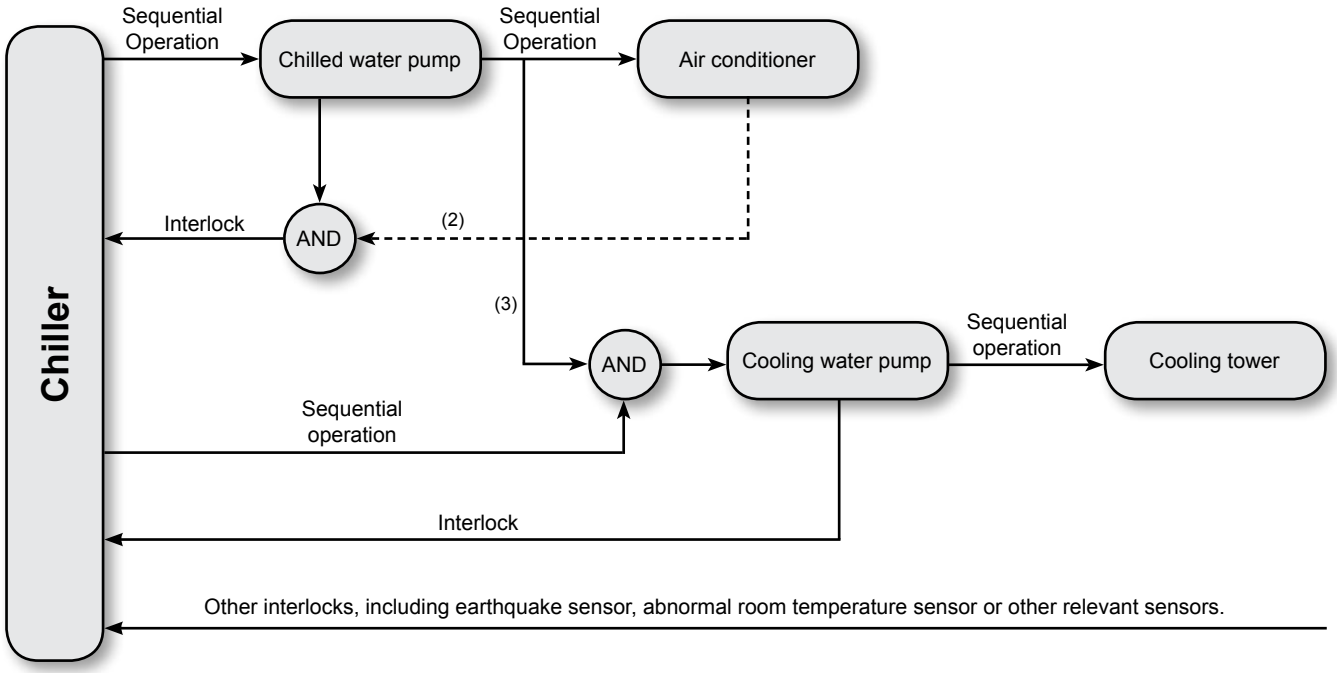


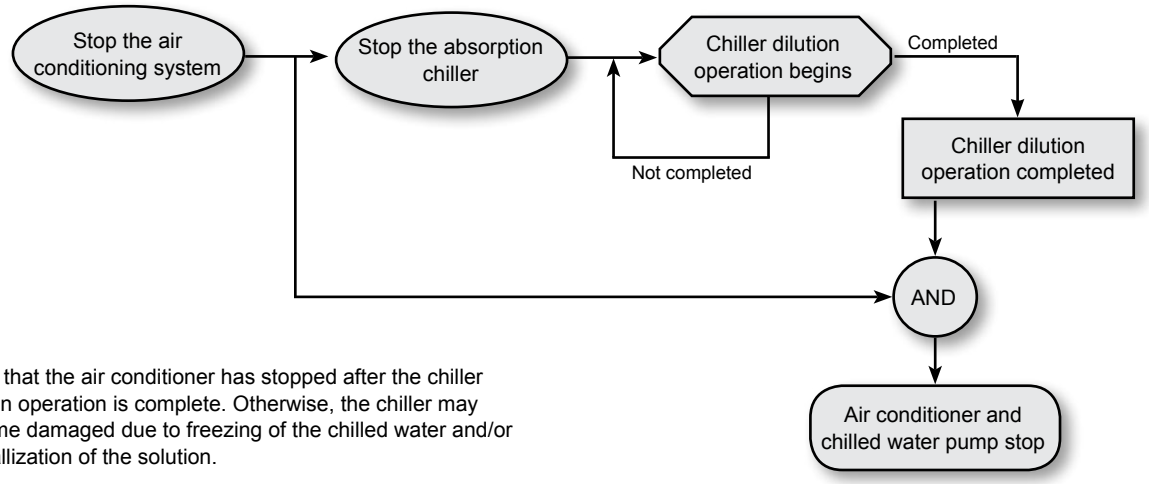
FIGURE 43 - COOLING STOP DIAGRAM



NOTES:

1. Be sure to implement sequential operation of the chilled water pump and the cooling water pump from the chiller.
2. If there is only one air conditioner, secure interlock for the air conditioner operation (the part indicated by broken lines).
3. Implement sequential operation in such a way that when the chilled water pump stops, the cooling water also stops.
4. If the chilled and cooling water system is the common system, you must install the isolation valve on the chilled water and cooling water inlet pipe entering the chiller, and interlock these isolation valves with the chiller control panel. This is imperative for safe and reliable operation of the chiller as well as to prevent potential crystallization of lithium bromide solution and freezing of the evaporator tubes.

FIGURE 44 - STEAM SEQUENTIAL OPERATION FLOWCHART



NOTE: Verify that the air conditioner has stopped after the chiller dilution operation is complete. Otherwise, the chiller may become damaged due to freezing of the chilled water and/or crystallization of the solution.

FIGURE 45 - STOPPING ABSORPTION CHILLER STEAM FLOWCHART

YORK®	YHAU-CW DOUBLE EFFECT STEAM FIRED ABSORPTION CHILLER	
CHECKLIST	Supersedes 155.31-CL1 (116)	Form 155.31-CL1 (317)

CHILLER START UP AND COMMISSIONING CHECKLIST

CUSTOMER: _____ JOB NAME: _____

ADDRESS: _____ LOCATION: _____

PHONE: _____ CUSTOMER ORDER NO: _____

JCI TEL NO: _____ JCI ORDER NO: _____ JCI CONTRACT NO: _____

CHILLER MODEL NO: _____ **UNIT SERIAL NO**: _____

The work (as checked below) is in process and will be completed by: _____ / _____ / _____
Month Day Year

The following work must be completed in accordance with installation instructions:

PRE-START UP

A. General

1. All major pieces, boxes, and crates have been received and accounted for by a YORK/Johnson Controls Service Representative. ☐
2. Any damage, or signs of possible damage, have been documented to the transportation company. ☐
3. Unit installed in an area protected from weather and maintained at a temperature above freezing. ☐
4. Vibration-proof rubber sheets are installed between the chiller base and the site foundation. ☐
5. Unit is located in accordance with minimum clearance dimensions. (Required maintenance space is available around the machine) ☐
6. Foundation bolts are properly installed ☐
7. The levelness of the unit is within acceptable range (The tolerance for leveling length and width: 1.0 mm for every 1,000 mm) ☐
8. The HG compound gauge displays the same pressure reading, or nearly the same reading, as prior to shipment ☐
9. Thermal insulation is done according to the specifications detailed in this manual. ☐
10. The following items are NOT covered with insulation:
    a. Valves ☐
    b. Thermo wells ☐
    c. Plugs ☐
    d. Sight glasses ☐

B. Piping

1. Piping is installed between the unit at the source of supply. ☐
2. Air vent valves and drain valves are closed for:
    a. Chilled water. ☐
    b. Cooling water. ☐
3. Loosen the U-band fixing bole around the steam drain cooler ☐
4. Close the drain valve for the steam drain pipe ☐
5. Install the plug to the drain valve for the steam drain pipe ☐
6. The pressure gauge and siphon tube are installed at the secondary side of the steam control valve ☐
7. The pressure gauge, check valve and adjusting valve are installed at the outlet line of the steam drain outlet line. ☐
8. The following and its related equipment are ready for operation:
    a. Chilled water pump ☐
    b. Cooling water pump ☐
    c. Cooling tower fan ☐
    d. Steam boiler or steam generation facility ☐
9. Detachable flanges are properly installed close to the:
    a. Chilled water box ☐
    b. Cooling water box ☐
    c. Steam box ☐

10. A mesh strainer is installed on the:
    a. Chilled water inlet line ☐
    b. Cooling water inlet line ☐
    c. Steam supply line ☐
11. Air piping work is complete, leak tested, and flushed for the following lines:
    a. Chilled water. ☐
    b. Hot water ☐
    c. Steam supply and steam drain return ☐
12. Clean the mesh strainers on the line ☐
13. Start the chilled water and cooling water pump ☐
14. The water box pressure does not exceed the maximum pressure for the:
    a. Chilled water ☐
    b. Cooling water ☐
15. The flow rate is adjusted within acceptable range for:
    a. Chilled water ☐
    b. Cooling water ☐
16. Steam supply pressure is stable and within acceptable range ☐
17. Steam supply temperature does not exceed its saturation temperature ☐

C. Valve and Sensor Check

1. Adjusting valves are set correctly. ☐
2. Diaphragm valves in the purge line are fully closed. ☐
3. Spindle valve is in the purge line is open. ☐
4. Detection component of the thermosensor is inserted into the thermowell according to design requirements. ☐

D. Electrical

1. The main and control power supply is available ☐
2. The insulation resistance of each motor and the MCB secondary side is within acceptable range ☐
3. The power supply voltage is set within acceptable range. ☐
4. The control panel wiring is correctly connected to the steam control ☐
5. The external control wiring is completed from the control panel to the water pump motor starters, and other related equipment ☐

E. Vacuum Pump

1. Vacuum pump is charged with the correct amount of lubricant oil. ☐
2. Vacuum pump motor rotation is correct. ☐

NOTES:

_____

_____

_____

_____

_____

_____

F. Evacuate Nitrogen Charge

1. Remove the plug in the purge line. ☐
2. Release the Nitrogen gas until the high-temperature generator compound gas reads approximately 0.005 MPa.G (0.725 PSI) ☐
3. Reinstall the plug in the purge line. ☐
4. Navigate to the Control Panel Setting screen. ☐
5. Press the Purge Pump **ON** button ☐
6. Check the oil level in the purge pump ☐
7. Using the vacuum pump, evacuate the Nitrogen gas until the high-temperature generator compound gauge indicates almost -0.1 MPa.G (-14.5 PSI) ☐
8. Close all open manual valves ☐
9. Press the Purge Pump **OFF** button. ☐
10. Turn the power switch (MCB) off. ☐
11. Replace or add oil to the purge pump ☐

G. Panel Checks

1. The thermal relays conform to the factory inspection sheet ☐
2. The interlock and answerback signals for the following work properly:
   a. Chilled water pump ☐
   b. Cooling water pump ☐
3. The indicators on the control panel are correct ☐
4. The temperature setting parameters for capacity control are correct ☐
5. Date and time reflect the local time zone ☐
6. The rotation direction is correct for the following:
   a. Solution circulation pump ☐
   b. Solution spray pump ☐
7. The water flow suspension switch works properly ☐

START UP CHECKLIST

A. Operation Check

1. Manually start each water pump. ☐
2. Confirm the water box covers do not leak during water pump operation. ☐
3. Stop each water pump manually. ☐
4. Set each water pump operation mode to automatic mode ☐
5. Navigate to the Setting screen. ☐
6. Press the Manual Purge **ON** button. ☐
7. Purge non-condensable gas from the absorber continuously. Use the procedure detailed in SECTION 7 - MAINTENANCE of the manual ☐
8. Open the refrigerant manual blow valve. ☐
9. Navigate to the Control Panel Setting screen. ☐
10. Press the Control Valve Mode **Manual** button. ☐
11. Make sure that the Refrigerant Pump **Auto** button is pressed ☐
12. Verify that the steam control valve is closed. ☐
13. Press the **OPER.** button on the Control Panel Setting screen. ☐
14. Check that the following start properly:
    a. Solution circulation pump ☐
    b. Solution spray pump ☐
    c. Refrigerant pump ☐
15. Check for abnormal noise or vibration ☐
16. Gradually open the steam control valve ☐
17. Press the Control Valve Mode **Auto** button. ☐
18. Check that the steam control valve works automatically according to the chilled water outlet temperature ☐

NOTES:

START UP

A. Operation Check

1. Press the Control Valve Mode **Auto** button. ☐
2. Check that the capacity control valve works automatically according to the chilled water outlet temperature. ☐
3. Press the **STOP** button on the Control Panel ☐
4. Check that the dilution process completes. ☐
5. Press the **OPER.** button on the Control Panel. ☐
6. Operate the chiller-heater for 3 hours or longer. ☐
7. Close the refrigerant manual blow valve. ☐
8. Operate the chiller-heater for an additional hour or longer. ☐
9. Check that the cooling water temperature is controlled within the acceptable range. ☐
10. Check that the specific gravity of the refrigerant is within the acceptable range. ☐
11. Check that the chilled water outlet temperature is lower than the chilled water inlet temperature. ☐
12. Record the running data on the data sheets. ☐

B. Purge Amount Check

1. Verify that the purge amount from the absorber is within acceptable range ☐
2. Close the spindle valve to facilitate purging from the absorber. ☐
3. Continuously purge from the purge tank until the exhausted gas amount reduces and becomes stable. ☐
4. Operate the chiller for about 1 hour without operating the vacuum pump. ☐
5. Verify that the amount of purge from the purge tank is within the acceptable range. ☐

C. Purge System Check

1. Press the Purge Mode **Auto** button ☐
2. Change the lubricant oil of the vacuum pump ☐
3. Open the valve of the ballast valve part-way. ☐

D. Remote Operation Check

Confirm that the chiller-heater starts and stops properly using the remote signal. ☐

E. Operation Instruction

Review the operation and maintenance instructions with the customer. ☐

a. Customer Names:

1. _____
2. _____
3. _____

Customer Signature: _____

Title: _____

Form Completed by: _____

: _____ / _____ / _____
Month Day Year

DOUBLE EFFECT STEAM ABSORPTION CHILLER COMMISSIONING DATA SHEET (1/2)

User:		
Model:	**MFG.No.:**	**User's machine code:**

Insulation Resistance					**Electric Power Supply**		
Standard: 5 MΩ or more (with 500 V megger)		R-Gnd	S-Gnd	T-Gnd	Specification: AC ☐ V / ☐ Hz		
Circuit breaker	MΩ				Standard: Within +/- 10% of spec.		
					R-S	V	
		U-Gnd	V-Gnd	W-Gnd	R-T	V	
Solution circulation pump	MΩ				S-T	V	
Solution spray pump	MΩ				R-Gnd	V	
Refrigerant pump	MΩ				S-Gnd	V	
Purge pump	MΩ				T-Gnd	V	

Thermal Relay Setting			**Refrigerant Purity**		**Temperature Setting**		
Solution circulation pump	A		Standard: 1.040 (kg/L) or less		Set base temp.	°C	
Solution spray pump	A		Specific gravity		Auto. stop temp.	°C	
Refrigerant pump	A		Turbidity		Auto restart diff.	°C	
Purge pump	A						

Pump Discharge Pressure		**Purge Amount**	
Solution circulation pump	MPa.G	Standard: 4 cc/min or less	
Solution spray pump	MPa.G	Purge tank	cc
Refrigerant pump	MPa.G	Absorber	cc

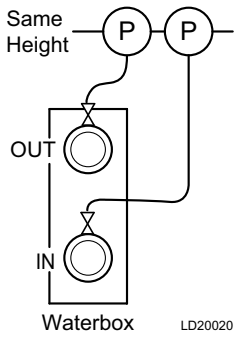
NOTES:

DOUBLE EFFECT STEAM ABSORPTION CHILLER COMMISSIONING DATA SHEET (2/2)

User:								
Model:		**MFG.No.:**			**User's machine code:**			
Running Data								
Date:			**Measured by**	**Specification**	**Standard**	**:**	**:**	**:**
Steam	Steam valve position	%	Control panel					
	Steam primary pressure		Pressure gauge		≤0.78 MPa.G			
	Steam secondary pressure		Pressure gauge					
	Steam temperature	°C	Thermometer		≤175°C			
	Drain outlet (back) pressure		Pressure gauge					
	Drain temperature	°C	Thermometer		≤95°C			
	Steam consumption		Flow meter					
Chilled Water	Inlet temperature	°C	Control panel					
	Outlet temperature	°C	Control panel					
	Inlet pressure		Pressure gauge					
	Outlet pressure		Pressure gauge					
	[3] Pressure drop		DPG or calculation	[4]				
	[1] Flow rate		FM or calculation	[2]				
Cooling Water	Inlet temperature	°C	Control panel		20.0~32.0°C			
	Outlet temperature	°C	Control panel		20.0~37.5°C			
	Inlet pressure		Pressure gauge					
	Outlet pressure		Pressure gauge					
	[7] Pressure drop		DPG or calculation	[8]				
	[5] Flow rate		FM or calculation	[6]				
Absorption Cycle	HG pressure (Gauge)	MPa.G	Compound gauge		≤-0.003 MPa			
	HG pressure (Sensor)	kPa. abs	Control panel		≤94.7 kPa			
	HG temperature	°C	Control panel		≤165°C			
	HG solution concentration	%	Control panel					
	Absorber temperature	°C	Control panel					
	Refrigerant temperature	°C	Control panel					
Liquid Level	HG		Level gauge			○	○	○
	LG		Level gauge			○	○	○
	Absorber		Level gauge		●	○	○	○
	Evaporator (Lower)		Level gauge		●	○	○	○
	Evaporator (Upper)		Level gauge			○	○	○

NOTES:
Operating hours hours
Number of purge times times
Fill out each specification pressure drop according to the factory inspection report (actual value).
If differential pressure gauge (DPG) is not available, calculate each pressure drop.
If flow meter (FM) is not available, calculate each flow rate as below.

$[1] = [2] \times \sqrt{[3]/[4]}$ $[5]=[6] \times \sqrt{[7]/[8]}$



PURGE AMOUNT DATA SHEET (1/1)

User:		
Model:	**MFG.No.:**	**User's machine code:**
Measured Date:	Measured by:	

Purge Amount from Purge Tank	Flame Reaction Test
Standard: 4.0 cc/min. or smaller	Reaction (Strong / Weak / None)
Amount of Gas (P) cc/min	

Purge Amount from Purge Line					
Elapsed time		1 hour			
Consumed time for measurement (m)	min.				
Total gas amount (a)	cc				
Actual gas amount (b)	cc				
(b) = (a) - (P) x (m)					

Purge Amount from Absorber									
Standard: 4.0 cc/min. or smaller									
Elapsed time (T)	min.	1	2	3	5	10	15	20	30
Total gas amount (A)	cc								
Increased gas amount (B)	cc								
Actual gas amount (C)	cc/min.								

(B) = (A) - previous(A)
(B) - $\underline{(P) \times \{ (T) - \text{previous}(T) \}}$
(C) = (T) - previous(T)

SECTION 6 – OPERATION

YHAU-CW CONTROL CENTER

The YHAU-CW Control Center, furnished as standard on each chiller, allows for efficiency, monitoring, data recording, chiller protection, and operating ease. The Control Center is factory-mounted, wired, and tested. It is used as a control system for lithium bromide absorption chillers.

The panel is configured with a color TFT Display with buttons that are integrated into the display. A single button reveals a wide array of information on a large, full-color illustration of the appropriate component, making information is easier to interpret.

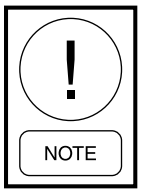
The LCD display allows for a graphic animated display of the chiller, its sub-systems and system parameters. In addition, you may view the historical operation of the chiller as well as the present operation. A Status Bar displays at all times on all screens. It contains the System Status Line and Details Line, the Control Source, Access Level, Time and Date.

The panel display is available in various languages. The language can be changed without having to turn off the chiller.

Data can be displayed in Metric units plus keypad entry of set points to 0.1 increments.

Security access using passwords is provided to prevent unauthorized changes of set points. There are three levels of access. Each level has its own password. There are certain screens, displayed values, programmable set points, and manual controls not shown that are used for servicing the chiller.

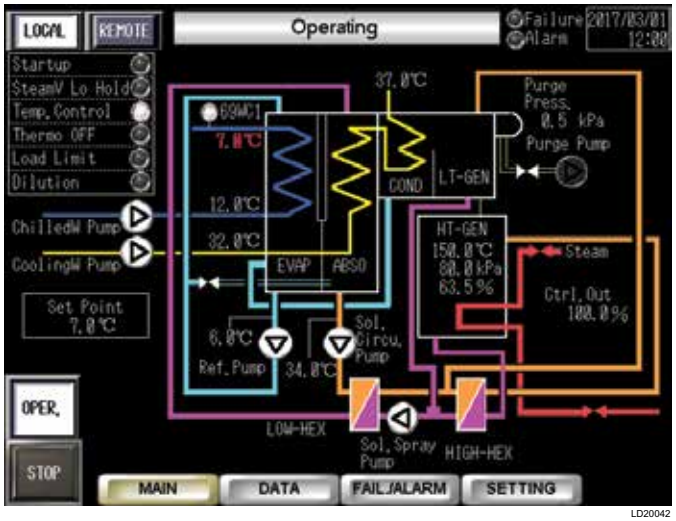
COMMON ITEMS



Buttons are listed in the order they are seen on the screen: left to right and top to bottom.

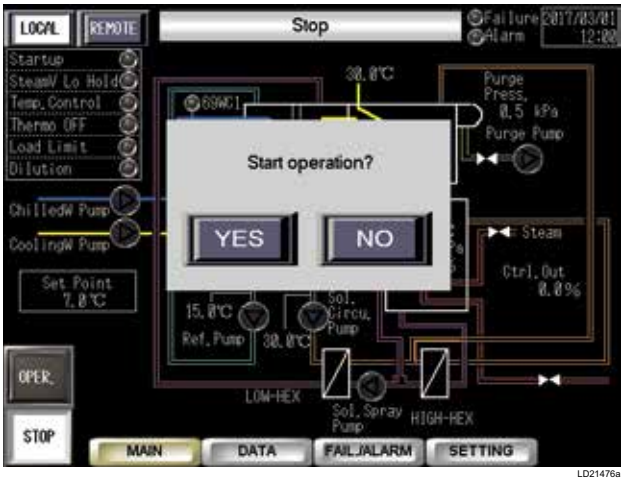
The Control Center screens have items that are applicable to each feature of the Control Center. This includes the following common items:

- **LOCAL** and **REMOTE:** Buttons that allow you to switch the operating location between remote and local. The setting can be changed while the chiller is operating. Press and hold the appropriate button for 2 seconds to make the change.
- **Operating Status:** The display appears at the center top of the screen. It shows the following operating conditions: Stop, Operating, and Failure Activating.
- **Failure** and **Alarm:** Warning lamps that light if the chiller has a failure or a warning alarm.
- **Date** and **Time:** Shown on the upper right corner of each screen.
- **OPER.** and **STOP:** Buttons in the lower left corner to allow you to stop or start the chiller.



LD20042

When you press the **OPER.** button while the chiller is stopped, or **STOP** while the chiller is operating, a confirmation message appears. Press **YES** or **NO** depending on whether you want to continue or cancel your selection.



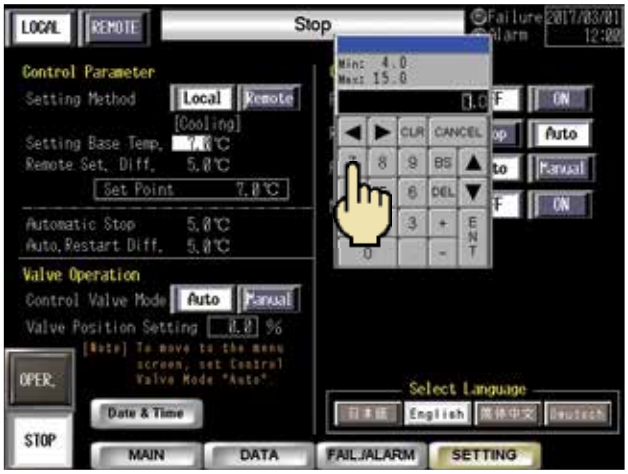
LD21476a

- **Screen Name Buttons:** Located along the bottom of the screen. These are used to change screens. The selected button lights when it is active.

CHANGE NUMERIC VALUES

Many numeric values, such as the set point and the ranges on the Trend screen, can be changed. Here's how:

1. Touch the number to be changed. A numeric keypad appears.



LD21154a

2. Enter the new value on the keypad.
3. Press the **ENT** button to set it.

MAIN SCREEN

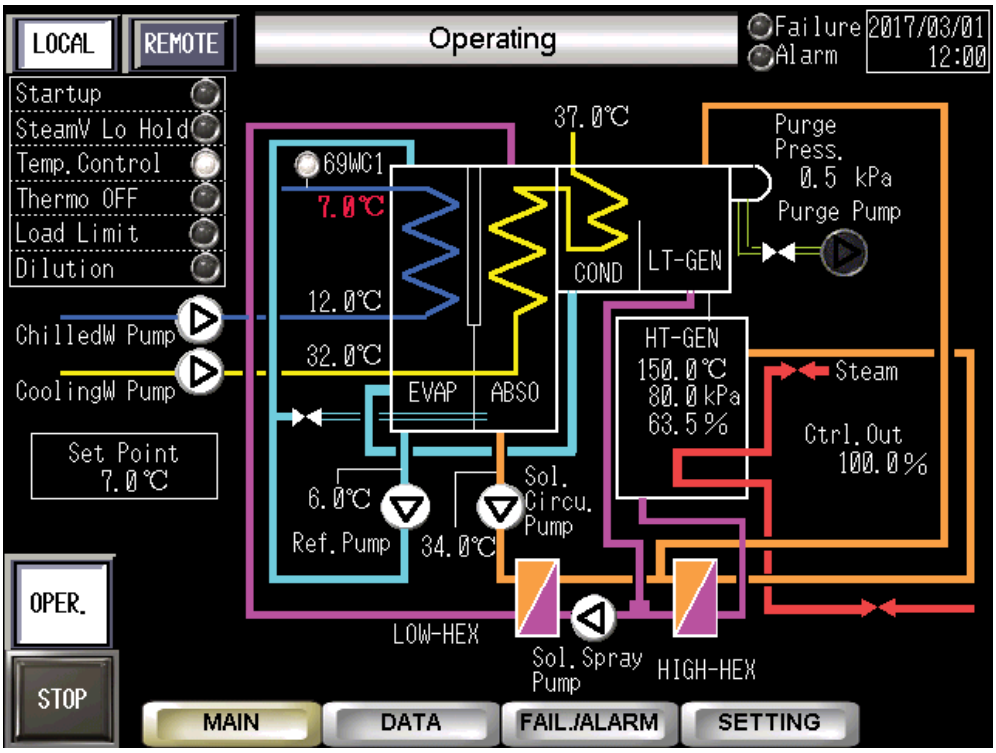


FIGURE 46 - MAIN SCREEN

The Main Screen displays the equipment status (chiller start or stop, operating, pumps ON or OFF, purge pump ON or OFF, and chilled, and cooling water pumps ON or OFF). Also, the operating status of the various modes of chiller operation.

OPERATING STATUS

On the upper left of the screen below the **LOCAL** and **REMOTE** buttons is a list of options. Each has a lamp to indicate on or off for the following:

- **Startup:** Lights if the chiller is ready to start. Light is off if the chiller is stopping or if it is not ready to start.
- **Steam V Lo Hold:** The steam control valve low hold light is on if the steam control valve low hold is operating. The steam control valve stays in the low position before the automatic temperature control process runs.
- **Temp. Control:** Light is lit if the temperature control of the microcomputer panel changes to RUN status. Turns off if the chiller stops.
- **Thermo OFF:** Lights if the chilled water temperature falls to the automatic stop temperature. Turns off when the temperature rises enough to allow an automatic restart.
- **Load Limit:** Light is lit if the load restriction activates due to the cooling water temperature, refrigerant temperature, or HG temperature or pressure is higher than the set point. Light turns off when the load restriction is removed.
- **Dilution:** Light is lit during the dilution operation after the chiller stops. It turns off when the dilution operation is complete.
- **ChilledW Pump:** indicates the temperature of the chilled water.
- **CoolingW Pump:** indicates the temperature of the cooling water.

Set Point: The set point of chilled water leaving temperature is shown on the left of the screen.

The system illustration lights (lines fill in) when the system is operating.

An illustration of the system shows the following information:

- steam control valve output
- chilled water entering and leaving temperature
- cooling water entering and leaving temperature
- refrigerant temperature
- absorber temperature
- high temperature generator pressure
- high temperature generator temperature
- high temperature generator concentration
- purge tank pressure

This screen shows the status of the equipment in the chiller process diagram.

Items in the chiller process diagram are:

Pump

Solution Circulating Pump, Solution Spray Pump, Refrigerant Pump, Purge Pump, Chilled Water pump, Cooling Water pump

Flickers white during operation. Remains black when the pump is stopped.

69WC1 or 69WC2 (option)

Differential pressure switch of chilled water (69WC1) and cooling water (69WC2)

White when water is flowing. Turns black when the water is stopped.

Valve

Steam control valve, steam drain valve, refrigerant blow valve, purge tank valve

White indicates valve is shut off. Any other color indicates the valve is open.

The condition lights show the current operating mode and status of the system.

The four (4) buttons along the bottom of the Main screen are common to many of the other screens in the Control Panel. They all can be used to move around and access other screen information. They are:

- **MAIN:** return to the initial screen
- **DATA:** move to the Data screen
- **FAIL** or **ALARM:** move to the Failure and Alarm screen
- **SETTING:** move to the Setting screen

DATA SCREEN

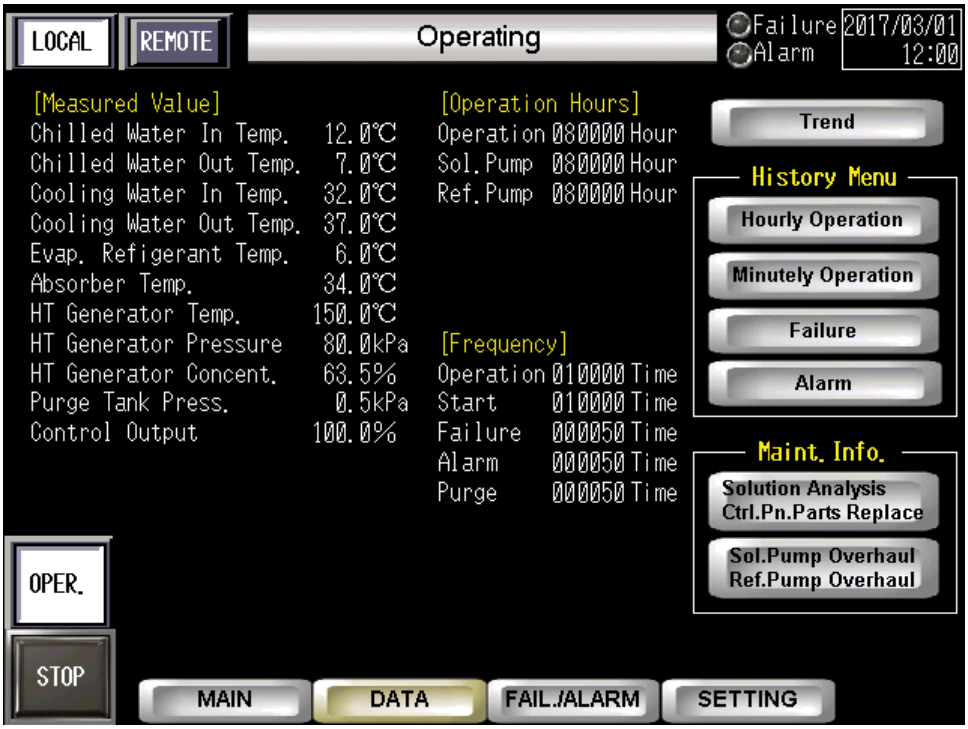


FIGURE 47 - DATA SCREEN

The Data Screen displays values showing temperatures, operating hours, operating frequency, data trends and a history of failures, alarms, and time based temperature trends.

In the Measured Value section of the Data screen the following display:

Chilled Water In Temp.: temperature of the chilled water measured as it enters the evaporator

Chilled Water Out Temp.: temperature of the chilled water measured as it leaves the evaporator

Cooling Water In Temp.: temperature of the cooling water measured as it enters the absorber

Cooling Water Out Temp.: temperature of the cooling water measured as it leaves the condenser

Evap. Refrigerant Temp.: temperature of the refrigerant in the evaporator

Absorber Temp.: temperature of the diluted solution in the absorber

HT Generator Temp.: temperature of the concentrated solution in the high temperature generator

HT Generator Pressure: pressure in the high temperature generator

HT Generator Concent.: concentration of the concentrated solution in the high temperature generator

Purge Tank Press.: pressure in the purge tank Control Output is shown as a percentage.

The Operation Hours section shows the following:

- **Operation:** displays how long the chiller has been running.
- **Sol. Pump:** displays how long the solution pump has been running.
- **Ref. Pump:** displays how long the refrigerant pump has been running.

The frequency of failures, alarms, and purges is shown in the Frequency section:

- **Operation:** displays how many times the chiller has started using the **OPER.** button or the remote start signal
- **Start:** displays how many times the heat source (steam) input has started.
- **Failure:** displays how many times the system has experienced a failure.
- **Alarm:** displays how many times an alarm has been activated.
- **Purge:** displays how many times the purge system has started automatically.

To move to the Trend screen, press the **Trend** button at the upper right of the screen.

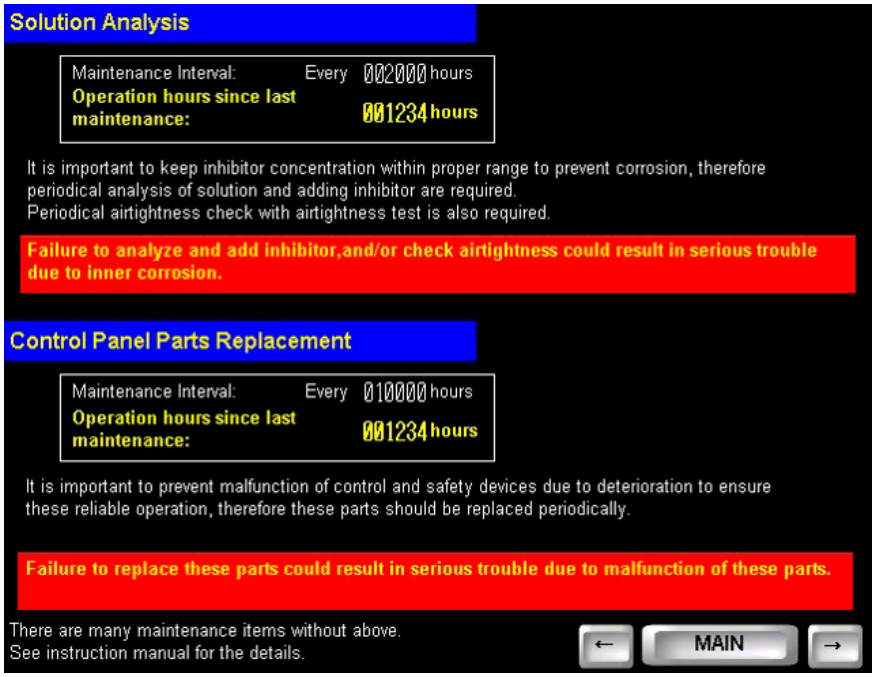
The History Menu section on the right side of the screen gives you access to the Operation History, Alarm History and to the Failure History screens. It contains four buttons:

- **Hourly Operation:** move to the Hourly Operation History screen
- **Minutely Operation:** move to the Minutely Operation History screen
- **Failure:** move to the Failure History screen
- **Alarm:** move to the Alarm History screen

The Maintenance Information section on the right side of the screen gives you access to the detailed maintenance information. If the maintenance interval has passed, the color of the button lettering changes to red. It contains two buttons:

- **Solution Analysis and Control Panel Parts Replace:** move to the Solution Analysis and Control Panel Parts Replacement screen
- **Solution Pump Overhaul and Refrigerant Pump Overhaul:** move to the Solution Pump Overhaul and Refrigerant Pump Overhaul screen

SOLUTION ANALYSIS / CONTROL PANEL PARTS REPLACEMENT SCREEN



LD21347

FIGURE 48 - SOLUTION ANALYSIS / CONTROL PANEL PARTS REPLACEMENT SCREEN

The Solution Analysis section of the screen shows the maintenance interval and current operation hours since the last inhibitor solution maintenance.

Keep the inhibitor concentration within the proper range to prevent corrosion. Periodic analysis of the solution and addition of inhibitor is required.

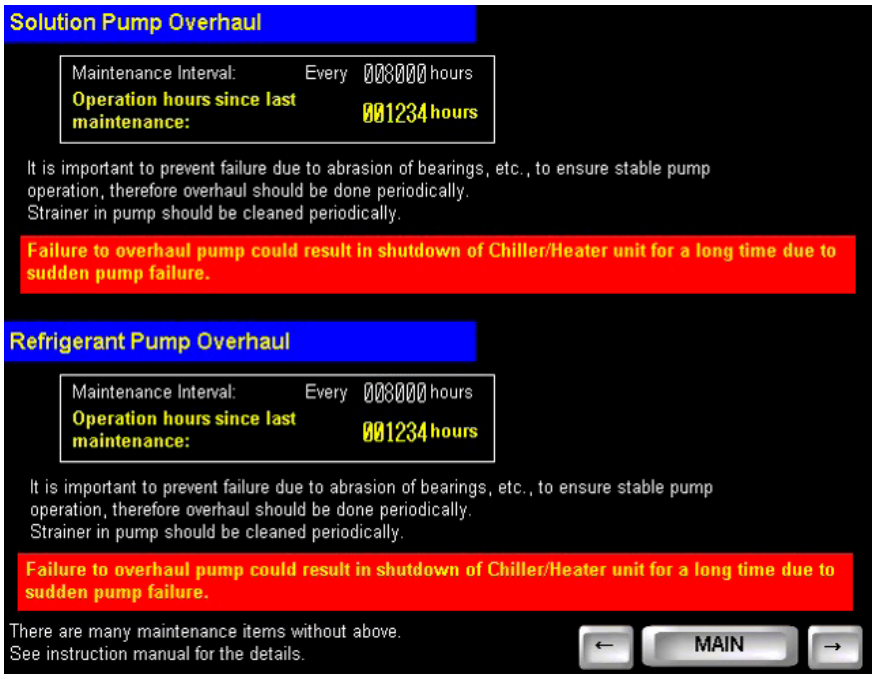
When maintenance is overdue, the maintenance alarm is activated with the warning "Solution analysis should be done." When the warning appears, contact your local Johnson Controls Service Center.

The Control Panel Parts Replacement section of the screen shows the maintenance interval and current operation hours since the last control panel maintenance.

Periodic maintenance prevents malfunctions of the control panel. It also helps keep safety devices from deteriorating.

When maintenance is overdue, the maintenance alarm is activated with the warning "Control panel parts should be replaced." When the warning appears, contact your local Johnson Controls Service Center.

SOLUTION PUMP OVERHAUL / REFRIGERANT PUMP OVERHAUL SCREEN



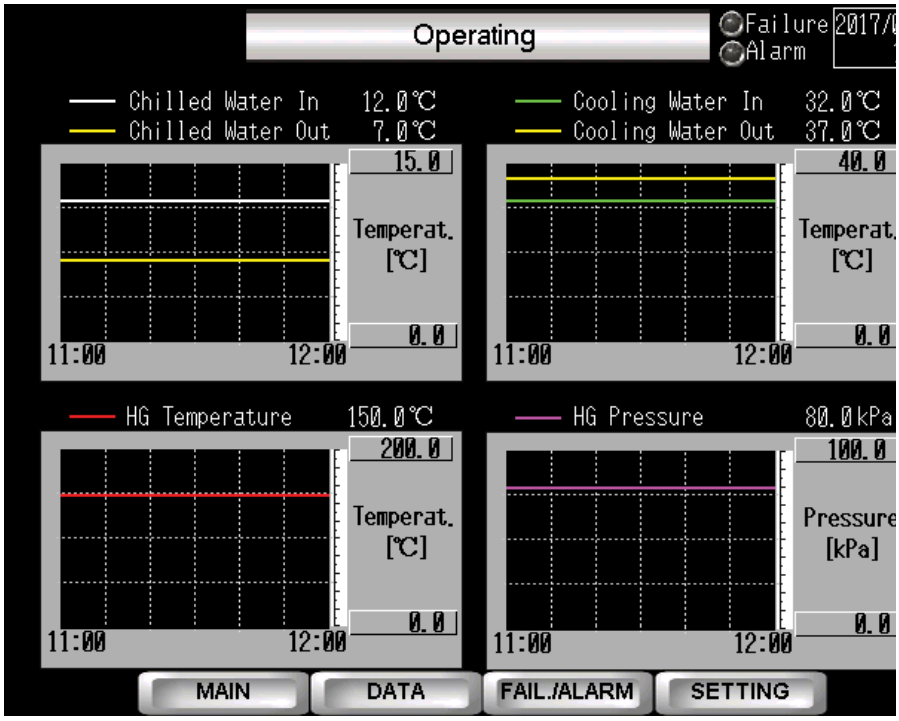
LD21554

FIGURE 49 - SOLUTION PUMP OVERHAUL / REFRIGERANT PUMP OVERHAUL SCREEN

The Solution Pump Overhaul section of the screen and the Refrigerant Pump Overhaul section of the screen both indicate the maintenance interval and the current operation hours since the last maintenance.

When the required maintenance period has passed, the maintenance alarm is activated with the warning, "Solution Pump should be overhauled" and/or "Refrigerant Pump should be overhauled". When the maintenance period has passed and the warning appears, contact your local Johnson Controls Service Center.

TREND SCREEN



LD20045

FIGURE 50 - TREND SCREEN

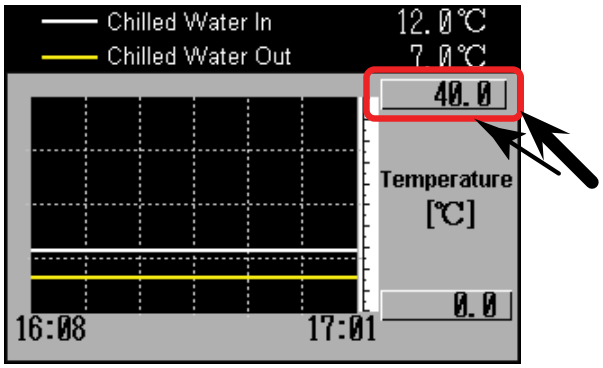
To view the Trend Screen, press the **Trend** button above the History Menu section on the Data screen.

This screen graphically illustrates the trend of the temperature and the pressure for the following:

- **Chilled Water In:** temperature of the chilled water measured as it enters the evaporator
- **Chilled Water Out:** temperature of the chilled water measured as it leaves the evaporator
- **Cooling Water In:** temperature of the cooling water as it enters the absorber
- **Cooling Water Out:** temperature of the cooling water as it leaves the condenser
- **HG Temperature:** temperature of the concentrated solution in the high temperature generator
- **HG Pressure:** pressure in the high temperature generator

The graphs are updated constantly regardless of the operating status of the chiller.

The display ranges in the Trend screen can be changed.

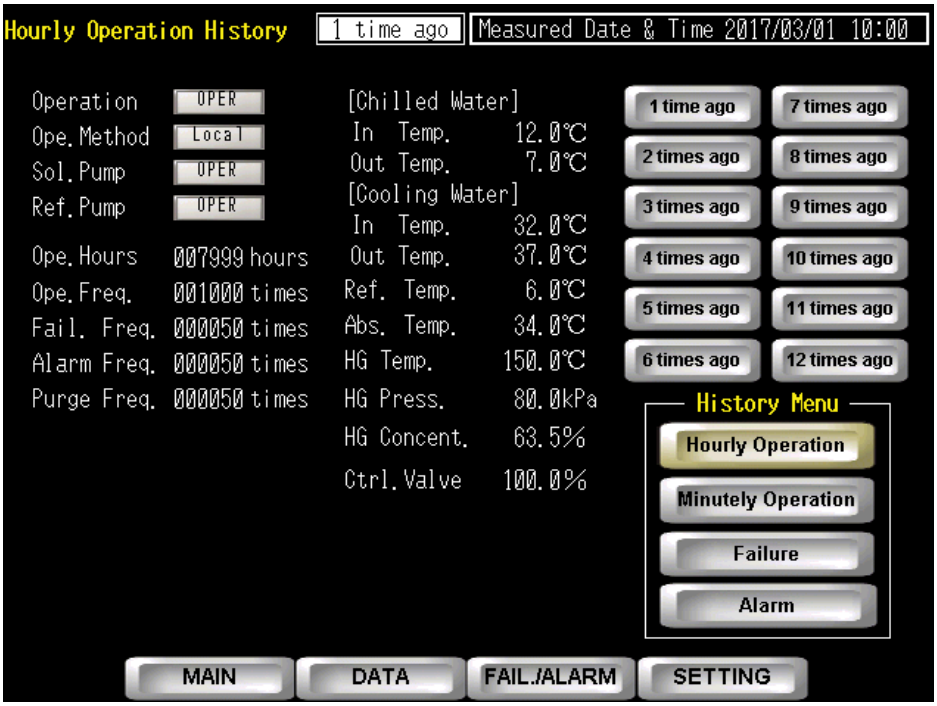


LD20093

Use the numeric keypad to make the changes. For more information on the procedure, see *Change Numeric Values on page 110.*

To move to another screen, press the any of the available buttons along the bottom of the screen.

HOURLY OPERATION HISTORY SCREEN



LD20079

FIGURE 51 - HOURLY OPERATION HISTORY SCREEN BY HOURS

To view the Hourly Operation History screen, press the **Hourly Operation** button in the History Menu screen section of the Data screen.

The Hourly Operation History screen shows operational information for the last 12 hours and contains the following fields of information:

The heading of the screen includes the X time ago and the Measured Date and Time. Buttons are available to select measurements for up to 12 times ago, to cover the 12 hour period.

The following information displays:

Operation: operation status of the chiller.

Ope. Method: selected operation method (local or remote).

Sol. Pump: operation status of the solution pump.

Ref. Pump: operation status of the refrigerant pump.

Ope. Hours: how many hours the chiller has been operating.

Ope. Freq.: how many times the chiller has started using the **OPER.** button or the remote start signal.

Fail. Freq.: how many times the chiller has had a failure alarm.

Alarm Freq.: how many times an alarm has been triggered for the chiller.

Purge Freq.: how many times a purge has been performed automatically.

The Chilled water section of the screen shows you the following information:

In Temp.: temperature of the chilled water measured as it enters the evaporator.

Out Temp.: temperature of the chilled water measured as it leaves the evaporator.

The Cooling Water section shows you:

In Temp: temperature of the cooling water measured as it enters the absorber.

Out Temp.: temperature of the cooling water measured as it leaves the condenser.

Ref. Temp.: temperature of the refrigerant in the evaporator.

Abs. Temp.: temperature of the diluted solution in the absorber.

HG Temp.: temperature of the concentrated solution in the high-temperature generator.

HG Press.: pressure in the high-temperature generator

HG Concent.: concentration of the concentrated solution in the high-temperature generator.

Ctrl Valve: percentage that the valve is open.

There are two sets of buttons on the right side of the screen. The first set gives you access to information about past occurrences. For instance, if you press the **3 times ago** button, you will see the settings as they appeared 3 hours ago.

The buttons in the History Menu section allow you to move between the various history screens:

Hourly Operation: Press this button to access the Hourly Operation History screen.

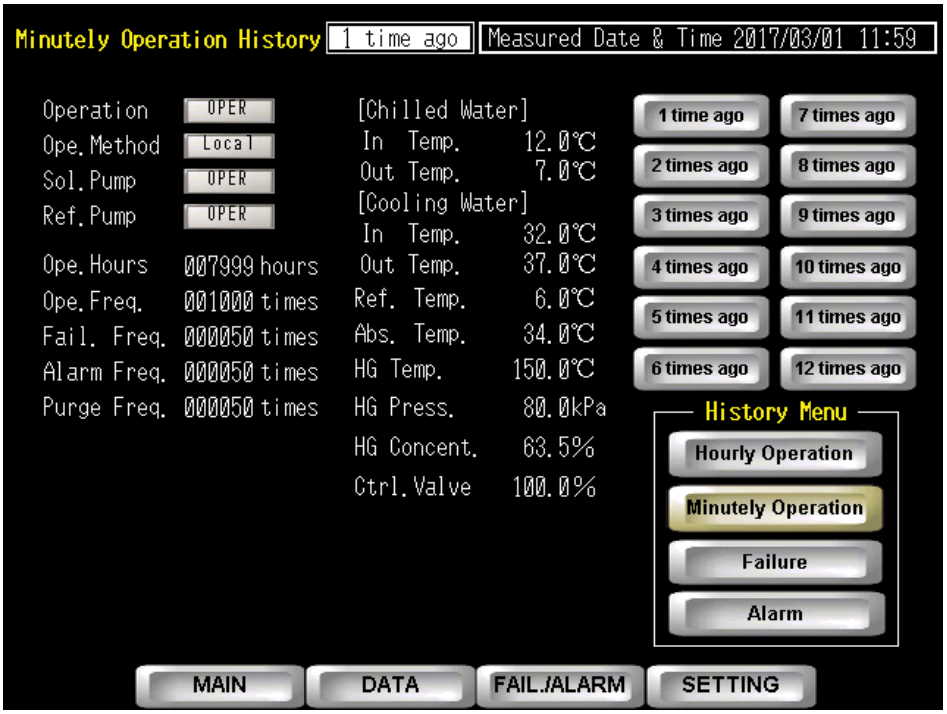
Minutely Operation: Press to view the Minutely Operation History screen.

Failure: Press this button to see the Failure History screen.

Alarm: Press to see the Alarm History screen.

To move to another screen, press the any of the available buttons along the bottom of the screen.

MINUTELY OPERATION HISTORY SCREEN



LD20080

FIGURE 52 - OPERATION HISTORY SCREEN BY MINUTES

To view the Minutely Operation History screen, press the **Minutely Operation** button in the History Menu section of the Data screen.

The Minutely Operation History screen shows operational information for the last 12 minutes and contains the following fields of information:

Operation: operation status of the chiller.

Ope. Method: selected operation method.

Sol. Pump: operation status of the solution pump.

Ref. Pump: operation status of the refrigerant pump.

Ope. Hours: how many hours the chiller has been running.

Ope. Freq.: how many times the chiller has started using the **OPER.** button or the remote start signal.

Fail. Freq.: how many times the chiller has had a failure alarm.

Alarm Freq.: how many times an alarm has been triggered for the chiller.

Purge Freq.: how many times a purge has been performed automatically.

The Chilled water section of the screen shows you the following information:

In Temp.: temperature of the chilled water measured as it enters the evaporator.

Out Temp.: temperature of the chilled water measured as it leaves the evaporator.

The Cooling Water section shows you:

In Temp.: temperature of the cooling water measured as it enters the absorber.

Out Temp.: temperature of the cooling water measured as it leaves the condenser.

Ref. Temp.: temperature of the refrigerant in the evaporator.

Abs. Temp.: temperature of the diluted solution in the absorber.

HG Temp.: temperature of the concentrated solution in the high temperature generator.

HG Press.: pressure in the high temperature generator.

HG Concent.: concentration of the concentrated solution in the high temperature generator.

Ctrl Valve: percentage that the valve is open

There are two sets of buttons on the right side of the screen. The first set gives you access to information about past occurrences. For instance, if you press the **3 times ago** button, you will see the settings as they appeared 3 minutes ago.

The buttons in the History Menu section allow you to move between the various screens:

Hourly Operation: Press this button to access the Hourly Operation History screen.

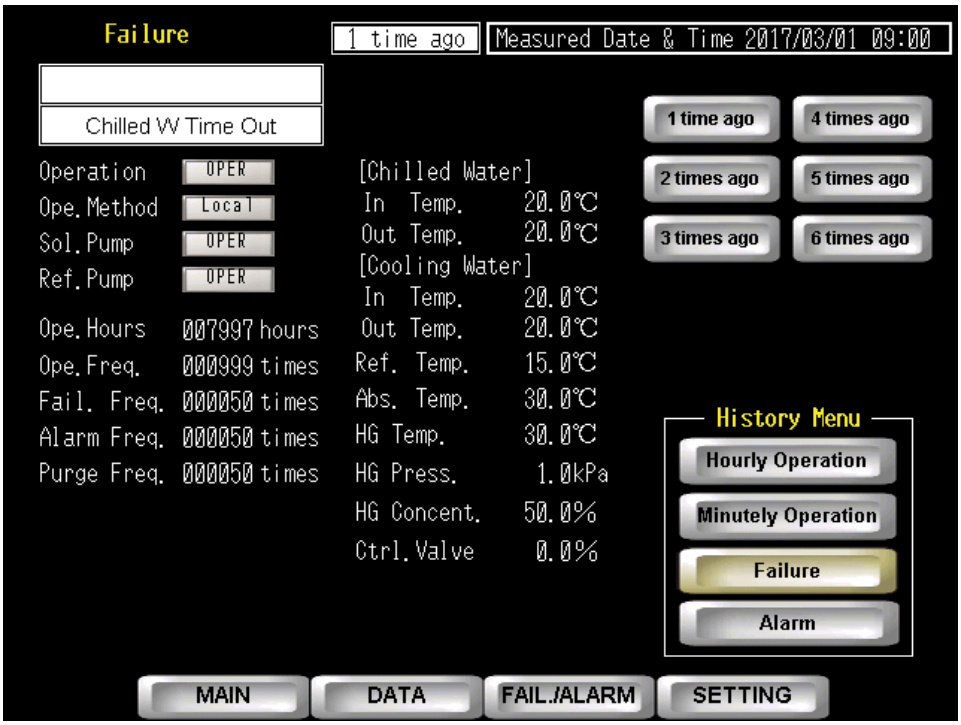
Minutely Operation: Press to view the Minutely Operation History screen.

Failure: Press this button to see the Failure History screen.

Alarm: Press to see the Alarm History screen.

To move to another screen, press the any of the available buttons along the bottom of the screen.

FAILURE HISTORY SCREEN



LD20076a

FIGURE 53 - FAILURE HISTORY SCREEN

You move to the Failure History screen after you press the **Failure** button in the History Menu screen section.

The Failure History screen shows failure information for the last failure and up to six previous failures. The Failure section contains the following fields of information:

Failure Name: name or type of failure.

Measured Date and Time: date and time of the failur.e

Operation: operation status of the chiller.

Ope. Method: selected operation method.

Sol. Pump: operation status of the solution pump.

Ref. Pump: operation status of the refrigerant pump.

Ope. Hours: total operation hours.

Ope. Freq.: how many times the chiller has started using the **OPER.** button or the remote start signal.

Fail. Freq.: how many times the chiller has had a failure alarm.

Alarm Freq.: how many times an alarm has been triggered for the chiller.

Purge Freq.: how many times a purge has been performed automatically.

The Chilled water section of the screen shows you the following information:

In Temp.: temperature of the chilled water measured as it enters the evaporator.

Out Temp.: temperature of the chilled water measured as it leaves the evaporator.

The Cooling Water section shows you:

In Temp.: temperature of the cooling water measured as it enters the absorber.

Out Temp.: temperature of the cooling water measured as it leaves the condenser.

Ref. Temp.: temperature of the refrigerant in the evaporator.

Abs. Temp.: temperature of the diluted solution in the absorber.

HG Temp.: temperature of the concentrated solution in the high temperature generator.

HG Press.: pressure in the high temperature generator.

HG Concent.: concentration of the concentrated solution in the high temperature generator.

Ctrl. Valve: percentage that the valve is open.

There are two sets of buttons on the right side of the screen. The first set gives you access to information about past occurrences. For instance, if you press the **3 times ago** button, you will see the settings as they appeared 3 events ago. You can see up to 6 past events.

The buttons in the History Menu section allow you to move between the various screens:

Hourly Operation: Press this button to access the Hourly Operation History screen.

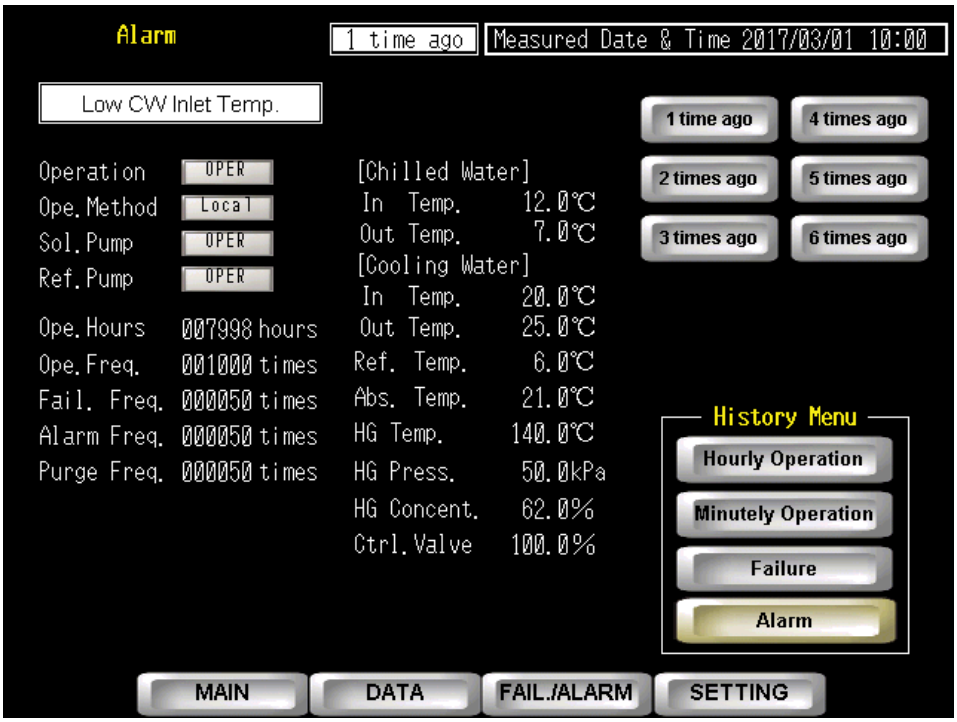
Minutely Operation: Press to view the Minutely Operation History screen.

Failure: Press this button to see the Failure History screen.

Alarm: Press to see the Alarm History screen.

To move to another screen, press the any of the available buttons along the bottom of the screen

ALARM HISTORY SCREEN



LD20081

FIGURE 54 - ALARM HISTORY SCREEN

View the Alarm History screen after you press the **Alarm** button in the History Menu section of the screen.

The Alarm History screen shows alarm information for the last alarm and up to six previous alarms. The alarm section contains the following fields of information:

Alarm Name: name or type of alarm.

Measured Date and Time: date and time of the alarm.

Operation: operation status of the chiller.

Ope. Method: selected operation method.

Sol. Pump: operation status of the solution pump.

Ref. Pump: operation status of the refrigerant pump.

Ope. Hours: total operation hours.

Ope. Freq.: how many times the chiller has started using the **OPER.** button or the remote start signal.

Fail. Freq.: how many times the chiller has had a failure alarm.

Alarm Freq.: how many times an alarm has been triggered for the chiller.

Purge Freq.: how many times a purge has been performed automatically.

The Chilled Water section of the screen shows you the following information:

In Temp.: temperature of the chilled water measured as it enters the evaporator.

Out Temp.: temperature of the chilled water measured as it leaves the evaporator.

The Cooling Water section shows you:

In Temp.: temperature of the cooling water measured as it enters the absorber.

Out Temp.: temperature of the cooling water measured as it leaves the condenser.

Ref. Temp.: temperature of the refrigerant in the evaporator.

Abs. Temp.: temperature of the diluted solution in the absorber.

HG Temp.: temperature of the concentrated solution in the high temperature generator.

HG Press.: pressure in the high temperature generator.

HG Concent.: concentration of the concentrated solution in the high temperature generator.

Ctrl. Valve: percentage that the valve is open.

There are two sets of buttons on the right side of the screen. The first set gives you access to information about past occurrences. For instance, if you press the **3 times ago** button, you will see the settings as they appeared 3 events ago. You can see up to 6 past events.

The buttons in the History Menu section allow you to move between the various screens:

Hourly Operation: Press this button to access the Hourly Operation History screen.

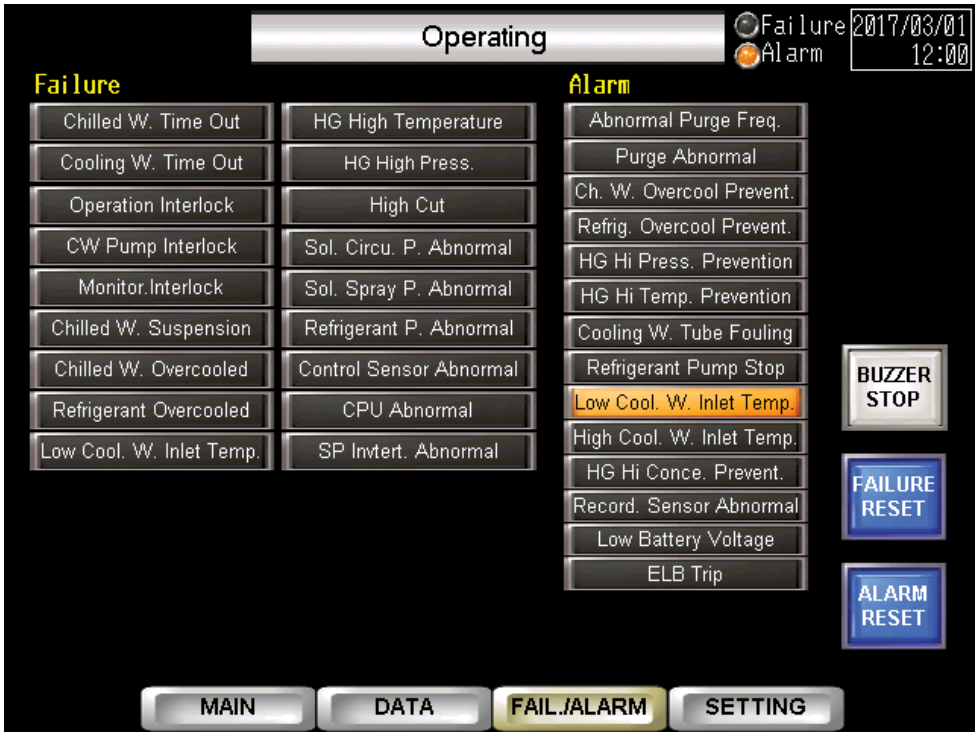
Minutely Operation: Press to view the Minutely Operation History screen.

Failure: Press this button to see the Failure History screen.

Alarm: Press to see the Alarm History screen.

To move to another screen, press the any of the available buttons along the bottom of the screen.

FAILURE AND ALARM SCREEN



LD19932

FIGURE 55 - FAILURE AND ALARM SCREEN

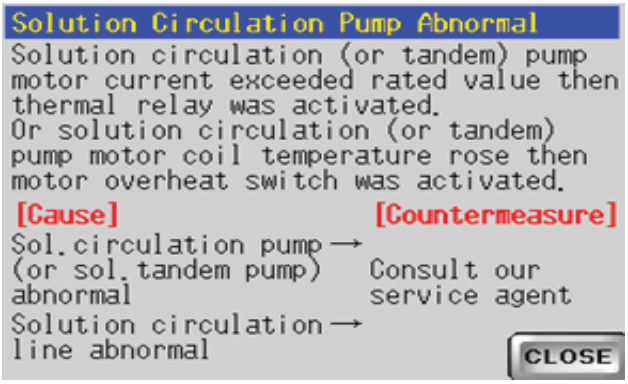
This screen displays failure indications (time-outs, operation interlock, overcooled refrigerant, over and under temperatures, and problems with the unit's pumps) and system alarms.

The failure light in the upper right corner is red. The alarm light is orange.

Failure

When a failure occurs, an alarm sounds (buzzer). The type of failure button lights in the Failure section of the screen. Press the **BUZZER STOP** button to turn off the alarm sound. This can be done even before the failure is addressed. Turning off the buzzer does NOT fix the problem.

Press the lit failure button to access an on-screen handling guide for each item. An on-screen guide is available for each item in the Failure and the Alarm sections. *See an example to the right.*



Press the **CLOSE** button to return to the Failure and Alarm screen.

After fixing the problem, press the **FAILURE RESET** button to reset the lighted failure button.

If you press the **FAILURE RESET** button before fixing the problem, the lighted failure button will not go out, and the buzzer will sound again.

The failures addressed in Failure section of this screen are:

TABLE 26 - FAILURE LIST

BUTTON LABEL (FAILURE NAME)	OPERATION AT FAILURE OCCURRENCE	CAUSE	COUNTER MEASURES
Chilled W. Time Out (Chilled Water Time Out)	Not start	Chilled water pump operation interlock and/or chilled water suspension relay was not established within a set time while start-up.	• Check the chilled water pump. • Check the chilled water line. • Check the chilled water flow. • Check the chilled water suspension relay. • Check whether or not the pipe is clogged.
Cooling W. Time Out (Cooling Water Time Out)		Cooling water pump operation interlock was not established within a set time while start-up.	
Operation Interlock	Stop after dilution	Operation interlock was not established during solution pump automatic operation.	Check interlocked equipment.
CW Pump Interlock (Cooling Water Pump Interlock)		Cooling water pump interlock was not established during cooling water pump operation command output.	Check the cooling water pump interlock.
Monitor Interlock (Constant Monitoring Interlock)		Constant monitoring interlock was not established.	• Check the components of the constant monitoring interlock. • If any of the components are not working, contact your local Johnson Controls Service Center.
Chilled W. Suspension (Chilled Water Suspension)	Stop without dilution	Chilled water flow was not detected continuously during solution pump automatic operation.	• Check the chilled water pump. • Check the chilled water line. • Check the chilled water flow. • Check the chilled water suspension relay. • Check whether or not the pipe is clogged.
Chilled W. Overcooled (Chilled Water Overcooled)		Chilled water outlet temperature was abnormally low during cooling operation.	• Check equipment in cooling load line. • Check the chilled water flow. • Check the chilled water flow control system. • Contact your local Johnson Controls Service Center.
Refrigerant Overcooled		Low refrigerant temperature during cooling operation, and then refrigerant overcool relay was activated.	• Check the chilled water line. • Check the chilled water flow. • Contact your local Johnson Controls Service Center.
Low Cool. W. Inlet Temp. (Low Cooling Water Inlet Temperature)	Stop after dilution	Cooling water inlet temperature had been kept at its lower limit or lower for 30 minutes or longer during cooling operation.	Check the cooling water inlet temperature control system.

TABLE 26 - FAILURE LIST (CONT'D)

BUTTON LABEL (FAILURE NAME)	OPERATION AT FAILURE OCCURRENCE	CAUSE	COUNTER MEASURES
HG High Temperature	Stop after dilution	HG solution temperature rose abnormally.	• Check the cooling water line. • Check the cooling water flow rate. • Check the cooling tower. • Purge manually (according to instructions in *SECTION 7 – MAINTENANCE)*
HG High Pressure		HG pressure rose abnormally.	
High Cut		HG high pressure relay was activated.	
Sol. Circu. P. Abnormal (Solution Circulation Pump Abnormal)	Stop without dilution	Solution circulation pump thermal relay, or overheat switch was activated.	Contact your local Johnson Controls Service Center.
Sol. Spray P. Abnormal (Solution Spray Pump Abnormal)		Solution spray pump thermal relay, or overheat switch was activated.	
Refrigerant P. Abnormal (Refrigerant Pump Abnormal)		Refrigerant pump thermal relay, or overheat switch was activated.	
Control Sensor Abnormal	Stop after dilution	Temperature sensor and/ or pressure sensor detected abnormal value due to disconnection, short circuit, or other applicable sensors.	• Tighten terminal in control panel. • Contact your local Johnson Controls Service Center.
CPU Abnormal		CPU was judged to be abnormal.	Contact your local Johnson Controls Service Center.
SP Invert. Abnormal (Solution Pump Inverter Abnormal)	Stop without dilution	The protection function of the solution pump inverter activated. Then, the inverter output stopped.	• Check the alarm code of the inverter. • Contact your local Johnson Controls Service Center.

Alarm

When an alarm occurs, the type of alarm will light up in the Alarm section of the screen. See *Figure 55 on page 126*. There is no buzzer.

Press the lit alarm button to access an on-screen handling guide for each item. An on-screen guide is available for every item in the Alarm section.

After fixing the alarm, press the **ALARM RESET** button to reset the lighted alarm button. If you press the **ALARM RESET** button before fixing the problem, the lit alarm button will not go out.

The alarms addressed in the Alarm section of the screen are:

TABLE 27 - ALARM LIST

BUTTON LABEL (ALARM NAME)	CAUSE OF ALARM AND CONDITION TO RESET	COUNTER MEASURES
Abnormal Purge Freq. (Abnormal Purge Frequency)	• Purge frequency within a set time exceeded its defined value, therefore chiller is suspected of poor air-tightness, , or other air leakages. • Press the **ALARM RESET** button to clear the alarm.	• Purge manually (according to instructions in *SECTION 7 – MAINTENANCE).* • Contact your local Johnson Controls Service Center.
Purge Abnormal (Purge System Abnormal)	• Purge switch was not turned OFF while automatic purge operation. • Press the **ALARM RESET** button to clear the alarm.	
Ch. W. Overcool Prevent. (Chilled Water Overcool Prevention Control)	Low chilled water outlet temperature during dilution operation. The dilution operation was interrupted (cooling water pump, solution pump, and refrigerant pump operations were suspended). The dilution operation resumes if the chilled water outlet temperature rises.	• Check the equipment in cooling load line. • Check the chilled water flow. • Check the chilled water flow control system.
Refrig. Overcool Prevent. (Refrigerant Overcool Prevention Control)	Low refrigerant temperature during dilution operation. The dilution operation was interrupted (cooling water pump, solution pump, and refrigerant pump operations were suspended). The dilution operation resumes if refrigerant temperature rises.	
HG Hi Press. Prevention (HG High Pressure Prevention Control)	HG pressure rose and the load limit operation was activated. The alarm resets if the HG pressure falls.	• Check the cooling water line. • Check the cooling water flow rate. • Check the cooling tower. • Purge manually (according to instructions in *SECTION 7 – MAINTENANCE*). • Contact your local Johnson Controls Service Center.
HG Hi Temp. Prevention (HG High Temperature Prevention Control)	High generator solution temperature and load limit operation was activated. The alarm resets if the HG temperature falls.	
Cooling W. Tube Fouling (Cooling Water Tube Fouling)	• Temperature difference between the absorber temperature and cooling water inlet temperature widened. Fouling of cooling water tube inside is likely to be accumulated. • Press the **ALARM RESET** button to clear the alarm.	• Check the cooling water line. • Check the cooling water flow.
Refrigerant Pump Stop (Refrigerant Pump Stop Time Out)	The Refrigerant Pump **Stop** button was pressed. The refrigerant pump has been off for 1 hour or more..	Press the Refrigerant Pump **Auto** button.
Low Cool W. Inlet Temp. (Low Cooling Water Inlet Temperature)	Cooling water inlet temperature fell down to its lower limit or lower during cooling operation, and then load limit operation was activated. The alarm resets if the cooling water inlet temperature rises.	Check the cooling water inlet temperature control system.

TABLE 25 - ALARM LIST (CONT'D)

BUTTON LABEL (ALARM NAME)	CAUSE OF ALARM AND CONDITION TO RESET	COUNTER MEASURES
High Cool. W. Inlet Temp (High Cooling Water Inlet Temperature)	Cooling water inlet temperature rose to or above it's upper limit or higher during cooling operation, and the load limit operation was activated. The alarm resets if the cooling water inlet temperature falls.	• Check the cooling water inlet temperature control system. • Check the cooling tower.
HG Hi Conce. Prevent. (HG High Concentration Prevention Control)	High solution concentration and load limit operation was activated. The alarm resets after 600 seconds.	• Check the cooling water line. • Check the cooling water flow rate. • Check the cooling tower. • Purge manually (according to instructions in *SECTION 7 – MAINTENANCE*). • Contact your local Johnson Controls Service Center.
Recording Sensor Abnormal	• Chilled water inlet temperature sensor, cooling water inlet temperature sensor, and/or absorber temperature sensor detected abnormal value, due to disconnection, short circuit, or other abnormal sensor readings. Remote setting signal was abnormal during remote SP mode (remote chilled water outlet temperature setting mode) • Press the **ALARM RESET** button to clear the alarm.	• Check the remote setting signal. • Tighten the terminal. • Contact your local Johnson Controls Service Center.
Low Battery Voltage	• Voltage level of the battery in the control board fell down. • Press the **ALARM RESET** button to clear the alarm after you replace the battery in the control board.	Replace the battery on the PWB.
ELB Trip (Earth Leakage Breaker Trip)	The Earth leakage breaker for the surge arrester activated.	Contact your local Johnson Controls Service Center.

SETTING SCREEN

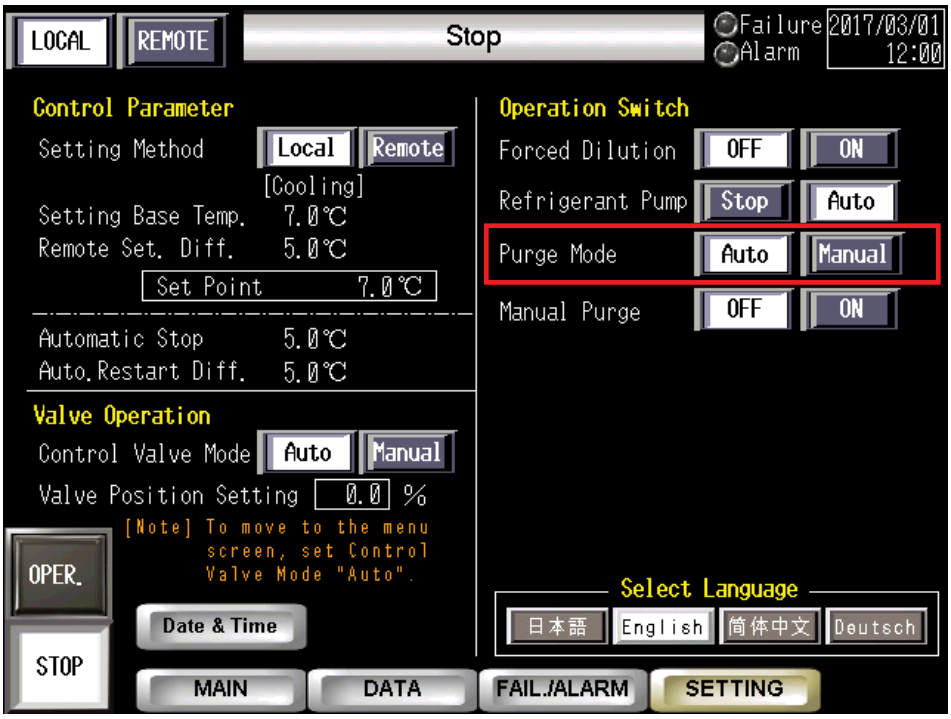


FIGURE 56 - SETTING SCREEN

This screen displays control parameters (setting method and each setting parameter), valve operation (control valve mode auto / manual and valve position setting), operation switch (forced dilution, refrigerant pump, purge mode, and manual purge), language (Japanese, English, German, Chinese, and Deutsche) and date and time parameters.

Press the **SETTING** button to access this screen.

Control Parameter

The Control Parameter section of the Setting screen is used to enter parameters for the cooling operation, such as target temperature, automatic stop temperature, and differential to automatic restart.

Setting Method: The **LOCAL** and **REMOTE** buttons control whether the set point is being set using the Control Panel or from a remote location. The button that is lit indicates if the set point is being set using the Control Panel or from a remote location

Setting Base Temp.: the base temperature for calculating the set point

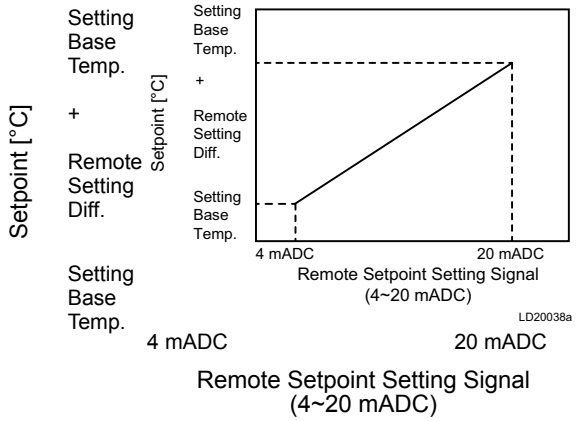
Remote Set. Diff.: the setting range with external 4-20 mADC signal

Set Point (Display): the set point of the chilled water leaving temperature

Automatic Stop: the temperature at which the chiller will automatically stop

Auto. Restart Diff.: temperature difference between the temperature at which the chiller will automatically stop and the temperature at which the chiller will automatically restart.

If you press the **LOCAL** button, the entered base temperature corresponds to the present target temperature. This temperature is shown in the Set Point field.



If you press the **REMOTE** button, the setting characteristics of the remote set point are determined based on the setting base temperature and the remote setting differential. The actual target temperature is calculated depending on these settings and the remote Set Point setting signal (4-20 mADC).

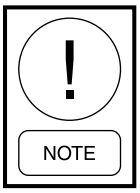
This calculated temperature is shown in Set Point as the present target temperature. If remote set point setting signal (4-20 mADC) is out of its range when you press the **REMOTE** button, the **Recording Sensor Abnormal Alarm** button lights. The target temperature changes to the Local setting.

If a failure occurs, you automatically see the Failure Alarm screen.

For detailed information on how to change an entry in one of these fields, see *Change Numeric Values on page 110.*

Valve Operation

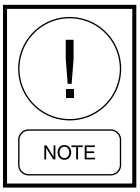
Control Valve Mode: the **Auto** and **Manual** buttons indicate whether the control valve is being operated automatically or manually. To change to manual operation mode, press and hold the **Manual** button for 3 seconds.



The Valve Position Setting may be changed ONLY when the Control Valve Mode Manual button is pushed.

Valve Position Setting: Shows the Steam Control Valve Position Setting, expressed as a percentage.

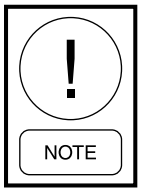
For detailed information on how to change the valve position settings, see *Change Numeric Values on page 110.*



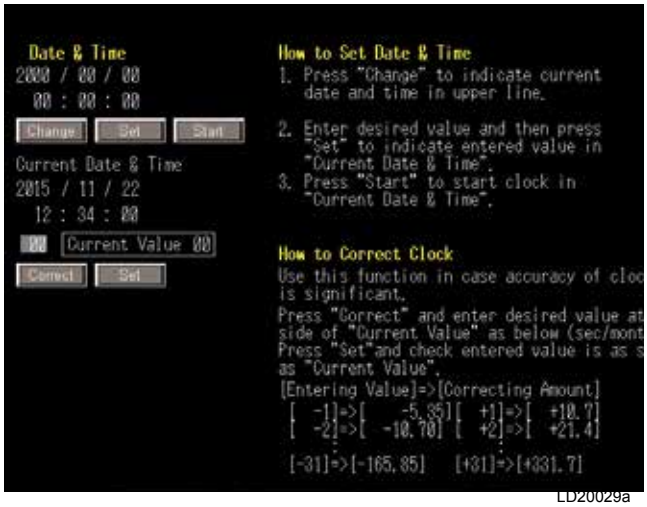
To move to the Menu screen, press the Control Valve Mode Auto button.

DATE AND TIME

To set the date and time, press the **Date and Time** button above the **MAIN** button. The Date and Time screen displays. Use the following procedure.



The date information format to use is: YYYY / MM / DD.



LD20029a

1. Press the **Change** button.
2. Enter the correct date and time.
3. Press the **Set** button to set the time.
4. Press the **Start** button to restart the clock.

If the clock is not keeping the correct time, use the following to fix it:

1. Press the **Correct** button to specify a correcting amount (+ or -).
2. Press the **Set** button to update the time.

Operation Switch

In this screen section, choices can be made about the mode of operation for the various devices. Use the buttons to make your choice. The choices are:

- **Forced Dilution:** indicates whether forced dilution is ON or OFF.
- **Refrigerant Pump:** indicates whether the refrigerant pump is operating automatically (Auto mode) or is stopped (Stop mode)
- **Purge Mode:** The **Auto** and **Manual** buttons control the purge operation. The lit button indicates if the purge mode is Automatic or Manual.
- **Manual Purge:** The **ON** and **OFF** buttons control the manual purge operation. The lit button tells you if the manual purge operation is running or not. If you press the Purge Mode **Auto** button, the purge is done automatically. If you press the Purge Mode **Manual** button, the purge starts when you press the Manual Purge **ON** button. The purge stops when you press the Manual Purge **OFF** button.

Any of the these may be changed.

SELECT LANGUAGE

Press the button to choose the language to display the desired language in the Control Center. Various languages are available.

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 7 – MAINTENANCE

When inspecting and maintaining the absorption chiller, observe the following items:

- Never splash water over the electrical parts installed to the control panel and absorption chiller.
- Do not change the set values of the control devices and safety switches without permission.
- Do not turn the internal cycle control valve of the absorption chiller without permission.
- When replacing the oil in the vacuum pump, be sure to turn OFF the main circuit breaker (MCB1) in the control panel.

VALVE INSPECTION

The chiller is equipped with a refrigerant manual blow valve (V8) that blows refrigerant from the refrigerant tank directly into the absorber (see *Figure 57 on page 137* and *Figure 29 on page 78*).

The valve must not be tampered with or settings altered, except for daily maintenance and inspection.

During service and maintenance work, be sure to turn OFF the main circuit breaker (MCB1) and fully close the main valve of steam line. If not, it may cause electric shock and burn.

Contact your local Johnson Controls Service Office for inspection and maintenance of the machine. Improper inspection and maintenance can cause a chiller malfunction or injury.

SOLENOID VALVES

The absorption chiller is equipped with the following solenoid valves.

TABLE 28 - SOLENOID VALVES

SOLENOID VALVE NAME	SYMBOL	FUNCTION
Purge solenoid valve (1)	SV1	Close vacuum pump piping
Purge solenoid valve (2)	SV2	
Refrigerant blow solenoid valve	SV3	Close automatic refrigerant blow piping

PUMP SHUT OFF VALVES

The chiller is equipped with the pump shut off valves shown in *Figure 57 on page 137*. They are used for inspection of the pumps.

If the absorption chiller is operated with incorrect valve settings, the pump may be damaged. Do NOT tamper with the valves.

AIR PURGING VALVES AND DRAINING VALVES

The chiller is equipped with air purge valves and drain valves for chilled water, and cooling water. It is equipped with a drain valve for the steam condensate (drain). They are used to drain the chilled water, cooling water, steam condensate (drain), and purge air when water is supplied.

PURGING VALVES

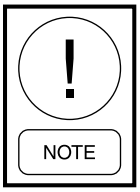
The chiller is equipped with the purging valves shown in *Figure 57 on page 137*. For operation of those valves, see *Purge Procedure on page 136*.

START THE CHILLER AFTER IT HAS BEEN STOPPED FOR A LONG PERIOD

When you start the chiller after it has not run for more than 15 days, use the procedure below:

Checks Before Operation Starts

1. Check the insulation of the Control Center and electric system.
2. Check the operation of the Control Center and safety devices.
3. Check that the refrigerant blow valves V8 are fully closed.
4. Check the vacuum level in the machine. Use the pressure gauge of the high temperature generator.



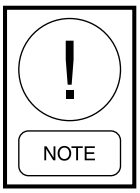
It should be less than -0.1 MPaG.

5. Check the steam supply.
6. Press the Refrigerant Pump **Stop** button.

If the checks validate, start the chiller.

Checks After Operation Starts

1. 10-15 minutes after the chiller and the solution pump start, check the level gauge of the refrigerant tank.
2. If the refrigerant level is within the level gauge, press the Refrigerant Pump **Auto** button.
3. Observe the operation for several minutes. Check that the refrigerant liquid level does not drop.
4. Use the procedure shown in *Purge Procedure on page 136* to purge air from the low pressure side (absorber).



Remember: Only deionized water may be used as the refrigerant in the chiller.

PURGE PROCEDURE

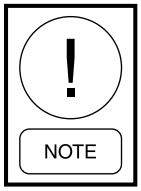
Air must be purged from the chiller to maintain peak performance and prevent deterioration of the internal parts. This chiller has an automatic purge system.

Even if the automatic purge mode is used during normal operation, perform the manual operation for the purging tank and absorber periodically. For the purging period, see *Table 29 on page 143*.

CAPACITY CHECK METHOD OF VACUUM PUMP

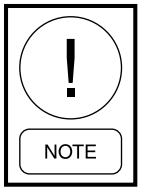
For commissioning and regular maintenance, check the capacity of the vacuum pump first according to the following procedure.

1. Check the oil level in the vacuum pump.
2. If the oil is cloudy, it contains water and must be replaced with new oil.



See the Operation Manual for the Vacuum Pump for more information on how to change the oil.

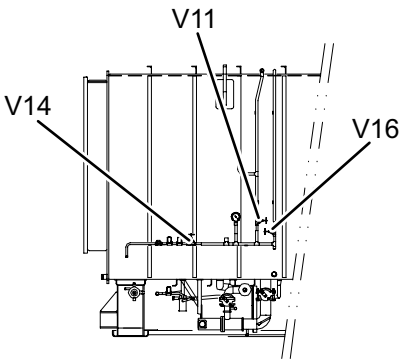
3. Open the gas ballast (remove the plug).



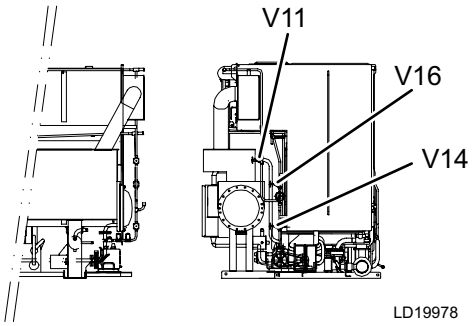
If the purge unit is operated with the gas ballast closed, water is left in the oil. The oil will need to be replaced approximately every 6 months.

4. Set the valves according to pattern A. See *Figure 57 on page 137*.
5. Press the Purge Mode **MANUAL** button.
6. Press the Manual Purge **ON** button. The vacuum pump starts. The solenoid valves SV1 and SV2 open.
7. 1-2 minutes after the vacuum pump starts, confirm that the vacuum gauge stands at 0-~1 kPa. abs.
8. Press the Manual Purge **OFF** button. The vacuum pump stops.
9. Wait for 30 minutes.
10. Confirm that the vacuum down is within 2 kPa.

YHAU-CW(L) 400-2000EX(W)(4)(S)P



YHAU-CW(L)150-300EX(S)P



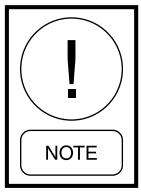
V11	Purging operating valve for purge tank line
V14	Purge main valve
V16	Purging operating valve for absorber line

FIGURE 57 - LOCATION OF MANUAL VALVE IN PURGING SYSTEM

MANUAL METHOD TO PURGE NON-CONDENSABLE GAS DIRECTLY FROM ABSORBER WITH VACUUM PUMP

When the chiller operates at a lower capacity than usual for a long period of time or when it restarts after a power failure, the absorber may contain non-condensable gases. If the machine starts under these conditions, its performance and efficiency decrease. If this happens, manually purge non-condensable gas directly from the absorber according to the following procedure:

1. Set the valves according to pattern B. See *Figure 57 on page 137*.
2. Press the Purge Mode **MANUAL** button.
3. Press the Manual Purge **ON** button. The vacuum pump starts. The solenoid valves SV1 and SV2 open.
4. After step 3 begins, confirm that vacuum gauge stands at 0-~1 kPa.abs.
5. Reading the vacuum gauge, open valve V13.
6. Then, open valve V16 gradually. Confirm that the pressure on the vacuum gauge increases slightly.



If the pressure decreases when valve V16 opens, the vacuum pump capacity is too small. Close valve V16 at once. See *Table 43 on page 164* ***and check the purge line***

7. If no problems are found, open valve V16 completely.

Make sure the valve is completely open.

8. Continue to purge for 2 to 3 hours.
9. Close valves V13 and V16.
10. Press the Manual Purge **OFF** button. The vacuum pump stops.

For information on how to set up an automatic purge, see *Automatic Method to Purge Non-condensable Gas from Purging Tank on page 138* .

MANUAL METHOD TO PURGE NON-CONDENSABLE GAS FROM PURGING TANK WITH VACUUM PUMP

While the absorption chiller operates, non-condensable gas collects in the purging tank. You can purge those gases manually using the following procedure.

1. Set the valves according to pattern C see *Figure 57 on page 137*.
2. Press the Purge Mode **Manual** button.
3. Press the Manual Purge **ON** button. The vacuum pump starts. The solenoid valves SV1 and SV2 open.
4. 3-4 minutes after the vacuum pump starts, confirm that the vacuum gauge stands at 0-~1 kPa. abs.
5. Verify that valve V10 is open.
6. Reading the vacuum gauge, gradually open valve V11.
7. The manual purge procedure is complete when the pressure reaches 3 kPa.abs or less on the vacuum gauge.
8. Close valve V11.
9. Press the Purge Pump **OFF** button. The vacuum pump stops.

For information on how to set up an automatic purge, see *Automatic Method to Purge Non-condensable Gas from Purging Tank on page 138.*

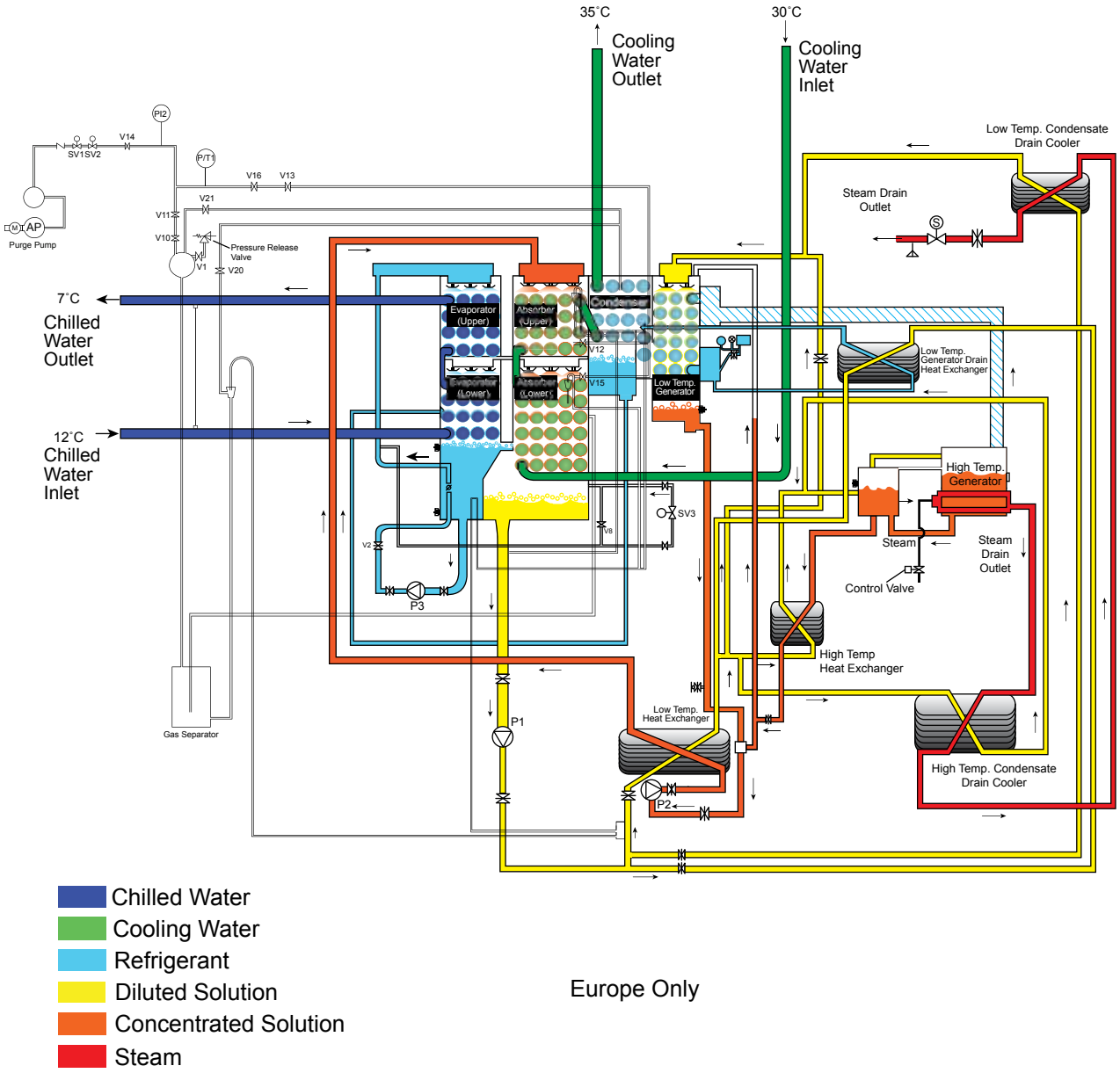
AUTOMATIC METHOD TO PURGE NON-CONDENSABLE GAS FROM PURGING TANK

This chiller has an automatic purge system. The vacuum pump starts and stops by detecting the pressure inside the purge tank.

1. Set the valves in accordance with purge pattern D shown in *Figure 57 on page 137*.
2. Press the Manual Purge **OFF** button.
3. Press the Purge Mode **AUTO** button.
4. The purge solenoid valves automatically open and close.

During the automatic purge operation, the vacuum pump starts when the purging tank pressure increases to 7 kPa abs and stops when it decreases to 3 kPa abs.

When you replace the oil in the vacuum pump or belt or perform maintenance work while the absorption chiller is running, be sure to turn off the circuit breaker of the vacuum pump in the control panel. If not, the vacuum pump could start abruptly and cause injury.



PURGING PATTERN	USE	OPERATION	VALVE OPERATION/LOCATION				
			V10	V11	V14	V13	V16
A	Check capacity of vacuum pump	–	×	×	◯	×	×
B	Direct purging from absorber	Preparation	×	×	◯	◯	×
		Starting purging	×	×	◯	◯	◯
C	Manual purging from purging tank	Preparation	◯	×	◯	×	×
		Starting purging	◯	◯	◯	×	×
D	Automatic purge of the purging tank		◯	◯	◯	×	×

◯: Open valve. X: Closed valve.

FIGURE 58 - LTC REFRIGERANT CONDENSATE HEAT EXCHANGER

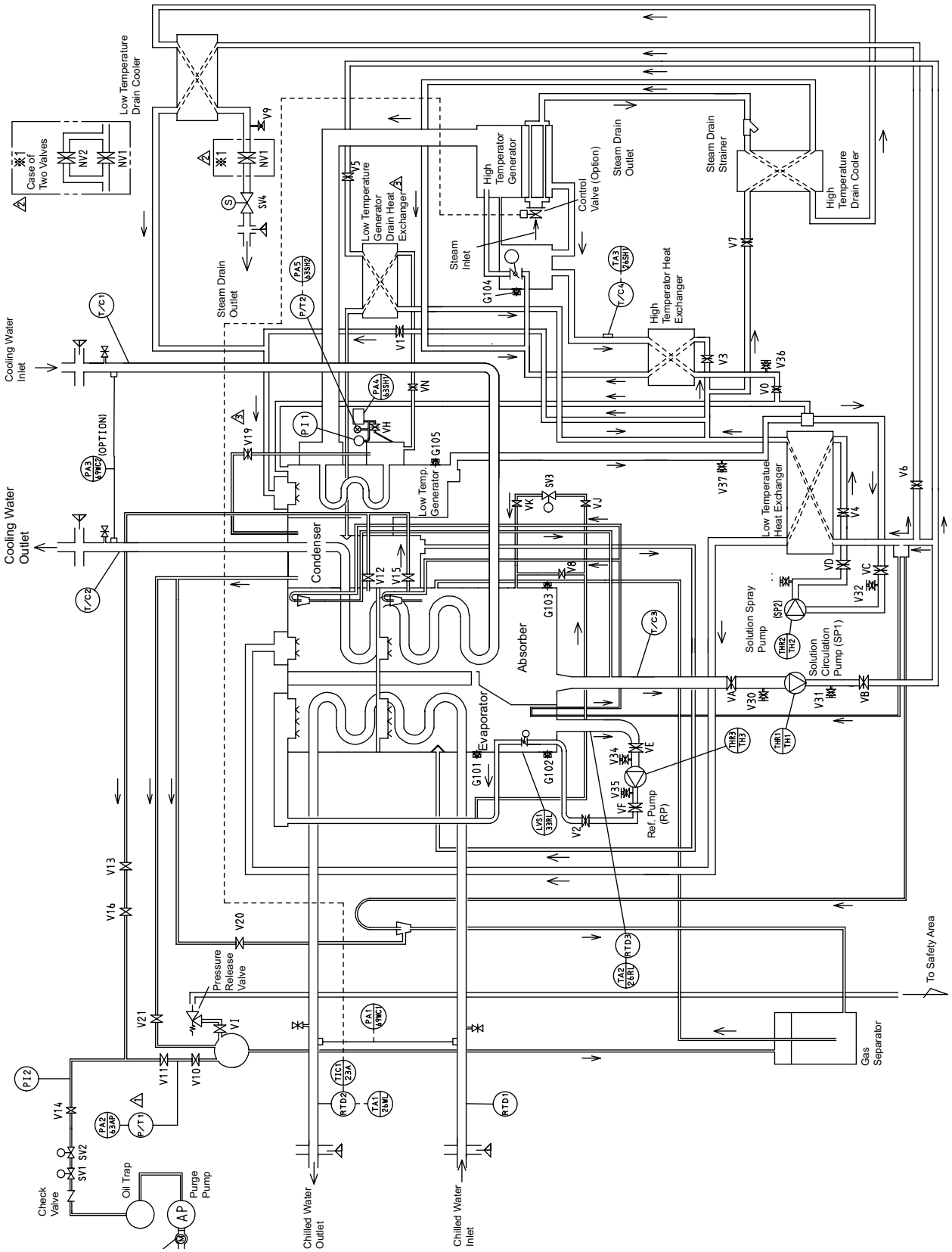


FIGURE 59 - PROCESS AND INSTRUMENTATION DIAGRAM

REFRIGERANT REFINING METHOD

With an increase in the operation time of the chiller, some of the solution can mix in with the refrigerant. Mixing the solution and the refrigerant lowers the refrigerating capacity. To prevent this, the refrigerant must be refined periodically.

Refine the refrigerant according to the following procedure. The chiller must be operating to refine refrigerant.

NOTE

Remember: Only deionized water may be used as the refrigerant in the chiller!

When refining refrigerant, operate the absorption chiller under a low load (50% or less) for higher refining efficiency. Note that the refrigerating capacity is dramatically reduced during the refrigerant refining operation.

1. Remove the cap of the refrigerant manual blow valve.

NOTE

For the location of the refrigerant manual blow valve, see *Figure 57 on page 137****.***

2. Turn the spindle in the valve to the left using an 8 mm hexagon wrench to start refining the refrigerant.
3. After the refining process is complete, close the spindle in the valve (turn it to the right until it stops).
4. Return the valve cap. There is an O-ring between the cap and valve. When fitting the cap, make sure that the O-ring is set normally.

NOTE

The time required for refinement of the refrigerant depends on the current load condition. Constantly check the liquid level in the refrigerant tank while the refrigerant is refined. If the refrigerant liquid level appears in the level gauge of the refrigerant tank, close the valve immediately and fully.

MANUAL REFRIGERANT BLOW DOWN AND DILUTING METHOD

When the chiller stops suddenly due to a power failure, the solution can become crystallized. If this happens, dilute the solution manually according to the following procedure.

NOTE

Perform the following procedure immediately after the power is restored.

1. Press the Forced Dilution **ON** button. The solution pump and the refrigerant pump start.
2. Remove the cap of the refrigerant manual blow valve.

NOTE

For the location of the refrigerant manual blow valve, see *Figure 57 on page 137****.***

3. Turn the spindle in the valve to the left with the 8 mm hexagon wrench. The refrigerant in the refrigerant tank is diverted into the absorber.
4. Watch the liquid level of the refrigerant tank. Immediately after the refrigerant liquid level appears in the level gauge of the refrigerant tank, close the valve (turn it to the right until it stops).
5. Press the Refrigerant Pump **Stop** button. The refrigerant pump stops.
6. Let the solution pump operate independently for 30 minutes.
7. Press the Forced Dilution **OFF** button to stop the solution pump.
8. Press the Refrigerant Pump **Auto** button.
9. Return the valve cap. There is an O-ring between the cap and valve. When fitting the cap, make sure that the O-ring is set normally.

DECRYSTALLIZATION METHOD

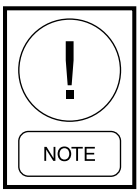
Even if the solution in the absorption chiller is crystallized during operation, it can be melted if the crystallization is not severe. Since it becomes more difficult to melt the crystals as time passes, perform the following operation immediately when crystallization is detected. If the crystals cannot be melted by the following procedure, notify your local Johnson Controls Service Center immediately.

Indications of Crystallization

- The refrigerating capacity goes down. The liquid level in the absorber drops. Cavitation noise comes out of the solution pump.
- One of the following buttons is lit and the solution pump trips:
  - **Sol. Circu. P. Abnormal**
  - **Sol. Spray P Abnormal**
- The solution level can be seen through the level gauges on the high temperature generator level gauges (G104).
- The liquid level in the absorber drops. The temperature of the solution returning from the generator also falls.

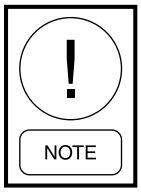
Decrystallization

1. Stop the chiller. If the solution pump tripped, reset the thermal relay.
2. Disconnect the electrical wiring of the solution pump.
3. Navigate to the Setting screen on the Control Panel.
4. Press the Forced Dilution **ON** button.



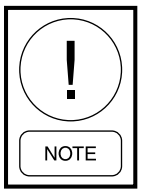
Since the electrical wiring of the solution pump is disconnected, only the refrigerant pump starts.

5. Remove the cap of the refrigerant manual blow-down valve.



For the location of the refrigerant manual blow valve, see *Figure 57 on page 137****.***

6. Turn the spindle in the valve to the left with the 8 mm hexagon wrench.



The refrigerant in the refrigerant tank diverts into the absorber.

7. Watch the liquid level of the refrigerant tank.
8. Immediately after the refrigerant liquid level appears in the level gauge of the refrigerant tank, close the refrigerant manual blow-down valve (turn it to the right until it stops).
9. Press the Refrigerant Pump **Stop** button. The refrigerant pump stops.
10. Press the Forced Dilution **OFF** button.
11. Re-connect the electrical wiring of the solution pump.
12. Press the Forced Dilution **ON** button. The solution pump starts.
13. Press the Control Valve Mode **Manual** button.
14. Set the Valve Position Setting to 30-40%. For detailed information on how to change the setting, see *Change Numeric Values on page 110* .
15. Observe the liquid level in the absorber.
16. When the liquid level in the absorber drops, press the Forced Dilution **OFF** button.
17. Repeat steps 12 through 16 three - four times. If the liquid level in the absorber does not go down, the crystals have melted.
18. Let the solution pump operate independently for about 30 minutes. Constantly observe the liquid level in the absorber while the solution pump operates.

19. After about 30 minutes, stop the solution pump.
20. Press the Refrigerant Pump **Auto** button.
21. Return the valve cap. There is an O-ring between the cap and valve. When fitting the cap, make sure that the O-ring is set normally.

Precautions for De-crystallization

- Cycle the chilled and cooling water pumps off and on during the melting process.
- Remove any sensors that are sensitive to heat before you start the melting operation. The temperature of the chilled and cooling water that remains in the absorption chiller may rise to about 70°C.
- When you start the chiller after melting the crystals, discharge the chilled and cooling water first. If that water is left in the machine, the paint on the inside walls may deteriorate.

MAINTENANCE ITEMS

Maintenance and inspection items along with standard inspection periods are shown in the next table. For details, contact your local Johnson Controls Service Center.

Inspection frequency may be adjusted according to the actual operating conditions.

TABLE 29 - MAINTENANCE AND INSPECTION

TASK	CONTENTS	FREQUENCY	SCOPE
Recording of operation data	Collect the operation data (Refer to *155.31-CL1*) and check the data with the data collected during the factory test.	Weekly	C
Check the steam control valve	Check to see that the steam control valve operates smoothly.		C
Check of liquid level	See *Table 44 on page 164*. Check the liquid level at each part.	Daily	C
Refine refrigerant	See *Refrigerant Refining Method on page 141*. Refine the refrigerant.	Every 2-3 weeks	S
Manual purging from purging tank	See *Purge Procedure on page 136* . Manually purge non-condensable gas from the purging tank.	Since, the chiller has an automatic purge system, perform the purge once at beginning of the seasons every year.	S
Manual purging from absorber	See *Purge Procedure on page 136* . Manually purge non-condensable gas from the absorber.	Every 2-3 months	S
Replacement of oil in vacuum pump	Replace the oil in the vacuum pump.	Monthly	C
Check of Vacuum Pump	After replacing the lubricant oil for the vacuum pump, be sure to pull the pulley belt and check the smooth motion of the pulley.		C
Appearance check	Check the outside of the machine for damage (e.g., leakage for chilled water and cooling water, rusting, and other evident deterioration of the chiller). Check the solution pump and refrigerant pump for abnormal sounds and vibration.		C

C = Customer, S = Johnson Controls Service

TABLE 27 - MAINTENANCE AND INSPECTION (CONT'D)

TASK	CONTENTS	FREQUENCY	SCOPE
Measurement of insulation resistance of electric devices	Measure the insulation resistance of the main circuit and motors (solution pump, refrigerant pump) mainly to check for lowering of insulation. When measuring the insulation resistance, be sure to disconnect the wires of the temperature controller, and other related controls.	Yearly	S
Check of terminals for looseness	Check each terminal in the control panel for looseness.		S
Check of operation of control panel	Check the operation of the control panel to prevent troubles caused by malfunction of the control panel.		S
Check capacity of purge unit	See *Purge Procedure on page 136*. Check the capacity of the purge unit.	Monthly	S
Check of leakage through purge solenoid valves	By measuring vacuum down speed, check for leakage through purge solenoid valves.	Yearly	S
Overhaul check of purge solenoid valves	Perform overhaul of purge solenoid valves.		S
Check of airtightness	Measure the quantity of non-condensable gas discharged from the vacuum pump.	Every 2-3 months	S
Check continuity of protective bonding circuit	Check continuity of protective bonding circuit.	Yearly	S
Analysis of quality of chilled water, cooling water, and steam drain	Reliable water treatment companies are available in most larger cities to supply a water treating process which will greatly reduce the corrosive and scale forming properties of almost any type of water. Be sure to request the first analysis within one month after the test operation is started.	Every 2-3 months	C
Check of quantity of solution and refrigerant	The solution is not consumed, but the refrigerant is discharged little by little each time purging is performed. If the quantity of the refrigerant becomes insufficient, the condensation preventive function does not work normally. Accordingly, check the quantity of the refrigerant.	Yearly (during operation at 100%)	S
Disassembly inspection and cleaning of solution pump and refrigerant pump	Sleeve bearings are used for the solution pump and refrigerant pump, and they are normally lubricated with water solution of lithium bromide and refrigerant. Since excessive wear can cause a pump problem, disassemble and inspect the bearings. The internal strainer must also be cleaned.	2-3 years or 10,000 hrs	S
Disassembly inspection and cleaning of vacuum pump	Disassemble, inspect, and clean the vacuum pump to maintain its capacity.	4 years	S
Replacement of gaskets of airtight parts	Replace the gaskets of the airtight parts to maintain the airtightness of the absorption chiller.	4 years	S
Inspection of chilled water box and replacement of packing	Open the waterbox cover, check the inside paint for damage, and check the inside of the tubes for scales.	Every 2 years	S
Inspection of cooling waterbox and replacement of gasket		Every 1 year	S
Inspection of the steam box and replacement of gasket	• Open the steam box. • Check the tube plate and the expanded sections of the tubes for abnormal thinning.	Every 3 years	S

C = Customer, S = Johnson Controls Service

TABLE 27 - MAINTENANCE AND INSPECTION (CONT'D)

TASK	CONTENTS	FREQUENCY	SCOPE
Repair of paint (tar epoxy paint) of inside wall of chilled water and cooling waterboxes	Repair the paint of the inside wall.	Chilled water: 2 years Cooling water: \1 year	S
Analysis of solution and addition of inhibitor	The concentration of the inhibitor must be kept proper to prevent corrosion of inside parts. Analyze the solution to detect leakage in the early stage of running the machine	Every 6 months	S
Filtration and refining of solution	As the inside of the chiller is corroded, corrosion particles are increased. Particles accumulated on the heat exchange tube surfaces lower the heat exchange rate, that is, the performance. Accordingly, filter the solution.	5-6 years	S
Check of operation of various safety relays	Check the operation of the safety relays.	Yearly	S
Cleaning of tubes with brush or water jet (Absorber, condenser)	If foreign matter sticks to the inside of the tubes of the chiller, refrigerating performance is lowered and the tubes become corroded. Accordingly, remove slime, soft scales, and other foreign matter from the inside of the tubes.		S
Cleaning of tubes with brush or water jet (Evaporator)		Every 2 years*	S
Cleaning of tubes with brush or water jet (High temperature generator)		Every 4 years	S
Chemical cleaning of tubes (Absorber, condenser)	Since hard scales sticking to the tubes cannot be removed with a brush or water jet, remove them chemically, depending on the condition.		S
Chemical cleaning of tubes (Evaporator)		Every 4 years*	S
Chemical cleaning of tubes (High temperature generator)		Every 8 years*	S
Check for slight leakage	Vacuum and airtightness must be maintained to ensure the reliability and performance of the absorption chiller. Accordingly, recommend that the machine should be checked for slight leakage with a special vacuum and airtightness diagnostic device.	Every 2 years	S
Eddy current test on tubes (Absorber, condenser)	Check the inside of the tubes for corrosion caused by bad quality chilled water, and cooling water.	Every 4 years	S
Eddy current test on tubes (Evaporator)		Every 6 years	S
Eddy current test on tubes (High temperature generator)	Check the inside of the tubes for corrosion caused by bad quality steam.	Every 4 years or 10,000 hours	S
Check of steam control valve seat	Check the steam control valve seat for leakage while the chiller is stopping.	Yearly	S
Check of the steam control valve regulator filter (pneumatic type steam control valve only)	Check the air filter of the steam control valve regulator for clogging.	Yearly	S

C = Customer, S = Johnson Controls Service

NOTE: *If water quality analysis indicates necessity.

Refrigerant Pump Manual Stop

The refrigerant pump can be stopped manually for maintenance purposes. It can be stopped even while the chiller operates.

1. Navigate to the Control Panel Setting screen.
2. Press the Refrigerant Pump **Stop** button.

NOTE

After maintenance of the Refrigerant Pump is complete, be sure to reset the pump to Auto. Continued operation in stop state may cause damage to and failure of the chiller.

Purge Manual Start and Stop

The purge can be started or stopped manually.

1. Navigate to the Control Panel Setting screen.

2. Press the Purge Mode **Manual** button.
3. Press the Manual Purge **ON** button.

The purge solenoid valves open. The purge operation begins.

4. Press the Manual Purge **OFF** button when the purge process is complete.
5. The solenoid valves close.

NOTE

After maintenance of the purge system is complete, be sure to reset the purge valve to Auto. Continued operation in stop state may cause damage to and failure of the chiller.

6. Press the Purge Mode **Auto** button.

LIFESPAN FOR VARIOUS PARTS

The replacement periods for some parts are shown in the next table. The following life spans are shown for reference only. (The replacement period may be changed according to the actual environment, frequency of use, or other contributing factors.) Other parts may need to be replaced if used incorrectly.

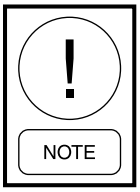
TABLE 30 - LIFESPAN OF COMMON PARTS

DESCRIPTION	APPLICABLE MODELS OR SECTIONS	LIFESPAN OF COMMON PARTS
Gasket	CHW Water Box	Every 2 years
Gasket	CW Water Box	Every 1 year
Gasket, O-Ring, Diaphragm		Every 24,000/Hr
Evaporator Tube		About 15 years Depends on the eddy current result at interval 24 - 36 KHr.
Absorber Tube		
Condenser Tube		
HT-G Tube		
LTG Tube		About 15 years
Gasket	HT-G Channel Box	Every 2 years
Main Circuit Board		Every 30,000/Hr
Relay	MY-2N, MY-4N	Every 30,000/Hr
Timer	H3Y-2	Every 30,000/Hr
Fuse		Every 30,000/Hr
Power Unit	RWS series	Every 30,000/Hr
Magnet Switch, Thermal Relay	HK series	Every 30,000/Hr
Battery for main circuit board	CR2032	Every 3 years
Battery for touch panel	PFXZCBBT1	Every 5 years
Touch Panel	GP4000 series	Every 30,000/Hr
Inverter (Option)	D700 series	Every 30,000/Hr
Temperature Controller (Option)	SDC series	Every 30,000/Hr
Fan for Control Panel		Every 30,000/Hr
Steam Control Valve		Every 60,000/Hr
Steam Shut-Off Valve (Option)		Every 60,000/Hr
Steam Drain Solenoid Valve	PVS series	Every 30,000/Hr
Differential Pressure Switch	YPS-C104Q/ 69WC1(69WC2)	Every 30,000/Hr
Pressure Switch	63SH1	Every 30,000/Hr
Pressure Sensor	PA-830-102A-10	Every 30,000/Hr
Resistance Temp. Sensor	Pt100 Ω	Every 30,000/Hr
Thermocouple		Every 30,000/Hr
Float Switch	Ref. tank	Every 60,000/Hr
Bearing for Sol. Circulation Pump		Every 20,000/Hr
Sol. Circulation Pump		Every 60,000/Hr
Bearing for Sol. Spray Pump		Every 20,000/Hr
Sol. Spray Pump		Every 60,000/Hr
Bearing For Refrigerant Pump		Every 20,000/Hr
Refrigerant Pump		Every 60,000/Hr
Vacuum Pump		Every 60,000/Hr
Pump Shut Off Valve		Every 48,000/Hr
Pressure Release Valve		Every 48,000/Hr
Purge Solenoid Valve	AB41	Every 30,000/Hr
Refrigerant Blow Solenoid Valve	AB41	Every 30,000/Hr
Float Valve	For HG float box	Every 60,000/Hr
Float Valve	For ref. tank	Every 60,000/Hr
Compound Gauge		Every 48,000/Hr
Vacuum Gauge		Every 48,000/Hr
Rubber Hose Set For Purge Line		Every 18,000/Hr
Oil For Purge Pump	ISO VG68	Every 3,000/Hr

WATER QUALITY CONTROL

Use the following guidelines to be sure of the highest water quality control standards:

- Limit the water pressure to the maximum safe working pressure for chilled and cooling water.
- Install a 10-20 or finer mesh strainer in the chilled and cooling water piping.
- Install a thermometer and a pressure gauge in the inlet and the outlet of the chilled and cooling water piping.
- Install tapping (with valve) for chemical cleaning of the inlet and the outlet of the chilled and cooling water piping.
- Install an air vent valve at the highest part of the piping and a drain valve at the lowest part of the piping.
- Replace the water regularly and control the water quality. Operating the chiller for long periods of time with low quality water will cause corrosion and the production of scale.
- Make sure the shut off valves installed at the chiller inlet of the chilled and cooling water are completely open.



If the chiller runs without the valves completely open, a strong turbulent flow can be generated. The turbulence may cause damage in the water chamber case and the copper tube of the chiller. If you need to adjust the flow rate of the chilled and cooling water, be sure to adjust the valves installed at the outlet side of the chiller.

CHEMICAL WATER TREATMENT

Since the mineral content of the water circulated through the evaporator, condenser, absorber, and generator varies, the water used may corrode the tubes or deposit heat resistant scale in them.

Perform a chemical analysis of the water before the system is installed. Consult a reliable water treatment company to determine if treatment is necessary. If it is, the water treatment company can provide treatment for the water to help prevent damage to the tubes.

REPLACEMENT OF WATER

Since the cooling water system can be polluted by various factors, it must be cleaned and the water it in must be replaced periodically. Generally, if the water is not treated at all by the cooling tower, the recommended interval to replace the cooling water is:

- District polluted with sulfurous acid gas --- 5 days
- Common district --- 10 days

If the water is blown manually or automatically, the replacement period may be lengthened as follows.

- District polluted with sulfurous acid gas --- 1 month
- Common district --- 1 month

TREATMENT FOR LONG STOPPAGE OF THE ABSORPTION CHILLER

If the absorption chiller is stopped for 15 days or longer, bacteria in the water or in the tubes may grow. The bacteria can corrode the tubes. When stopping the chiller for more than 15 days, drain the water from the absorber, condenser, evaporator, and high temperature generator (steam drain line) through the drain valve at the bottom of the waterbox.

CHEMICAL TREATMENT

Corrosion inhibitors are attracted chemically to corroded metal surfaces. Or, they form inert protective compounds over the metal surfaces. For effective use of the corrosion inhibitors, be sure to choose the correct type and concentration. Water quality, temperature, flow speed, metals used, existence of crevices and deposits and type of water system are also part of the equation. For more information about corrosion preventive measures, consult a water treatment company.

FLOW SPEED IN TUBES

Since the water flow speed in the tubes is closely related to any existing corrosion, do not increase the water supply rate more than recommended. If the flow speed reaches 3.5 to 4 meters per second, the tubes may erode. When changing the flow rate, contact your local Johnson Controls Service Center.

If the water supply rate is adjusted at the inlet side of the heat exchanger (evaporator, condenser, and absorber), the eddy current at the inlet may corrode the tube.

Be sure to control the flow rate on the outlet side.

The eddy current caused by foreign matter in the heat exchanger is also a factor in corrosion. Be sure to install a strainer on the inlet side of the heat exchanger and clean the strainer monthly.

TABLE 31 - TENDENCY OF GENERATION OF SCALES AND CORROSION BY QUALITY OF COOLING WATER

	QUALITY OF COOLING WATER	GENERAL TENDENCY			
		SCALE AND ITS COLOR		CORROSION AND ITS COLOR	
Water Quality Factors	Low PH of the water	Hard scales are generated and iron bacteria propagate		Bad corrosion of iron and copper	Dark brown ~ Pale greenish blue
	High PH of the water	Calcium carbonate scales are generated easily.	Pale yellow	—	
	Water contains many calcium ions (Ca^{2+}) and magnesium ions(Mg^{2+})	Sulfuric ion SO_4^{2-}, silica SiO_2 and 2 carbonate ion CO_3^{2-} combine together to generate hard scales.	Pale yellow	—	
	Water contains chlorine ions (Cl^-)	—		Iron and copper tubes are corroded badly.	
	Water contains many sulfuric ions (SO_4^{2-}) and silica (SiO_2)	Calcium sulfide ($CaSO_4$) and calcium silicate ($CaSiO_3$) combine together to generate hard scales.	Gray	SO_4^{2-} corrodes copper tubes.	Greenish Blue
	Water contains many iron (Ferrous ion (Fe^{2+}),ferric ion (Fe^{3+}))	Fe^{3+} becomes ferric hydroxide ($Fe(OH)_3$) to make red water and sets red rust of ferric dioxide (Fe_2O_3). Iron bacteria propagate remarkably.	Reddish brown-Black	Fe^{3+} corrodes iron and copper tubes.	Reddish brown-Black
Environmental Factors	Water smells bad (Containing compounds of sulfur, hydrogen sulfide (H_2S), ammonium ion (NH_4^+), methane, or other gases)	Scales are generated easily, and slime is generated.	Greenish Blue – Dark brown	H_2S and NH_4^+ corrodes copper tubes.	Black – Greenish blue
	Water contains organic matters (High COD and BOD)	Scales are generated easily, and slime is generated.		—	
	Exhaust gases (Sulfurous acid gas (SO_2), nitrogen oxide (NO_2), hydrogen chloride (HCl), ammonia (NH_3), or other attributing gases) mixed in water in cooling tower	If organic nitrogen and inorganic nitrogen are contained, algae propagate. SO_2 becomes SO_4^{2-} and combines with Ca^{2+} and Mg^{2+} to generate scales.	Algae: Green Pale yellow	Exhaust gas from automobiles, factories, sewage plants, ammonia refrigerating machine, or other environmental elements, lower or heighten PH number. As SO_4^{2-}, Cl^- and NH_4^+ are increased, tubes are corroded and pitted very quickly.	
	Solid matter (Mud, sand, fibers, dust, insects) in water in cooling tower	Scales are generated easily. Solid matters set. Slime is generated.		———	
	Sea wind (District by sea)	Scales are generated easily.		Tubes are heavily corroded.	Reddish brown-Black

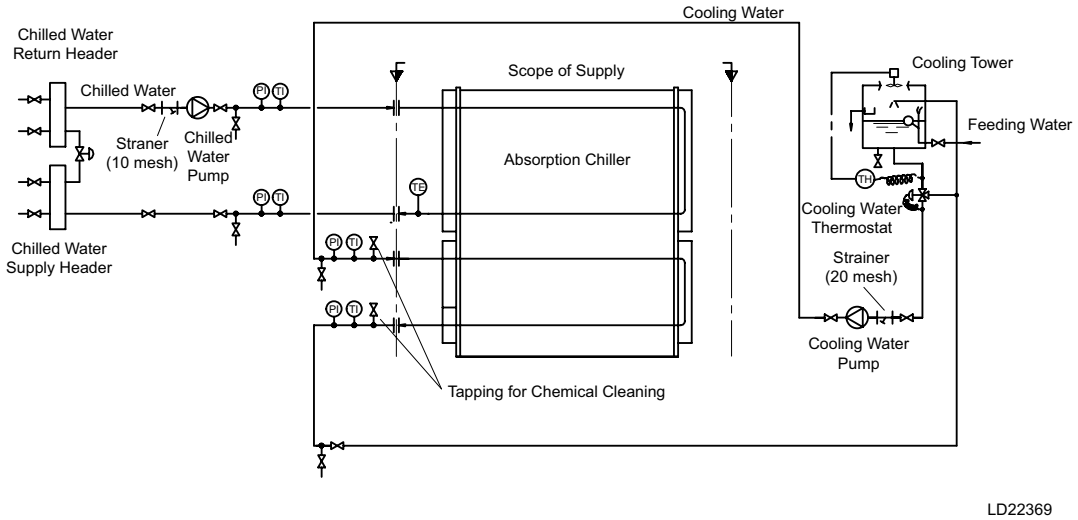


FIGURE 60 - CHILLED WATER AND COOLING SYSTEM

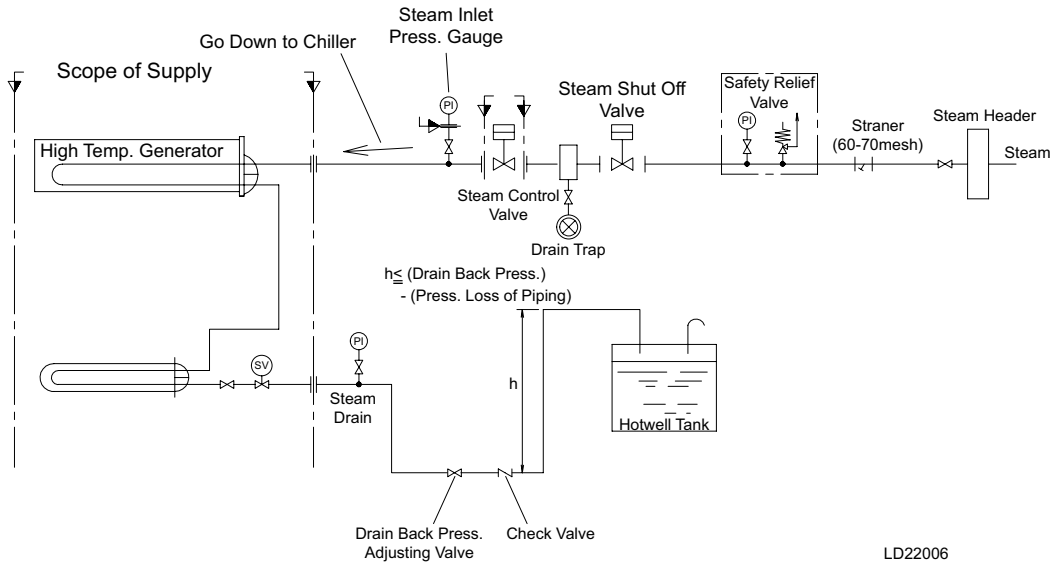


FIGURE 61 - STEAM AND DRAIN SYSTEM (OPEN SYSTEM)

Steam and Drain System
(Example of Closed System)

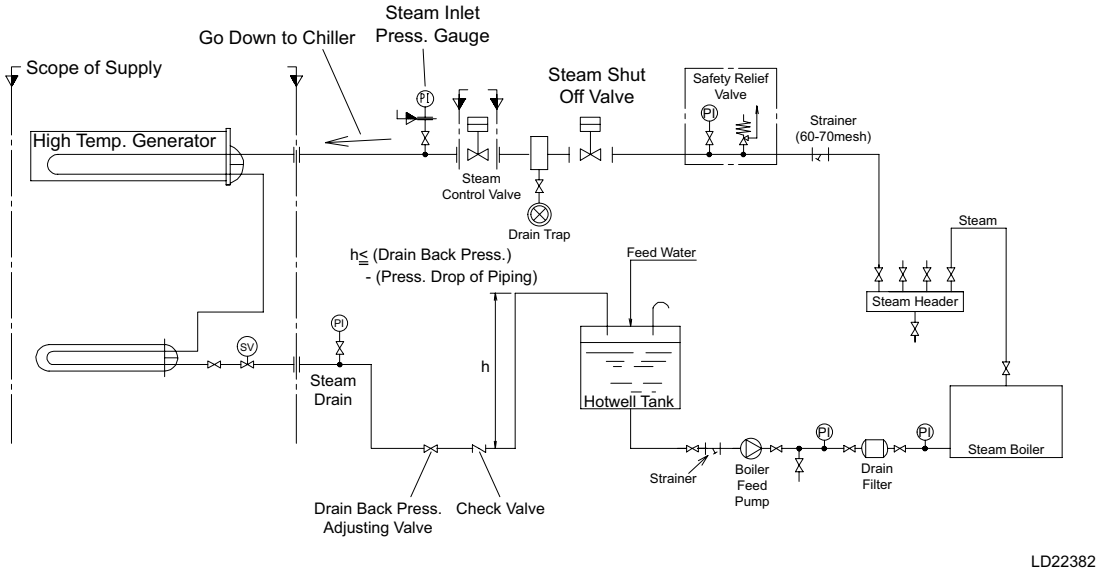


FIGURE 62 - STEAM AND DRAIN SYSTEM (CLOSED SYSTEM)

TABLE 32 - STEAM DRAIN QUALITY CONTROL

COMPONENT	STANDARD VALUE
PH	7.5 ~ 8.5
Cl^- (ppm)	≤ 20
SO_4^{2-} (ppm)	≤ 10
H_2S (ppm)	nil
DO (ppm)	≤ 0.5
All carbonate (ppm)	≤ 20

TABLE 33 - CHILLED AND COOLING WATER QUALITY CONTROL (MAXIMUM CONCENTRATIONS)

ELEMENT (1) (6)		COOLING WATER SYSTEM(4)			CHILLED WATER SYSTEM		TENDENCY(2)	
		CIRCULATING TYPE		NON-CIRCULATING WATER				
		CIRCULATING WATER	REPLENISH WATER	PASSING WATER	CIRCULATING WATER (20°C OR LOWER)	REPLENISH WATER	CORROSION	SCALE FORMING
STANDARD ITEMS	pH (25 °C)	6.5~8.2	6.0~8.0	6.8~8.0	6.8~8.0	6.8~8.0	○	○
	Electric Conductivity (mS/m) (25 °C) (μS/cm) (25 °C)(1)	Max. 80 (Max. 800)	Max. 30 (Max. 300)	Max. 40 (Max. 400)	Max. 40 (Max. 400)	Max. 30 (Max. 300)	○	○
	Chloride Ion ($MGCL^-/L$)	Max. 200	Max. 50	Max. 50	Max. 50	Max. 50	○	
	Sulfulic Acid Ion ($mgSO_4^{2-}/l$)	Max. 200	Max. 50	Max. 50	Max. 50	Max. 50	○	
	Acid Consumption (PH4.8) ($mgCaCO_3/l$)	Max. 100	Max. 50	Max. 50	Max. 50	Max. 50		○
	Total Hardness ($mgCaCO_3/l$)	Max. 200	Max. 70	Max. 70	Max. 70	Max. 70		○
	Calcium Hardness ($mgCaCO_3/l$)	Max. 150	Max. 50	Max. 50	Max. 50	Max. 50		○
	Ionized Silica (mgS_1O_3/l)	Max. 50	Max. 30	Max. 30	Max. 30	Max. 30		○
REFERENCE ITEMS	Iron (mgFe/l)	Max. 1.0	Max. 0.3	Max. 1.0	Max. 1.0	Max. 0.3	○	○
	Copper (mgCu/l)	Max. 0.3	Max. 0.1	Max. 0.1	Max. 0.1	Max. 0.1	○	
	Sulfurization Ion (mgS^{2-}/l)	NO IONS ALLOWED					○	
	Ammonium Ion ($mgNH_4+/l$)	Max. 1.0	Max. 0.1	Max. 1.0	Max. 1.0	Max. 0.1	○	
	Residual Chlorine (mgCl/l)	Max. 0.3	Max. 0.3	Max. 0.3	Max. 0.3	Max. 0.3	○	
	Free Carbonate Acid ($mgCO_2/l$)	Max. 4.0	Max. 4.0	Max. 4.0	Max. 4.0	Max. 4.0	○	
	Stability Index	6.0~7.0	–	–	–	–	○	○

NOTES:

1. The item names, their definitions, and units are based on JIS K 0101. Units and figures in parentheses () are those which were previously used. They are shown here for reference purposes.
2. In the "Tendency" column, a white circle (○) indicates that a particular item is a factor in corrosion/scale formation.
3. Generally speaking, when the water temperature is high (40 °C or higher), noticeable corrosion develops. Especially when steel material which makes direct contact with water has no protective covering, it is desirable to provide a suitable corrosion-preventive measure, such as adding a corrosion-preventive agent or applying deaeration treatment.
4. In a cooling water system using a closed cooling tower, the closed-circuit circulating water and its replenishment water shall meet the quality standards for a hot water system, and the sprinkling water and its replenishment water shall meet the quality standards for a circulation-type cooling water system.
5. The supply water and replenishment water shall be tap water, industrial water, or ground water. Do NOT use demineralized water, neutral water, or softened water.
6. The items shown above are representative factors in corrosion and scale formation.

STORAGE METHOD OF THE CHILLER

In case of long-term storage of the chiller (3 months or longer), the storage method varies depending on the storage period and machine room temperature condition. If the machine room temperature is below 0 °C, you should drain off the chilled water, cooling water, and steam condensate (drain). Dry the tube insides and all equipment installed in chilled water, cooling water, and steam condensate (drain) lines completely.

Nitrogen gas pressurization inside the absorption chiller is required when the storage period exceeds 6 months. Contact your local Johnson Controls Service Center for more details.

The chiller is not explosion proof. Highly flammable items, gas, or liquids should not be handled or stored near the chiller. Failure to do this may result in explosion, injury, or damage to the equipment and/or building.

There are two storage methods of chiller for a long stoppage during off-season (winter) or plant suspension; wet storage method and dry storage method. (Wet storage method is available only in case where chilled water and cooling water will not freeze.)

Each storage method has its own characteristics. Select the method to use based on the plant's features and the storage period.

Wet Storage Method

The wet storage method is applicable in cases where there is no concern of chilled water and/or cooling water freezing in winter. Store the machine in a place where the ambient temperature will remain higher than 0 °C.

If it is likely that the temperature will drop below that, provide a heater for the machine. If a heater is not possible, contact your local Johnson Controls service center for further information. For details on the wet storage method, see *Table 34 on page 156.*

The wet storage procedure is as follows if either the chilled water line or the cooling water line is an open system:

1. Completely drain the water from the systems if it has deteriorated in quality.
2. Clean the water systems by passing clear water through them from a position higher than the chiller.
3. Fill the water systems with clear water.
4. Circulate the clear water through the water pump for 30 minutes to one hour to clean it.
5. Drain the water.
6. Completely fill the water systems with clear water again.
7. Store the machine.

Dry Storage Method

The dry storage method should be used if the chilled or cooling water system may freeze in the winter or, if the chilled or cooling water system has a lining tube. Do not simply drain the chilled or cooling water and store the machine. This significantly increases the possibility of corrosion of the heat transfer tube and rust. For details, see *Table 35 on page 156*.

The dry storage procedure is as follows if either the chilled water line or the cooling line is an open system:

1. Completely drain the water.
2. Clean the water systems by passing clear water through them from a position higher than the chiller.
3. Fill the water systems with clear water.
4. Circulate the clear water through the water pump for 30 minutes to one hour to clean it.
5. Drain the water from each waterbox.
6. Dry the interior of each waterbox and the heat transfer tube.
7. Store the machine.

PRECAUTIONS AGAINST EXTERNAL DAMAGE

Avoid storing the machine in a place that is easily accessible or near a construction site. If this is unavoidable, provide the machine with protection.

If it is not possible to protect the machine, fill the interior with N2 to minimize the amount of air leakage. For details, contact your local Johnson Controls service center.

TABLE 34 - WET STORAGE METHOD

	PART	STORAGE METHOD	NOTES
Storage Period; less than 2 months	Chilled water line	Filled with water	1. The manual valve on the purge piping should be fully closed (See *Figure 57 on page 137*). 2. The main supply valve supplying steam must be closed. 3. If the storage period exceeds 2 months, algae and bacteria may propagate and corrode the tubes depending on the water quality, chemicals should be added to avoid such propagation. 4. If the storage period exceeds 2 months, water inside the chiller should be replaced. If the same water remains in the chiller for more than 2 months, bacteria may propagate and corrode the tubes depending on the environmental condition and water quality. Hence, the chilled water and cooling water pumps should be operated for a short time and the water inside chiller should be replaced completely (at least once a month). 5. If the storage period exceeds 6 months, apply pressure 0.01~0.02 Mpa with nitrogen inside the shells and leave as it is. Internal-pressure should be checked (at least once a week) to confirm that no pressure drop occurs.
	Cooling water line		
	Steam line	Vacuum	
	Inside of shells		
Storage Period; more than 2 months and less than 6 months	Chilled water system	Filled with water	
	Cooling water system		
	Steam line	Pressurized with Nitrogen (0.01~0.02 MpaG)	
	Inside of shells	Vacuum	
Storage Period; more than 6 months	Chilled water system	Filled with water	
	Cooling water system		
	Steam line	Dried and pressurized with Nitrogen (0.01~0.02 MpaG)	
	Inside of shells	Pressurized with Nitrogen (0.01~0.02 MpaG)	

TABLE 35 - DRY STORAGE METHOD

	PART	STORAGE METHOD	NOTES
Storage Period; less than 2 months	Chilled water system	Dried and pressurized with Nitrogen (0.01~0.02 MpaG)	1. Chilled water and cooling water systems should be drained completely and dried by nitrogen blow, then pressurized with nitrogen and left as is. Depending on the water quality, hard scale may be fixed on the inside surface of tubes by drying and it can be removed only by chemical cleaning. For more than 1 year's storage, it is necessary to, after cleaning the tubes, drain completely, dry the inside by nitrogen blow, then pressurize with nitrogen and leave as is. 2. The main supply valve supplying steam must be closed. 3. If the storage period exceeds 6 months, apply pressure 0.01~0.02 Mpa with nitrogen inside the shells and leave as is. Internal-pressure should be checked (at least once a week) to confirm no pressure drop occurs. 4. The manual valve on the purge piping should be fully closed.
	Cooling water system		
	Steam line	Vacuum	
	Inside of shells		
Storage Period: more than 2 months and less than 6 months	Chilled water system	Dried and pressurized with Nitrogen (0.01~0.02 MpaG)	
	Cooling water system		
	Steam line		
	Inside of shells	Vacuum	
Storage Period; more than 6 months	Chilled water system	Dried and pressurized with Nitrogen (0.01~0.02 MpaG)	
	Cooling water system		
	Steam line		
	Inside of shells	Pressurized with Nitrogen (0.01~0.02 MpaG)	

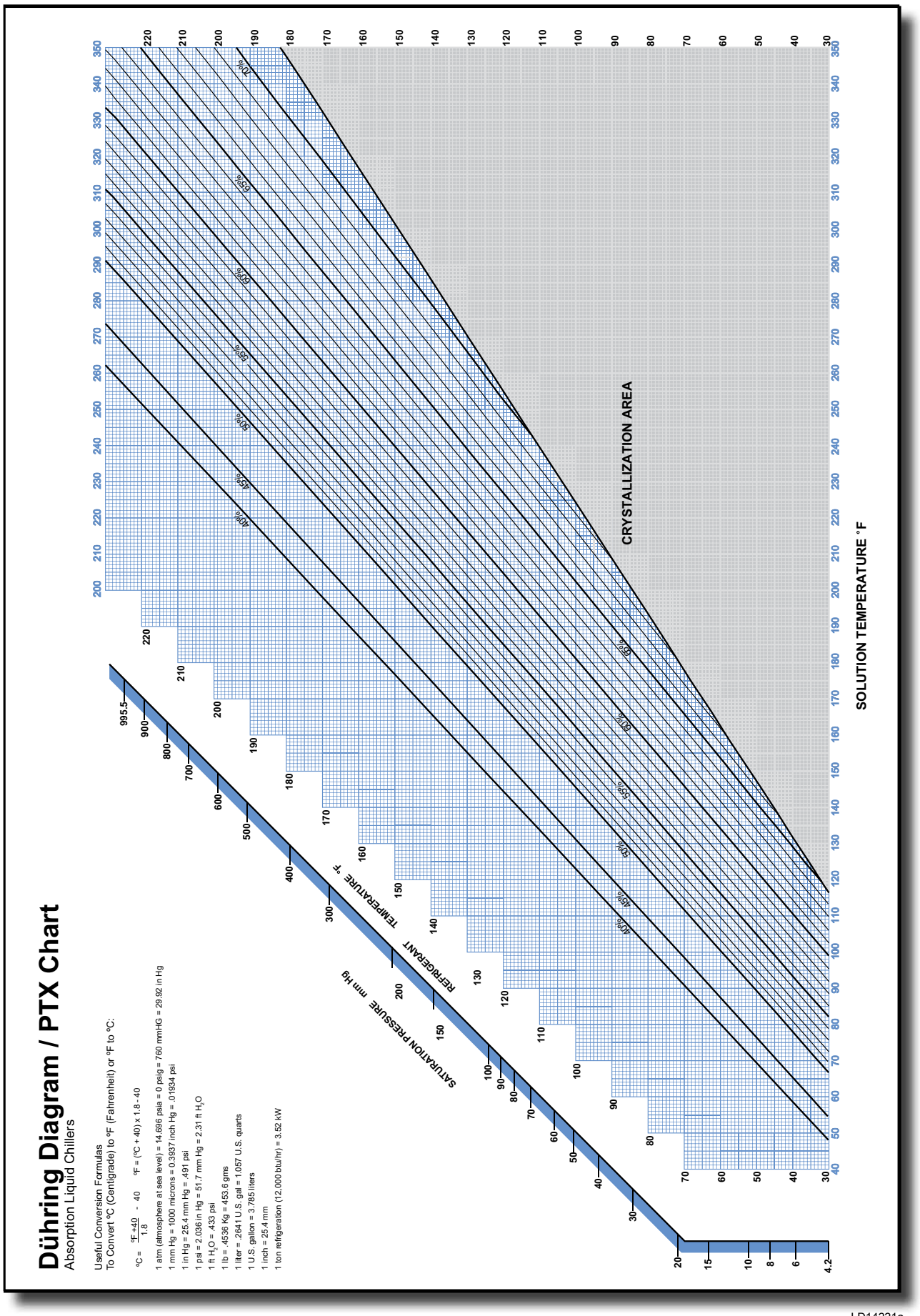
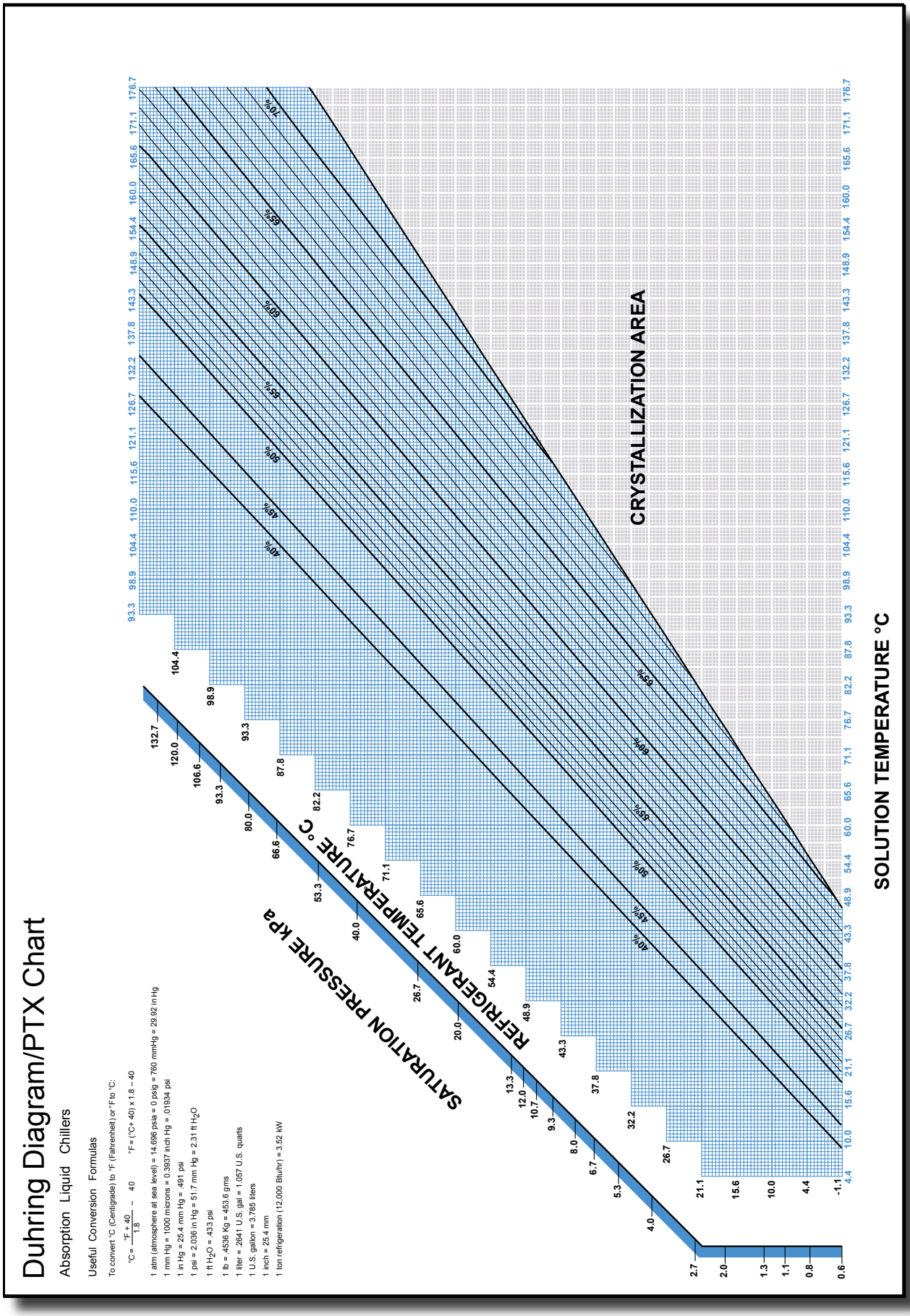


FIGURE 63 - DUHRING DIAGRAM / PTX CHART (°F)

7



LD14221a

FIGURE 64 - DUHRING DIAGRAM / PTX CHART (°C)

SPECIFIC GRAVITY - CONCENTRATION TABLES
AQUEOUS LiBr SOLUTIONS

Refrigerant Table (%LiBr by Weight)

Temperature ˚F

S.G.	40	45	50	55	60	65	70	75	80	85	90	95	100
1.00	—	—	—	—	—	—	0.08	0.18	0.28	0.37	0.47	0.57	0.67
1.01	0.98	1.08	1.17	1.27	1.37	1.47	1.56	1.66	1.76	1.85	1.95	2.05	2.15
1.02	2.43	2.52	2.62	2.72	2.82	2.91	3.01	3.11	3.20	3.30	3.40	3.50	3.59
1.03	3.84	3.94	4.03	4.13	4.23	4.33	4.42	4.52	4.62	4.72	4.81	4.91	5.01
1.04	5.22	5.32	5.42	5.51	5.61	5.71	5.81	5.90	6.00	6.10	6.19	6.29	6.39
1.05	6.57	6.67	6.77	6.87	6.96	7.06	7.16	7.26	7.35	7.45	7.55	7.64	7.74

Solution Tables

Temperature ˚F

S.G	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
1.350	37.27	37.5	37.75	37.98	38.21	38.44	38.67	38.90	39.13	39.35	39.58	39.80	40.02	40.24	40.46	40.68	40.90	41.11	41.33
1.360	38.03	38.26	38.50	38.73	38.96	39.19	39.42	39.64	39.87	40.09	40.31	40.53	40.75	40.97	41.19	41.41	41.62	41.83	42.05
1.370	38.78	39.01	39.24	39.47	39.70	39.93	40.15	40.38	40.60	40.82	41.04	41.26	41.48	41.69	41.91	42.12	42.34	42.55	42.76
1.380	39.52	39.75	39.98	40.20	40.43	40.66	40.88	41.10	41.32	41.54	41.76	41.98	42.20	42.41	42.62	42.83	43.04	43.25	43.46
1.390	40.25	40.48	40.70	40.93	41.16	41.38	41.60	41.82	42.04	42.26	42.48	42.69	42.90	43.12	43.33	43.54	43.75	43.95	44.16
1.400	40.97	41.20	41.42	41.65	41.87	42.09	42.31	42.53	42.75	42.97	43.18	43.39	43.61	43.82	44.03	44.23	44.44	44.64	44.85
1.410	41.69	41.91	42.14	42.36	42.58	42.80	43.02	43.24	43.45	43.67	43.88	44.09	44.30	44.51	44.72	44.92	45.12	45.33	45.53
1.420	42.39	42.62	42.84	43.06	43.28	43.50	43.72	43.93	44.15	44.36	44.57	44.78	44.99	45.19	45.40	45.60	45.80	46.00	46.20
1.430	43.10	43.32	43.54	43.76	43.98	44.19	44.41	44.62	44.83	45.04	45.25	45.46	45.67	45.87	46.07	46.27	46.47	46.67	46.87
1.440	43.79	44.01	44.23	44.45	44.66	44.88	45.09	45.30	45.51	45.72	45.93	46.13	46.34	46.54	46.74	46.94	47.14	47.33	47.53
1.450	44.47	44.69	44.91	45.13	45.34	45.55	45.76	45.97	46.18	46.39	46.59	46.80	47.00	47.20	47.40	47.60	47.79	47.99	48.18
1.460	45.15	45.37	45.58	45.80	46.01	46.22	46.43	46.6	446.85	47.05	47.25	47.46	47.66	47.85	48.05	48.25	48.44	48.63	48.82
1.470	45.82	46.03	46.25	46.46	46.67	46.88	47.09	47.30	47.50	47.70	47.91	48.11	48.30	48.50	48.70	48.89	49.08	49.27	49.46
1.480	46.48	46.69	46.91	47.12	47.33	47.54	47.74	47.95	48.15	48.35	48.55	48.75	48.94	49.14	49.33	49.52	49.71	49.90	50.09
1.490	47.13	47.35	47.56	47.77	47.97	48.18	48.38	48.59	48.79	48.99	49.19	49.38	49.58	49.77	49.96	50.15	50.34	50.53	50.71
1.500	47.78	47.99	48.20	48.41	48.61	48.82	49.02	49.22	49.42	49.62	49.82	50.01	50.20	50.39	50.58	50.77	50.96	51.14	51.33
1.510	48.42	48.63	48.84	49.04	49.25	49.45	49.65	49.85	50.05	50.24	50.44	50.63	50.82	51.01	51.20	51.38	51.57	51.75	51.93
1.520	49.05	49.26	49.46	49.67	49.87	50.07	50.27	50.47	50.66	50.86	51.05	51.24	51.43	51.62	51.80	51.99	52.17	52.35	52.53
1.530	49.67	49.88	50.08	50.28	50.49	50.68	50.88	51.08	51.27	51.46	51.66	51.84	52.03	52.22	52.40	52.59	52.77	52.95	53.12
1.540	50.29	50.49	50.69	50.89	51.09	51.29	51.49	51.68	51.87	52.06	52.25	52.44	52.63	52.81	52.99	53.18	53.36	53.53	53.71
1.550	50.89	51.10	51.30	51.50	51.69	51.89	52.08	52.28	52.47	52.66	52.84	53.03	53.21	53.40	53.58	53.76	53.94	54.11	54.29
1.560	51.49	51.69	51.89	52.09	52.29	52.48	52.67	52.86	53.05	53.24	53.43	53.61	53.79	53.97	54.15	54.33	54.51	54.68	54.86
1.570	52.09	52.28	52.48	52.68	52.87	53.06	53.25	53.44	53.6	353.82	54.00	54.18	54.37	54.55	54.72	54.90	55.07	55.25	55.42
1.580	52.67	52.87	53.06	53.26	53.45	53.64	53.83	54.02	54.20	54.39	54.57	54.75	54.93	55.11	55.28	55.46	55.63	55.80	55.97
1.590	53.25	53.44	53.64	53.83	54.02	54.21	54.39	54.58	54.77	54.95	55.13	55.31	55.49	55.66	55.84	56.01	56.18	56.35	56.52
1.600	53.81	54.01	54.20	54.39	54.58	54.77	54.95	55.14	55.32	55.50	55.68	55.86	56.04	56.21	56.38	56.55	56.72	56.89	57.06
1.610	54.37	54.57	54.76	54.95	55.13	55.32	55.50	55.69	55.87	56.05	56.23	56.40	56.58	56.75	56.92	57.09	57.26	57.43	57.59
1.620	54.93	55.12	55.31	55.49	55.68	55.86	56.05	56.23	56.41	56.59	56.76	56.94	57.11	57.28	57.45	57.62	57.79	57.95	58.12
1.630	55.47	55.66	55.85	56.03	56.22	56.40	56.58	56.76	56.94	57.12	57.29	57.46	57.64	57.81	57.97	58.14	58.31	58.47	58.63
1.640	56.01	56.20	56.38	56.57	56.75	56.93	57.11	57.29	57.46	57.64	57.81	57.98	58.15	58.32	58.49	58.66	58.82	58.98	59.14
1.650	56.54	56.72	56.91	57.09	57.27	57.45	57.63	57.81	57.98	58.15	58.33	58.50	58.67	58.83	59.00	59.16	59.32	59.49	59.65
1.660	57.06	57.25	57.43	57.61	57.79	57.97	58.14	58.32	58.49	58.66	58.83	59.00	59.17	59.33	59.50	59.66	59.82	59.98	60.14
1.670	57.58	57.76	57.94	58.12	58.29	58.47	58.65	58.82	58.99	59.16	59.33	59.50	59.66	59.83	59.99	60.15	60.31	60.47	60.63
1.680	58.08	58.26	58.44	58.62	58.79	58.97	59.14	59.31	59.48	59.65	59.82	59.99	60.15	60.31	60.48	60.64	60.79	60.95	61.11
1.690	58.58	58.76	58.94	59.11	59.29	59.46	59.63	59.80	59.97	60.14	60.30	60.47	60.63	60.79	60.95	61.11	61.27	61.43	61.58
1.700	59.07	59.25	59.42	59.60	59.77	59.94	60.11	60.28	60.45	60.61	60.78	60.94	61.10	61.26	61.42	61.58	61.74	61.89	62.05
1.710	59.55	59.73	59.90	60.08	60.25	60.42	60.59	60.75	60.92	61.08	61.25	61.41	61.57	61.73	61.89	62.04	62.20	62.35	62.50
1.720		60.20	60.38	60.55	60.72	60.88	61.05	61.22	61.38	61.54	61.71	61.87	62.03	62.18	62.34	62.50	62.65	62.80	62.95
1.730		60.67	60.84	61.01	61.18	61.34	61.51	61.67	61.84	62.00	62.16	62.32	62.48	62.63	62.79	62.94	63.09	63.25	63.40
1.740		61.13	61.30	61.46	61.63	61.80	61.96	62.12	62.28	62.44	62.60	62.76	62.92	63.07	63.23	63.38	63.53	63.68	63.83
1.750			61.74	61.91	62.08	62.24	62.40	62.56	62.72	62.88	63.04	63.20	63.35	63.51	63.66	63.81	63.96	64.11	64.26
1.760				62.35	62.51	62.68	62.84	63.00	63.16	63.31	63.47	63.62	63.78	63.93	64.08	64.23	64.38	64.53	64.68
1.770				62.78	62.94	63.10	63.26	63.42	63.58	63.74	63.89	64.04	64.20	64.35	64.50	64.65	64.80	64.95	65.09
1.780					63.37	63.52	63.68	63.84	64.00	64.15	64.30	64.46	64.61	64.76	64.91	65.06	65.21	65.35	65.50
1.790					63.78	63.94	64.09	64.25	64.40	64.56	64.71	64.86	65.01	65.16	65.31	65.46	65.60	65.75	65.89
1.800						64.34	64.50	64.65	64.81	64.96	65.11	65.26	65.41	65.56	65.70	65.85	66.00	66.14	66.28
1.810							64.89	65.05	65.20	65.35	65.50	65.65	65.80	65.94	66.09	66.24	66.38	66.52	66.67
1.820								65.43	65.58	65.73	65.88	66.03	66.18	66.32	66.47	66.61	66.76	66.90	67.04
1.830									65.96	66.11	66.26	66.41	66.55	66.70	66.84	66.98	67.13	67.27	67.41
1.840										66.48	66.63	66.77	66.92	67.06	67.20	67.35	67.49	67.63	67.77
1.850											66.99	67.13	67.27	67.42	67.56	67.70	67.84	67.98	68.12

CRYSTALLIZATION AREA

LD14222

FIGURE 65 - SPECIFIC GRAVITY - CONCENTRATION (°F)

SPECIFIC GRAVITY – CONCENTRATION TABLES
AQUEOUS LiBr SOLUTIONS
Refrigerant Table (%LiBr by Weight)
Temperature °C

S.G.	4.4	7.2	10.0	12.8	15.6	18.3	21.1	23.9	26.7	29.4	32.2	35.0	37.8
1.00							0.08	0.18	0.28	0.37	0.47	0.57	0.67
1.01	0.98	1.08	1.17	1.27	1.37	1.47	1.56	1.66	1.76	1.85	1.95	2.05	2.15
1.02	2.43	2.52	2.62	2.72	2.82	2.91	3.01	3.11	3.2	3.3	3.4	3.5	3.59
1.03	3.84	3.94	4.03	4.13	4.23	4.33	4.42	4.52	4.62	4.72	4.81	4.91	5.01
1.04	5.22	5.32	5.42	5.51	5.61	5.71	5.81	5.9	6	6.1	6.19	6.29	6.39
1.05	6.57	6.67	6.77	6.87	6.96	7.06	7.16	7.26	7.35	7.45	7.55	7.64	7.74

Solution Tables
Temperature °C

S.G.	15.6	21.1	26.7	32.2	37.8	43.3	48.9	54.4	60.0	65.6	71.1	76.7	82.2	87.8	93.3	98.9	104.4	110.0	115.6
1.35	37.27	37.50	37.75	37.98	38.21	38.44	38.67	38.90	39.13	39.35	39.58	39.80	40.02	40.24	40.46	40.68	40.90	41.11	41.33
1.36	38.03	38.26	38.50	38.73	38.96	39.19	39.42	39.64	39.87	40.09	40.31	40.53	40.75	40.97	41.19	41.41	41.62	41.83	42.05
1.37	38.78	39.01	39.24	39.47	39.70	39.93	40.15	40.38	40.60	40.82	41.04	41.26	41.48	41.69	41.91	42.12	42.34	42.55	42.76
1.38	39.52	39.75	39.98	40.20	40.43	40.66	40.88	41.10	41.32	41.54	41.76	41.98	42.20	42.41	42.62	42.83	43.04	43.25	43.46
1.39	40.25	40.48	40.70	40.93	41.16	41.38	41.60	41.82	42.04	42.26	42.48	42.69	42.90	43.12	43.33	43.54	43.75	43.95	44.16
1.40	40.97	41.20	41.42	41.65	41.87	42.09	42.31	42.53	42.75	42.97	43.18	43.39	43.61	43.82	44.03	44.23	44.44	44.64	44.85
1.41	41.69	41.91	42.14	42.36	42.58	42.80	43.02	43.24	43.45	43.67	43.88	44.09	44.30	44.51	44.72	44.92	45.12	45.33	45.53
1.42	42.39	42.62	42.84	43.06	43.28	43.50	43.72	43.93	44.15	44.36	44.57	44.78	44.99	45.19	45.40	45.60	45.80	46.00	46.20
1.43	43.10	43.32	43.54	43.76	43.98	44.19	44.41	44.62	44.83	45.04	45.25	45.46	45.67	45.87	46.07	46.27	46.47	46.67	46.87
1.44	43.79	44.01	44.23	44.45	44.66	44.88	45.09	45.30	45.51	45.72	45.93	46.13	46.34	46.54	46.74	46.94	47.14	47.33	47.53
1.45	44.47	44.69	44.91	45.13	45.34	45.55	45.76	45.97	46.18	46.39	46.59	46.80	47.00	47.20	47.40	47.60	47.79	47.99	48.18
1.46	45.15	45.37	45.58	45.80	46.01	46.22	46.43	46.60	46.85	47.05	47.25	47.46	47.66	47.85	48.05	48.25	48.44	48.63	48.82
1.47	45.82	46.03	46.25	46.46	46.67	46.88	47.09	47.30	47.50	47.70	47.91	48.11	48.30	48.50	48.70	48.89	49.08	49.27	49.46
1.48	46.48	46.69	46.91	47.12	47.33	47.54	47.74	47.95	48.15	48.35	48.55	48.75	48.94	49.14	49.33	49.52	49.71	49.90	50.09
1.49	47.13	47.35	47.56	47.77	47.97	48.18	48.38	48.59	48.79	48.99	49.19	49.38	49.58	49.77	49.96	50.15	50.34	50.53	50.71
1.50	47.78	47.99	48.20	48.41	48.61	48.82	49.02	49.22	49.42	49.62	49.82	50.01	50.20	50.39	50.58	50.77	50.96	51.14	51.33
1.51	48.42	48.63	48.84	49.04	49.25	49.45	49.65	49.85	50.05	50.24	50.44	50.63	50.82	51.01	51.20	51.38	51.57	51.75	51.93
1.52	49.05	49.26	49.46	49.67	49.87	50.07	50.27	50.47	50.66	50.86	51.05	51.24	51.43	51.62	51.80	51.99	52.17	52.35	52.53
1.53	49.67	49.88	50.08	50.28	50.49	50.68	50.88	51.08	51.27	51.46	51.66	51.84	52.03	52.22	52.40	52.59	52.77	52.95	53.12
1.54	50.29	50.49	50.69	50.89	51.09	51.29	51.49	51.68	51.87	52.06	52.25	52.44	52.63	52.81	52.99	53.18	53.36	53.53	53.71
1.55	50.89	51.10	51.30	51.50	51.69	51.89	52.08	52.28	52.47	52.66	52.84	53.03	53.21	53.40	53.58	53.76	53.94	54.11	54.29
1.56	51.49	51.69	51.89	52.09	52.29	52.48	52.67	52.86	53.05	53.24	53.43	53.61	53.79	53.97	54.15	54.33	54.51	54.68	54.86
1.57	52.09	52.28	52.48	52.68	52.87	53.06	53.25	53.44	53.60	53.82	54.00	54.18	54.37	54.55	54.72	54.90	55.07	55.25	55.42
1.58	52.67	52.87	53.06	53.26	53.45	53.64	53.83	54.02	54.20	54.39	54.57	54.75	54.93	55.11	55.28	55.46	55.63	55.80	55.97
1.59	53.25	53.44	53.64	53.83	54.02	54.21	54.39	54.58	54.77	54.95	55.13	55.31	55.49	55.66	55.84	56.01	56.18	56.35	56.52
1.60	53.81	54.01	54.20	54.39	54.58	54.77	54.95	55.14	55.32	55.50	55.68	55.86	56.04	56.21	56.38	56.55	56.72	56.89	57.06
1.61	54.37	54.57	54.76	54.95	55.13	55.32	55.50	55.69	55.87	56.05	56.23	56.40	56.58	56.75	56.92	57.09	57.26	57.43	57.59
1.62	54.93	55.12	55.31	55.49	55.68	55.86	56.05	56.23	56.41	56.59	56.76	56.94	57.11	57.28	57.45	57.62	57.79	57.95	58.12
1.63	55.47	55.66	55.85	56.03	56.22	56.40	56.58	56.76	56.94	57.12	57.29	57.46	57.64	57.81	57.97	58.14	58.31	58.47	58.63
1.64	56.01	56.20	56.38	56.57	56.75	56.93	57.11	57.29	57.46	57.64	57.81	57.98	58.15	58.32	58.49	58.66	58.82	58.98	59.14
1.65	56.54	56.72	56.91	57.09	57.27	57.45	57.63	57.81	57.98	58.15	58.33	58.50	58.67	58.83	59.00	59.16	59.32	59.49	59.65
1.66	57.06	57.25	57.43	57.61	57.79	57.97	58.14	58.32	58.49	58.66	58.83	59.00	59.17	59.33	59.50	59.66	59.82	59.98	60.14
1.67	57.58	57.76	57.94	58.12	58.29	58.47	58.65	58.82	58.99	59.16	59.33	59.50	59.66	59.83	59.99	60.15	60.31	60.47	60.63
1.68	58.08	58.26	58.44	58.62	58.79	58.97	59.14	59.31	59.48	59.65	59.82	59.99	60.15	60.31	60.48	60.64	60.79	60.95	61.11
1.69	58.58	58.76	58.94	59.11	59.29	59.46	59.63	59.80	59.97	60.14	60.30	60.47	60.63	60.79	60.95	61.11	61.27	61.43	61.58
1.70	59.07	59.25	59.42	59.60	59.77	59.94	60.11	60.28	60.45	60.61	60.78	60.94	61.10	61.26	61.42	61.58	61.74	61.89	62.05
1.71	59.55	59.73	59.90	60.08	60.25	60.42	60.59	60.75	60.92	61.08	61.25	61.41	61.57	61.73	61.89	62.04	62.20	62.35	62.50
1.72		60.20	60.38	60.55	60.72	60.88	61.05	61.22	61.38	61.54	61.71	61.87	62.03	62.18	62.34	62.50	62.65	62.80	62.95
1.73		60.67	60.84	61.01	61.18	61.34	61.51	61.67	61.84	62.00	62.16	62.32	62.48	62.63	62.79	62.94	63.09	63.25	63.40
1.74		61.13	61.30	61.46	61.63	61.80	61.96	62.12	62.28	62.44	62.60	62.76	62.92	63.07	63.23	63.38	63.53	63.68	63.83
1.75			61.74	61.91	62.08	62.24	62.40	62.56	62.72	62.88	63.04	63.20	63.35	63.51	63.66	63.81	63.96	64.11	64.26
1.76				62.35	62.51	62.68	62.84	63.00	63.16	63.31	63.47	63.62	63.78	63.93	64.08	64.23	64.38	64.53	64.68
1.77				62.78	62.94	63.10	63.26	63.42	63.58	63.74	63.89	64.04	64.20	64.35	64.50	64.65	64.80	64.95	65.09
1.78					63.37	63.52	63.68	63.84	64.00	64.15	64.30	64.46	64.61	64.76	64.91	65.06	65.21	65.35	65.50
1.79					63.78	63.94	64.09	64.25	64.40	64.56	64.71	64.86	65.01	65.16	65.31	65.46	65.60	65.75	65.89
1.80						64.34	64.50	64.65	64.81	64.96	65.11	65.26	65.41	65.56	65.70	65.85	66.00	66.14	66.28
1.81							64.89	65.05	65.20	65.35	65.50	65.65	65.80	65.94	66.09	66.24	66.38	66.52	66.67
1.82								65.43	65.58	65.73	65.88	66.03	66.18	66.32	66.47	66.61	66.76	66.90	67.04
1.83									65.96	66.11	66.26	66.41	66.55	66.70	66.84	66.98	67.13	67.27	67.41
1.84										66.48	66.63	66.77	66.92	67.06	67.20	67.35	67.49	67.63	67.77
1.85											66.99	67.13	67.27	67.42	67.56	67.70	67.84	67.98	68.12

CRYSTALLIZATON AREA

LD20924

FIGURE 66 - SPECIFIC GRAVITY - CONCENTRATION (°C)

SECTION 8 – TROUBLESHOOTING

If the chiller malfunctions or an abnormal condition is detected while it operates, locate the cause. Use the procedures listed below to fix the problem.

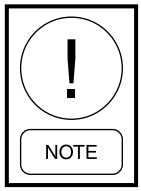
If the cause is not clear, using the countermeasure will not repair the problem, or if the chiller seems to have a serious malfunction, contact your local Johnson Controls Service Center immediately.

If the chiller stops because of a problem, wait until the chilled water pump, cooling water pump, and chiller unit stop completely, then verify the following items.

Causes of lighting of trouble indicator lamps on control panel of absorption chiller and countermeasures against them.

Several items should be checked routinely whenever the chiller experiences any trouble or abnormality.

- Check to see if the main steam valve was closed by mistake.
- Open the main valve.



Check the causes in order. Any of these causes will state the diluting operation automatically then stop the chiller. Check that the diluting operation was completed, and if not, dilute the solution according to the Manual Refrigerant Blow Down and Diluting Method on page 141.

- See if the valves of the chilled water system and cooling water system are set correctly. Verify the flow rate.
- See if the cooling tower is operating normally.
- Check the valves and pumps of the cooling water system. Verify the flow rate.

Contact your local Johnson Controls Service Center if any of the following apply:

- The water flow rate setting is unknown.
- It takes 30 minutes or more to restore operations.
- Solution is crystallized.
- The cause of the trouble is not readily apparent.

TABLE 36 - TROUBLESHOOTING THE HIGH TEMPERATURE GENERATOR

ITEM	CAUSE	COUNTERMEASURE
1	Cooling water is Insufficient or suspended.	• See if the cooling water supply rate conforms to the specification. Check the flow meter, discharge pressure of the cooling water pump, current,and other applicable pumps or pressures. • If the flow rate is insufficient, check the opening ratio of the flow controller valve and check the strainer for clogging.
2	Cooling water temperature at inlet is high.	Check the capacity of the cooling tower.
3	Non-condensable gas stays in the machine.	• Check the capacity of the vacuum pump. • Check the purge unit. • Purge air from the chiller (See *SECTION 7 – MAINTENANCE*). • If partial load operation is continued for a long period, non-condensable gas tends to stay in the absorber. In this case, purge directly from the low pressure side (according to instructions in *SECTION 7 – MAINTENANCE*).
4	Heat exchange tube is dirty (chilled water, cooling water).	Contact your local Johnson Controls Service Office.
5	Solution is crystallized.	
6	Corrosion inhibitor is worn.	
7	Air leaks in absorption chiller.	

TABLE 37 - CHILLED WATER OVERCOOLING OR REFRIGERANT OVERCOOLED

ITEM	CAUSE	COUNTERMEASURE
1	Chilled water flow rate lowers or changes sharply.	See if the chilled water flow rate changes sharply (particularly in the case of variable flow rate specification). If it changes sharply, apply a limit of the change rate to the chilled water flow control or take another measure.
2	Cooling water temperature at inlet changes sharply.	• See if the cooling water temperature at inlet changes sharply. Checking the start and stop of the fan). • If the chiller refrigerant temperature is low, the chiller stops immediately but does not perform the diluting operation. If left as it is, the solution may be crystallized in 4-5 hours. To prevent this, dilute the solution according to the procedure shown in *Manual Refrigerant Blow Down and Diluting Method on page 141*.
3	Load lowers sharply.	See if the load changes sharply.
4	Refrigerant is dirty (contains solution).	See if the refrigerant refining operation has been performed. For the refrigerant refining method, see *Refrigerant Refining Method on page 141*
5	Heat exchange tube is dirty (Chilled water).	Contact your local Johnson Controls Service Office.
6	Temperature controller or safety switch is broken.	

In the case of chilled water suspension, the absorption chiller does not perform the dilution operation. It stops immediately. If the absorption chiller is left as it is, the solution in it may crystallize in 4-5 hours. To prevent this, dilute the solution. Use the procedure shown in *Manual Refrigerant Blow Down and Diluting Method on page 141*.

TABLE 38 - CHILLED WATER SUSPENSION

ITEM	CAUSE	COUNTERMEASURE
1	Chilled water pump has a problem.	Check the chilled water pump for a problem.
2	Chilled water flow rate is low.	Check to see if the chilled water flow rate is below the set point of the water suspension switch. If it is low, check the flow controller, check the strainer for clogging, and check the opening ratio of the flow control valve.
3	Pressure transfer pipe of water suspension switch is clogged.	Contact your local Johnson Controls Service Office.
4	Water suspension switch is broken.	

If the chiller has a pump problem it does not perform the dilution operation. It stops immediately. If left as is, the solution in it may crystallize in 4-5 hours. To prevent this, contact your local Johnson Controls Service Office immediately.

TABLE 39 - PUMPS OVERLOADED OR

OVERHEATED

ITEM	CAUSE	COUNTERMEASURE
1	Bearings of the pump are worn or clogged.	Contact your local Johnson Controls Service Office.
2	Pump is damaged by cavitation caused by low liquid level.	
3	Thermal switch is not set properly.	
4	Internal cycle control valve is not set properly.	
5	Filter in the pump is clogged.	
6	Solution is crystallized.	
7	Circuit breaker has tripped.	

TABLE 40 - CHILLED WATER TIME OUT OR
COOLING WATER TIME OUT

ITEM	CAUSE	COUNTERMEASURE
1	Pump abnormal	Check the water pump
2	Insufficient water flow	Check the water line and check the water flow
3	Water suspension relay abnormal	Check the water suspension relay. Check to see if the pipe is clogged or not.
4	Water pump interlock abnormal	Check the water pump.

TABLE 41 - PUMP INTERLOCKS

ITEM	CAUSE	COUNTERMEASURE
1	Water pump interlock was not established	Check the water pump interlock.

TABLE 42 - LOW COOLING WATER INLET TEMPERATURE

ITEM	CAUSE	COUNTERMEASURE
1	Cooling water inlet temperature control system is abnormal	Check the cooling water inlet temperature control system. If this problem occurs, the absorption chiller performs the diluting operations automatically, and then stops. Go to the Control Center immediately and confirm that the diluting operation took place. If the diluting operation did not occur, dilute the solution according to the procedure shown in *Manual Refrigerant Blow Down and Diluting Method on page 141*.

If these problems occur, the absorption chiller performs the dilution operation automatically and stops. Go to the Control Center immediately and confirm that the dilution took place. If the dilution operation did not run, dilute the solution. Use the instructions shown in *Manual Refrigerant Blow Down and Diluting Method on page 141*.

TABLE 43 - ABNORMAL CONTROL SENSOR

ITEM	CAUSE	COUNTERMEASURE
1	Contact failure	Tighten terminal in control panel.
2	Sensor abnormal or disconnected	Contact your local Johnson Controls Service Office.
3	Inductive noise	

TABLE 44 - CPU ABNORMAL

ITEM	CAUSE	COUNTERMEASURE
1	Control board malfunction	Contact your local Johnson Controls Service Office.

TROUBLESHOOTING PERFORMANCE ISSUES

If the performance is insufficient while the steam control valve is fully opened or if the steam control valve does not fully open while the load is sufficient, check numbers 1-7 in the following table in order. If the cause of the malfunction is other than numbers 1-7, it may be one of number 8-14. In this case, contact your local Johnson Controls Service Center immediately.

TABLE 45 - TROUBLESHOOTING PERFORMANCE ISSUES

ITEM	CAUSE	COUNTERMEASURE
1	Cooling water temp. is high.	Check the capacity of the cooling tower.
2	Cooling water flow rate is too low.	See if the cooling water supply rate matches the specification. (Check the flow meter, discharge pressure of the cooling water pump, current, and other relevant water gauges). If the flow rate is insufficient, check the opening ratio of the flow controller valve and check the strainer for clogging.
3	Cooling water heat exchange tube is dirty.	Contact your local Johnson Controls Service Office.
4	Non-condensable gas remains in machine.	• See *Purge Procedure on page 136* . • Check the capacity of the vacuum pump. • Check the purge unit for a problem. • Purge air from the absorption chiller. If partial-load operation is continued for a long period, non-condensable gas tends to stay in the absorber. In this case, purge directly from the low-pressure side (absorber), see *Purge Procedure on page 136* . Even if the automatic purge unit is installed, purge from the lower pressure side (absorber) manually.
5	Chilled water outlet temperature controller is not set properly.	Be certain that each setting parameter of the chilled water outlet temperature controller is set properly.
6	Manual refrigerant blow valves are kept open.	Check that manual refrigerant blow valve V8 is fully closed.
7	The Refrigerant Pump **Stop** button is pressed.	Press the Refrigerant Pump **Auto** button.
8	Corrosion inhibitor is depleted.	Contact your local Johnson Controls Service Office.
9	Surface active agent is depleted.	
10	Refrigerant is dirty (contains solution).	
12	Chilled water outlet temperature controller is broken.	
11	Internal cycle control valve is not set properly.	
13	Solution is crystallized.	
14	Air leaks in absorption chiller.	

VACUUM PUMP

When the **Purge Abnormal** alarm button lights, the vacuum pump needs to be disassembled for inspection. Contact your local Johnson Controls Service Center. When the **Abnormal Purge Freq.** alarm button lights or the vacuum level of the purging line did not reach the specified level during the vacuum pump capacity, check to see if the entire purge line needs to be inspected. See *Table 46 on page 166*.

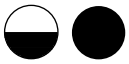
TABLE 46 - VACUUM PUMP TROUBLESHOOTING

ITEM	CAUSE	COUNTERMEASURE
1	Deterioration of vacuum pump oil	Replace the vacuum pump oil.
2	Wrong operation of purging line switching when vacuum pump capacity was checked.	See *Purge Procedure on page 136*. Confirm the valves are open or closed.
3	Deterioration of vacuum pump belt	Contact your local Johnson Controls Service Center.
4	Leakage in purge pipe lines.	
5	Solenoid valve or check valve in the purge line is clogged.	

ABNORMAL SOLUTION AND REFRIGERANT LEVELS

Causes of abnormal levels of solution and refrigerant and countermeasures against them are shown in the table below. If the level of the solution or refrigerant is wrong, correct it according to the following procedure.

TABLE 47 - ABNORMAL SOLUTION REFRIGERANT LEVELS

SECTION	NORMAL CONDITION	ABNORMAL CONDITION	CAUSE	COUNTERMEASURE
Refrigerant Overflow (G101)			High temperature of cooling water inlet temperature.	• See if the cooling water supply rate is conformed to the specification. (Check the flow meter, discharge pressure of the cooling water pump, current, and other relevant water gauges) If the flow rate is low, check the opening ratio of the flow controller valve and check the strainer for clogging. • Check the capacity of the cooling tower. • See *Purge Procedure on page 136*. • Check the capacity of the vacuum pump. • Check the purge unit for trouble. • Purge air from the absorption chiller. If partial-load operation is continued for a long period, non-condensable gas tends to stay in the absorber. In this case, purge directly from the low pressure side (absorber), see *Purge Procedure on page 136*.
			Low temperature of chilled water outlet temperature.	
			Cooling water tube fouling	
			Purge trouble	
			Air leakage	
Refrigerant Tank (G102)			Cooling water inlet temperature is low. Setpoint error of automatic start and stop switch.	• Check cooling water inlet temperature . • Check the setpoint.
Solution Tank (G103)			Purging is insufficient.	See *Purge Procedure on page 136*.
			Adjusting valve opening setting error.	Contact your local Johnson Controls Service Center.
			Solution is crystallized.	

8

INSUFFICIENT VACUUM LEVELS

Causes of insufficient vacuum level of purging line and countermeasures against them.

TABLE 48 - INSUFFICIENT VACUUM LEVELS

ITEM	CAUSE	COUNTERMEASURE
1	Purge pump trouble.	Contact your local Johnson Controls Service Office.
2	Deterioration of vacuum pump oil.	Replace the vacuum pump oil.
3	Wrong operation of purging line switching when vacuum pump capacity was checked.	• See *Purge Procedure on page 136*. • Confirm that the valves are either open or closed.
4	Deterioration of vacuum pump belt.	Contact your local Johnson Controls Service Office.
5	Leakage in purge pipe line.	
6	Blocked or broken purge solenoid valves.	
7	Check valve does not open.	
8	Valve V21 left open by mistake.	• See *Purge Procedure on page 136*. • Confirm that the valves are either open or closed.

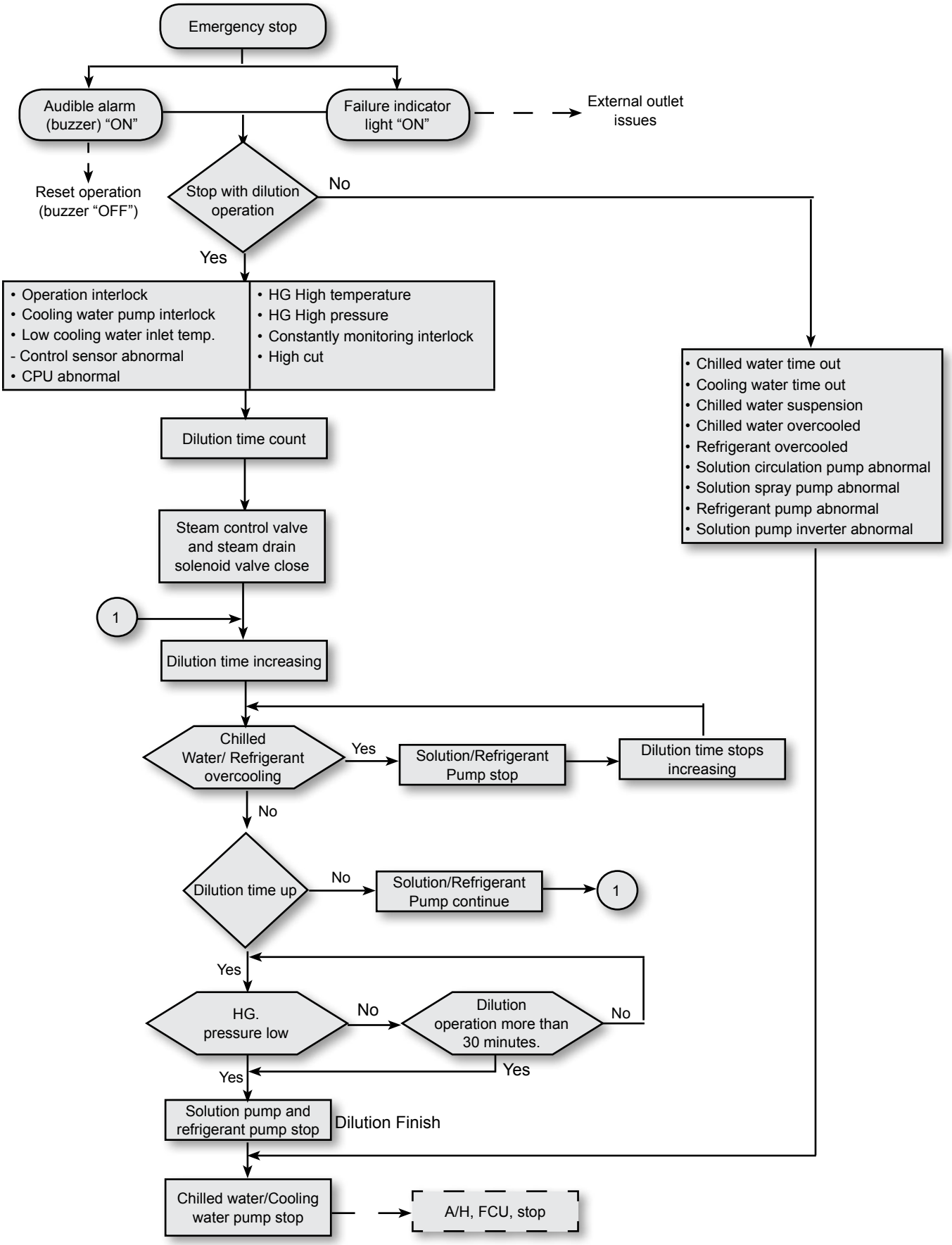


FIGURE 67 - TROUBLESHOOTING SEQUENCE FLOW CHART

8

ACTIONS TO TAKE AGAINST POWER FAILURE

If the main power fails, take the following actions.

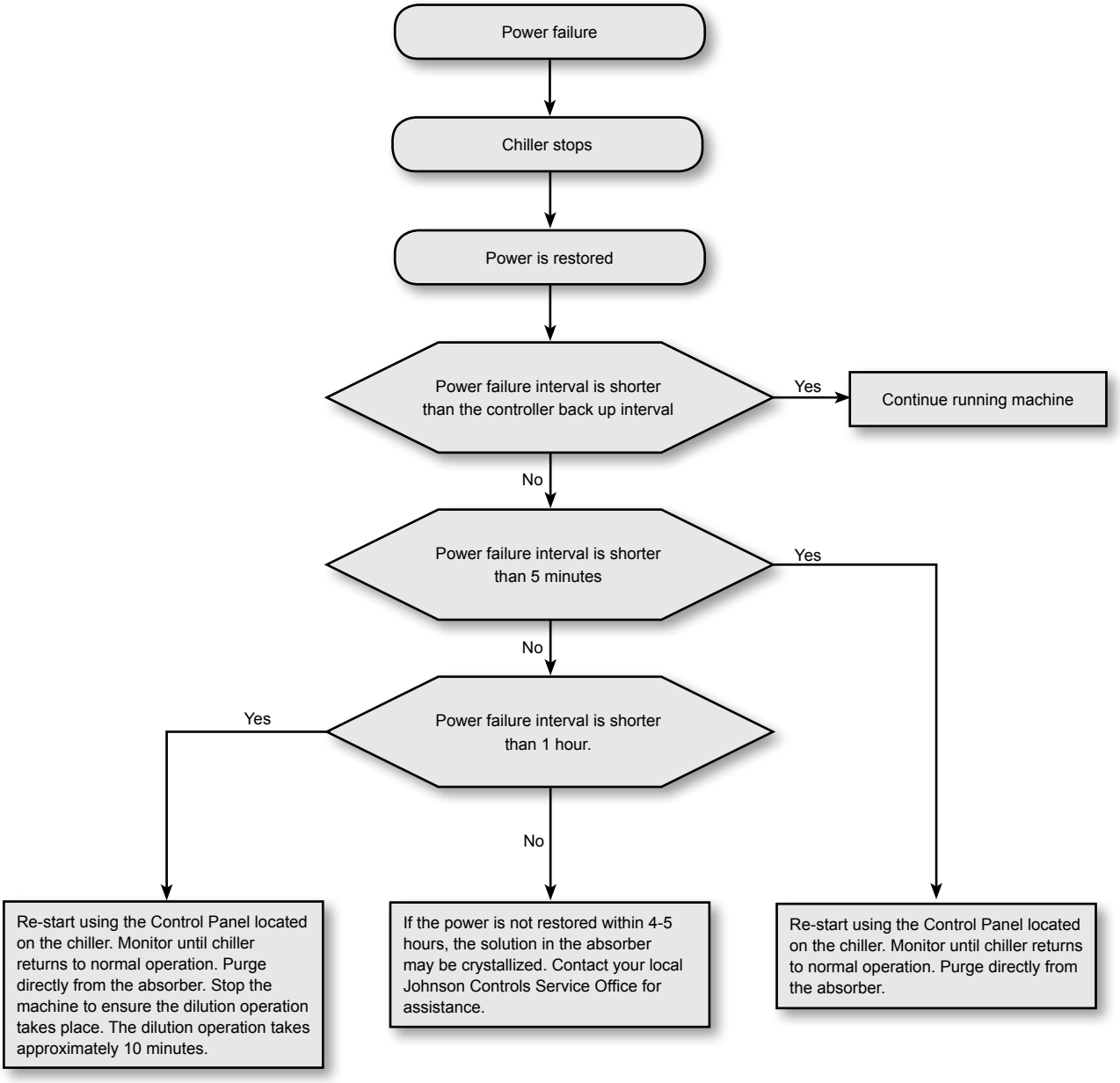
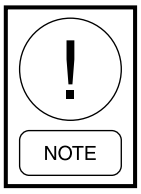


FIGURE 68 - ACTIONS TO TAKE AGAINST POWER FAILURE

SECTION 9 - DECOMMISSIONING, DISMANTLING, AND DISPOSAL

Unless otherwise indicated, the operations described below can be performed by any properly trained maintenance technician.

1. Isolate all sources of electrical supply to the unit, including any control system supplies switched by the unit. Make sure that all points of isolation are secured in the OFF position.
2. Disconnect and remove the supply cables. For connection points, see *SECTION 3 – HANDLING, STORAGE, INSTALLATION AND REASSEMBLY*.
3. Fill the interior of the unit with N2 gas to pressurize up to 0.01~0.02 MPa.G.
4. Prepare a suitable container. See *Table 13 on page 44* and *Table 9 on page 38*.
5. Drain the remainder of the solution and refrigerant in the unit from each service valve as completely as possible into the container.
6. Dispose of the refrigerant and solution in a suitable and safe manner.
7. Isolate the unit heat exchanger from the external water systems. Drain the heat exchanger section of the system. If no isolation valves are installed it may be necessary to drain the complete system.
8. If glycol was used in the water system, or chemical additives are contained, dispose of the solution in a suitable and safe manner. After draining, disconnect and remove the water.



Under NO circumstances should any system containing glycol be drained directly into domestic waste or natural water systems.

9. Remove fixing down bolts. Lift the unit from position, using the points provided and equipment with adequate lifting capacity.

See *SECTION 3 – HANDLING, STORAGE, INSTALLATION AND REASSEMBLY* for unit installation instructions, and *Table 13 on page 44* and *Table 9 on page 38* for unit weights.

Units which cannot be removed in one piece after disconnection, must be dismantled in position. Handle each component carefully. Where possible, dismantle units in the reverse order of installation.

Make sure that while components are being removed, the remaining parts are supported in a safe manner.

Only use lifting equipment of adequate capacity.

After removing the unit from position, dispose of the unit parts according to local laws and regulations.

THIS PAGE INTENTIONALLY LEFT BLANK.

APPENDIX - MSDS

2-ETHYLHEXYL ALCOHOL

MSDS No. 11921-(3)(07-015) Revised: Sep-15, 2004 Printed:Aug-29, 2007

1. CHEMICAL PRODUCT IDENTIFICATION AND COMPANY IDENTIFICATION

Product Name : : 2-Ethylhexyl Alcohol
Koso Chemical Co.,Ltd. 13-15,2-chome,Higashisakashita,Itabashi-ku,Tokyo,Japan
Emergency Telephone No. : 048-556-6261

2. COMPOSITION/INFORMATION ON INGREDIENTS

Material : 2-Ethylhexyl Alcohol, 2-Ethyl-1-Hexanol
CAS No. : 104-76-7
Formula : $CH_3(CH_2)_3CH(C_2H_5)CH_2OH$
Purity : 99 wt%

3. HAZARDS IDENTIFICATION

Irritating to eyes and skin.
Flammable liquids.

4. FIRST AID MEASURES

In case of contact, immediately flush eyes or skin with copious amounts of water for at least 15 minutes while removing contaminated clothing and shoes.
If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen.
If swallowed, wash out mouth with water provided person is conscious.
Call a physician. Wash contaminated clothing before reuse.

5. FIRE FIGHTING MEASURES

Flammable properties
Flash point : 78°C (close)
Flammable limits in air : LEL 0.88 vol%, UEL 9.7 vol%
Autoignition : 305°C
Extinguishing media
Carbon dioxide, Dry chemical powder or Appropriate foam.
Special firefighting procedures
Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.
Unusual fire and explosions hazards
Emits toxic fumes under fire conditions.

6. ACCIDENTAL RELEASE MEASURES

Wear respirator, chemical safety goggles, rubber boots and heavy rubber gloves.
In case of insufficient ventilation, wear suitable respiratory equipment.
To clean the floor contaminated by this material, absorb into waste, sawdust or sand, and collect.
May cause fire.

7. HANDLING AND STORAGE

When using do not eat, drink or smoke.
Avoid contact with eyes, skin and clothing. Avoid prolonged or repeated exposure.
Wash thoroughly after handling.
Use only in well-ventilated areas.
After contact with skin, wash immediately with plenty of water.
In use, may form flammable/explosive vapour-air mixture.
Keep container tightly closed. Store in a cool place away from heat.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Wear appropriate NIOSH/MSHA-approved respirator, chemical-resistant gloves, safety goggles, other protective clothing.
Safety shower and eye bath. Mechanical exhaust required. Take precautionary measures against static discharges.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance and odor : Colorless clear liquid and peculiar fragrant odor.
Boiling point : 184.7°C Melting point : -76°C
Vapor pressure : 0.36 mmHg(20°C)
Specific gravity(water=1) : 0.8325

10. STABILITY AND REACTIVITY

Stability
Stable in a tightly closed container and a cool place.
Incompatibilities
Oxidizing agents.
Hazardous combustion or decomposition products
In use, may form flammable/explosive vapour-air mixture.
Hazardous polymerization
Will not occur.

11. TOXICOLOGICAL INFORMATION

LD_{50} = 3,730 mg/kg (orally in rats)(RTECS)

12. ECOLOGICAL INFORMATION

Ecotoxicological information
Aquatic toxicity TLm96 = 32~37 ppm (rainbow trout)

13. DISPOSAL CONSIDERATIONS

Do not empty into drains.
May be incinerated, sent to an approved hazardous material disposal area, or transferred to a disposal contractor.
Very dilute solutions are biodegradable by specially acclimated bacteria.
When using wear suitable protective clothing, gloves and eye/face protection.

14. TRANSPORT INFORMATION

Shipping information
No information

15. REGULATORY INFORMATION

TLV and source
ACGIH(1997) : TWA(8h) (skin)50 ppm (266 mg/m3)(as isomer 2-octanol)

16. OTHER INFORMATION

The above information is believed to be correct but dose not purport to be all inclusive and shall be used only as a guide.
Responsibility for MSDS : Koso Chemical Co,.Ltd.
Address : 13-15,2-chome,Higashisakashita,Itabashi-ku,Tokyo,Japan
Telephone No. for information : 03-3966-8545

MATERIAL SAFETY DATA SHEET

LITHIUM BROMIDE SOLUTION

Product name	Lithium bromide solution	
Product id	19105	
Revision date	04/12/2012	Revision: 7
Supersedes	04/01/2010	

1. IDENTIFICATION OF THE SUBSTANCE AND THE COMPANY

Chemical name	Lithium bromide water solution
Type of product and use	Inorganic solution used as desiccant medium in air conditioning and cooling systems
Supplier	ICL-IP America Inc 622 Emerson Road - Suite 500 St Louis, Missouri 63141 . USA Tel:(314)983-7884 Fax:(314)983-7607
Emergency Telephone	Chemtrec (800)424-9300

2. HAZARD IDENTIFICATION

Emergency Overview	Clear. colourless to yellow liquid, odourless May cause eye irritation .
Potential Health Effects:	
- Eye Contact	Irritant.
- Skin contact	Mild irritant to intact skin.
- Inhalation	May irritate the upper respiratory tract
- Ingestion	May cause vomiting , nausea . diarrhea and ataxia. Slurred speech , blurred vision , dizziness , sensory loss, convulsions and stupor may occur in cases of large intake.
Chronic effects/Carcinogenicity	Repeated skin contact may cause dermatitis. Repeated oral intake of bromides (>9 mg/kg body weight/day) may affect the central nervous system. Warning symptoms include mental dullness , slurred speech, weakened memory, apathy . anorexia, constipation , drowsiness and loss of sensitivity to touch and pain

3. COMPOSITION / INFORMATION ON INGREDIENTS

Components	CAS No.	Weight %
Lithium bromide	7550-35-8	47-58

4. FIRST AID MEASURES

Eye contact	Holding the eyelids apart, flush eyes promptly with copious flowing water for at least 20 minutes. Get medical attention immediately.
Skin contact	Remove contaminated clothing. Wash skin thoroughly with mild soap and plenty of water for at least 15 minutes. Wash clothing before re-use. Get medical attention if irritation persists.
Inhalation	In case of mist inhalation or breathing fumes released from heated material, remove person to fresh air. Keep him quiet and warm. Apply artificial respiration if necessary and get medical attention immediately.

Ingestion	If swallowed, wash mouth thoroughly with plenty of water. Get medical attention immediately **NOTE:** Never give an unconscious person anything to drink
Notes to the physician	Irritant No specific antidote Treat symptomatically and supportively .

5. FIRE FIGHTING MEASURES

Suitable extinguishing media	Material is not combustible. Use extinguishing media appropriate to surrounding fire conditions.
Fire fighting procedure	Cool containers with water spray. In closed stores, provide fire-fighters with self-contained breathing apparatus in positive pressure mode.
Unusual fire and explosion hazards	None known

6. ACCIDENTAL RELEASE MEASURES

Personal precautions	Wear respirator, chemical safety goggles, rubber gloves and boots.
Methods for cleaning up	Absorb on sand or vermiculite and place in closed container for disposal. Avoid access to streams, lakes or ponds. Ventilate area and wash spill site after material pickup is complete.

7. HANDLING AND STORAGE

Handling	Avoid bodily contact. Keep containers tightly closed.
Storage	Store in a dry, cool, well-ventilated area away from incompatible materials (see "materials to avoid").

8. EXPOSURE CONTROLS

Exposure Limits :

Components	ACGIH-TLV Data	OSHA (PEL) Data
Lithium bromide 7550-35-8	Not determined	Not determined

Ventilation requirements	Provide adequate ventilation Use local exhaust as necessary, especially under mist conditions.
Personal protective equipment:	
- Respiratory protection	Approved respirator
- Hand protection	Rubber gloves
- Eye protection	Chemical safety goggles
- Skin and body protection	Body covering clothes and boots
Hygiene measures	Wash hands thoroughly after handling and before eating or smoking. Do not eat, smoke or drink where material is handled, processed or stored. Safety shower and eye bath should be provided.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Clear, colourless to yellow liquid, odourless
Boiling point/range	146°C (55%)

Melting point/range	10°c (58%)
Flash point	None
FlammablelExplosion limits	Not flammable
Auto-ignition temperature	Not available
Vapour pressure	2.1mmHg @ 20°C (55%)
Evaporation rate (ether=1)	Not available
Vapor density	Not available
Solubility:	
Solubility in water	70 g/100ml at 101°c
Solubility in other solvents	Miscible with methanol, ethanol (absolute), n-propanol
Specific gravity	1.627 (55°C)
pH	Not available
Decomposition temperature	Not available

10. STABILITY AND REACTIVITY

Stability	Stable under normal conditions
Materials to avoid	Strong acids.
Conditions to avoid	None known
Hazardous decomposition products	None known
Hazardous polymerization	Will not occur

11. TOXICALOGICAL INFORMATION

Acute toxicity:	
- Rat oral LD50	>2000 mg/kg
- Rat dermal LD50	>2000 mg/kg
- Rat inhalation LC50	>5.1 mg/1/4hour Irritant
- Eye irritation (rabbit)	Mild irritant.
- Dermal irritation (rabbit)	
- Dermal sensitization	Not a sensitizer.
- Chronic toxicity	Repeated skin contact may cause dermatitis. Repeated oral intake of bromides (>9 mg/kg body weight/day) may affect the central nervous system. Warning symptoms include mental dullness, slurred speech, weakened memory, apathy, anorexia, constipation, drowsiness and loss of sensitivity to touch and pain.
Mutagenicity	Not mutagenic by the Ames Test
Carcinogenicity	Not classified by IARC Not included in NTP 12th Report on Carcinogens
Reproductive toxicity	No data available
Developmental toxicity	No data available
Biomass	test test 1 Npt available

12. ECOLOGICAL INFORMATION

Aquatictoxicity:	
- 96 Hour-LCSO, Fish	>1000 mg/l
- 72 hour - ECSO, Marine algae	751.9 mg/l
- 48 Hour-ECSO,Marine Invertebrate	1527.7 mg/l

13. DISPOSAL CONSIDERATIONS

Waste disposal	Avoid access to streams, lakes or ponds Observe all federal, state and local environmental regulations when disposing of this material.

14. TRANSPORTATION INFORMATION

DOT	Not regulated
IMDG	Not regulated
ICAO/IATA	Not regulated

15. REGULATORY INFORMATION

USA	Reported in the EPA TSCA Inventory.
Canada	Listed in DSL
EU	Reported in EINECS
Japan	ENCS no. (1)-110 ISHL no. (1)-110
Australia	Listed in AICS
New Zealand Inventory	Listed in NZIoC
CHINA - China inventory	Listed in IECSC
Korea	Listed in the Korea Existing Chemicals Inventory (KECI), number KE-22549
Philippines	Listed in PICCS

OTHER INFORMATION:

GHS
Label elements

Signal word	Warning
Hazard statements	H319 - Causes serious eye irritation
Precautionary statements	P264 - Wash hands thoroughly after handling P280 - Wear protective gloves/protective clothing/eye protection/face protection P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing P337 + P313 - If eye irritation persists: Get medical advice/attention.

This data sheet contains changes from the previous version in section(s)
1, 2(ROW), 3(ROW), 8, 15

Health, Safety & Environment Policy
We will strive to ensure that our operations and products meet the needs of the present global community without compromising the ability of future generations to meet their needs We accept that the success of our business is dependent on the supply of products and services that will benefit society whilst ensuring human safety and protection of the environment and natural resources Within the framework of our commitment to the Responsible Care program, we will provide a healthy and safe work environment for employees and will responsibly manage our products at all stages of their life cycle in order to protect human health and the environment whilst maintaining high production standards of operation

TO MEET THIS COMMITMENT WE WILL: Comply with or exceed applicable national and international regulatory requirements and other requirements to which we subscribe Communicate openly and actively encourage dialogue with employees, customers and community concerning our products and operations Implement documented management systems consistent with and for promotion of the Responsible Care ethics
Develop and supply products that can be manufactured, transported, used and disposed of safely whilst best meeting the needs of our customers Regularly assess, continually improve and responsibly manage health, safety and environmental risks associated with products and processes throughout their life-cycles Share knowledge and expertise with others and seek to learn from and incorporate improved practices into our own operations

Educate and train employees, contractors and customers to improve their HSE performance Communicate up-to-date information to enable our workers, customers and other interested parties to handle our products in a safe and environmentally responsible manner Endeavor to work with customers, suppliers, distributors and contractors to foster the safe use, transport and disposal of our chemicals Support Product Stewardship programs in cooperation with customers, distributors and transporters

Although the information and recommendations set forth herein (hereinafter "information") are presented in good faith and believed to be correct as of the date hereof, ICL-IP America Inc. makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving same will make their own determination as to its safety and suitability for their purposes prior to use. In no event will ICL-IP America Inc. be responsible for damages of any nature whatsoever resulting from the use of or reliance upon information. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESSED OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE, ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR THE PRODUCT TO WHICH THE INFORMATION REFERS.

In an event of discrepancy between the contents of this MSDS and the English version of it, the English version shall prevail.

Prepared by

HERA Division in ISRAEL
telephone: +/972-8-6297835
telefax: +/972-8-6297832
www.icl-ip.com
e-mail:msdsinfo@icl-ip.com

End of safety data sheet

LITHIUM MOLYBDATE

FIRST ISSUE: MAY.2.2007
REVISED: FEBRUARY.2.2017
PRODUCT NAME: LITHIUM MOLYBDATE
SDS 61-04E

SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

a. Product Name Lithium Molybdate

- General Use The corrosion inhibitor for Lithium Bromide solution
- Product Description Solution of Lithium Molybdate
- SDS Number 61-04E

b. MANUFACTURER

- Company Name CLEARLIGHT INDUSTRY CO.,LTD.
- Address 1539-3 Yamada , Seki City , Gifu , Japan 501-3944
- Telephone No. +81-575-27-3051
- Fax No. +81-575-27-3053

c. EMERGENCY TELEPHONE NUMBER

- +81-575-27-3051

2. HAZARDS IDENTIFICATION

GHS classification

Classification of the substance or mixture

Carcinogenicity Category 2

Pictograms

Signal word Warning

Hazard statements

- H351 - Suspected of causing cancer

Precautionary statements-(Prevention)

- Wash face, hands and any exposed skin thoroughly after handling
- Wear protective gloves/protective clothing/eye protection/face protection

Precautionary statements-(Response)

- IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- If eye irritation persists: Get medical advice/attention.
- IF ON SKIN: Wash with plenty of soap and water
- If skin irritation occurs: Get medical advice/attention
- Take off contaminated clothing and wash before reuse

FIRST ISSUE: MAY.2.2007
REVISED: FEBRUARY.2.2017
PRODUCT NAME: LITHIUM MOLYBDATE
SDS 61-04E

Precautionary statements-(Storage)

- Not applicable

Precautionary statements-(Disposal)

- Not applicable

Others

3. COMPOSITION / INFORMATION ON INGREDIENTS

Single Substance or Mixture Mixture
Formula Li2MoO4

CHEMICAL NAME	CONTENT	CAS NO	ENCS
Lithium Molybdate	300 g / L	13568-40-6	(1)-764
water	the rest	7732-18-5	-

4. FIRST AID MEASURES

Inhalation

- Remove to fresh air. If symptoms persist, call a physician.

Skin contact

- Wash off immediately with soap and plenty of water. If symptoms persist, call a physician.

Eye contact

- IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediate medical attention is required.

Ingestion

- Rinse mouth. Never give anything by mouth to an unconscious person. Call a physician or poison control center immediately.
- Do not induce vomiting without medical advice.

Protection of first-aiders

- Use personal protective equipment as required.

5. FIRE FIGHTING MEASURES

Suitable extinguishing media

- Water spray (fog), carbon dioxide (CO2), Foam, Extinguishing powder, Sand

Unsuitable extinguishing media

- No information available

Special extinguishing method

- Evacuate area and fight fire from a safe distance

Specific hazards arising from the chemical product

- Thermal decomposition can lead to release of irritating and toxic gases and vapors.

Protection of fire-fighters

- Use personal protective equipment as required. Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

- For indoor, provide adequate ventilation process until the end of working. Deny unnecessary entry other than the people involved by, for example, using a rope. While working, wear appropriate protective equipments to avoid adhering it on skin, or inhaling the gas. Work from windward, and retract the people downwind.

Environmental precautions

- To be careful not discharged to the environment without being properly handled waste water contaminated. SeeSection 12 for additional ecological information.

Methods and materials for contaminent and methods and materials for cleaning up

- Do not touch spilled material without suitable protection (See section 8). After material is completely picked up, wash the spill site with soap and water and ventilate the area. Put all wastes in a plastic bag for disposal and seal it tightly. Remove, clean, or dispose of contaminated clothing.

Recoverly, neutralization

- No information available

Secondary disaster prevention measures

- Clean contaminated objects and areas thoroughly observing environmental regulations.

7. HANDLING AND STORAGE

Handling

Technical measures

- Avoid contact with strong oxidizing agents. Use with local exhaust ventilation.

Precautions

- Do not rough handling containers, such as upsetting, falling, giving a shock, and dragging. Prevent leakage, overflow, and scattering. Not to generate steam and dust in vain. Seal the container after use. After handling, wash hands and face, and then gargle. In places other than those specified, should not be smoking or eating and drinking. Should not be brought contaminated protective equipment and gloves to rest stops. Deny unnecessary entry of non-emergency personnel to the handling area.

Safety handling precautions

- Use personal protective equipment as required.

Storage

Storage conditions

- Store away from sunlight in well-ventilated place at room temperature (preferably cool).
- Keep container tightly closed.

FIRST ISSUE: MAY.2.2007
REVISED: FEBRUARY.2.2017
PRODUCT NAME: LITHIUM MOLYBDATE
SDS 61-04E

Safe packaging material
- Polypropylene

Incompatible substances
- Strong oxidizing agents

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering controls
- In case of indoor workplace, seal the source or use a local exhaust system. Provide the safety shower facility, and hand- and eye-wash facility. And display their position clearly.

Exposure limits

CHEMICAL NAME	JOSH (JAPAN)	ISHL (JAPAN)	ACGIH
Lithium Molybdate 13568-40-6	N/A	N/A	TWA: 0.5 mg / m^3Mo respirable fraction

Personal protective equipment

Respiratory protection
- Dust mask

Hand protection
- Protection gloves

Eye protection
- protective eyeglasses or chemical safety goggles

Skin and body protection
- Long-sleeved work clothes

General hygiene considerations
- Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form
Color Colorless clear
Appearance Liquid
Odor No data available
pH 8.0~9.0
Melting point/freezing point No data available
Boiling point, initial boiling point and boiling range No data available
Flash point No data available
Evaporation rate: No data available
Flammability (solid, gas): No data available
Upper/lower flammability or explosive limits
Upper: No data available
Lower No data available
Vapour pressure No data available
Vapour density No data available

Specific Gravity / Relative density 1.19~1.29
Solubilities water : soluble .
n-Octanol/water partition coefficient:(log Pow) No data available
Auto-ignition temperature: No data available
Decomposition temperature: No data available
Viscosity (coefficient of viscosity) No data available
Dynamic viscosity No data available

10. STABILITY AND REACTIVITY

Stability

Stability

- Stable under recommended storage conditions.

Reactivity

- No data available

Hazardous reactions

- None under normal processing

Conditions to avoid

- Extremes of temperature and direct sunlight

Incompatible materials

- Strong oxidizing agents

Hazardous decomposition products

- Metal oxides

11. TOXICOLOGICAL INFORMATION

Acute toxicity No data available
Skin irritation/corrosion No data available
Serious eye damage/ irritation No data available
Respiratory or skin sensitization No data available
Reproductive cell mutagenicity No data available
Carcinogenicity

CHEMICAL NAME	NTP	IARC	ACGIH	JSOH (JAPAN)
Lithium Molybdate 13568-40-6	N/A	N/A	A3	N/A

Reproductive toxicity No data available
STOT-single exposure No data available
STOT-repeated exposure No data available
Aspiration hazard No data available

FIRST ISSUE: MAY.2.2007
REVISED: FEBRUARY.2.2017
PRODUCT NAME: LITHIUM MOLYBDATE
SDS 61-04E

12. ECOLOGICAL INFORMATION

Ecotoxicity	No information available
Other data	No data available
Persistence and degradability	No information available
Bioaccumulative potential	No information available
Mobility in soil	No information available
Hazard to the ozone layer	No information available

13. DISPOSAL CONSIDERATION

Waste from residues

- Disposal should be in accordance with applicable regional, national and local laws and regulations.

Contaminated container and contaminated packaging

- Disposal should be in accordance with applicable regional, national and local laws and regulations.

14. TRANSPORT INFORMATION

ADR/RID Not regulated

UN number -
Proper shipping name:
UN classfication
Packing group
Marine pollutant Not applicable

IMDG Not regulated

UN number -
Proper shipping name:
UN classfication
Packing group
Marine pollutant (Sea) Not applicable
Transport in bulk according to No information available
Annex II of MARPOL 73/78 and the IBC Code

IATA Not regulated

UN number -
Proper shipping name:
UN classfication
Packing group
Environmentally Hazardous Substance

15. REGULATORY INFORMATION

International Inventories

EINECS/ELINCS Listed
TSCA Listed

Japanese regulations

Fire Service Act Not applicable
Poisonous and Deleterious Substances Control Law Not applicable
Industrial Safety and Health Act Notifiable Substances (Law Art.57-2, Enforcement Oder Art.18-2
Attached Table No.9)No.603
Harmful Substances Whose Names Are to be Indi cated on the Label
(Law Art.57, Para.1, Enforcement Order Art.18)
Regulations for the carriage and storage of dangerous goods in ship Not applicable
Civil Aeronautics Law Not applicable
Pollutant Release and Transfer Register Law Class 1
Class 1 - No. 453
Water Pollution Control Act Specified substances(Law Art.2 Para.4, Enforcement Order Art.3-3)
Export Trade Control Order Not applicable
Air Pollution Control Law Hazardous Air Pollutants

16. OTHER INFORMATION

MSDS first issued May.2.2007
MSDS revised November.22.2011

Key literature references and sources for data etc.

- NITE: National Institute of Technology and Evaluation (JAPAN)
- http://www.safe.nite.go.jp/japan/db.html
- IATA dangerous Goods Regulations

This information is furnished without warranty, express or implied, except that it is accurate to the best knowledge of CLEARLIGHT INDUSTRY CO.,LTD. It relates only to the specific product designated herein, and does not relate to use in combination with any other material or any process. CLEARLIGHT INDUSTRY CO.,LTD. assumes no legal responsibility for use of or reliance upon this information.

ULVAC R-7 OIL

Material Safety Data Sheet

Revision Date January 2013

1. Product and Company Identification

PRODUCT NAME: **ULVAC R-7**
MATERIAL USES: Lubricating Oil
COMPANY: Inland Vacuum Industries
35 Howard Ave
Churchville NY 14428
(585) 293-3330
VALIDATION DATE: 1/15/2013

2. Hazards Identification

Physical State: Bright oily liquid
Odor: Petroleum
OSHA/HCS Status: While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this MSDS contains valuable information critical to the safe handling and proper use of the product. This MSDS should be retained and available for employees and other users of this product
Emergency Overview: Caution - May cause eye and skin irritation. Prolonged or repeated contact may dry skin and cause irritation. Harmful or fatal if swallowed. Can enter lungs and cause damage.
Slightly irritating to the eyes and skin. Defatting to the skin. Aspiration hazard if swallowed. Can enter lungs and cause damage. Do not ingest. Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Wash thoroughly after handling.
Routes of entry: Dermal contact. Eye contact. Inhalation. Ingestion.
Potential acute health effects
- Inhalation: No known significant effects or critical hazards.
- Ingestion: Aspiration hazard if swallowed. Can enter lungs and cause damage.
- Skin: Slightly irritating to the skin.
- Eyes: Slightly irritating to the eyes.

Potential chronic health effects
- Chronic effects: Prolonged or repeated contact can defat the skin and lead to irritation, cracking and/or dermatitis.
- Carcinogenicity: No known significant effects or critical hazards.
- Mutagenicity: No known significant effects or critical hazards.
- Teratogenicity: No known significant effects or critical hazards
- Developmental effects: No known significant effects or critical hazards.
- Fertility effects: No known significant effects or critical hazards

Over-exposure signs/symptoms
- Inhalation: No specific data.
- Ingestion: Adverse symptoms may include the following: nausea or vomiting
- Skin: Adverse symptoms may include the following: irritation. redness, dryness, Cracking
- Eyes: Adverse symptoms may include the following irritation. watering. redness
- Medical conditions: None known

Aggravated by over-exposure
See toxicological information (section 11)

3. Composition/information on ingredients

United States

Chemical Name	CAS number	%
Distillates (petroleum) hydrotreated heavy paraffinic	64742-54-7	>99

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

4. First aid measures

Eye Contact: Check for and remove any contact lenses. In case of contact with eyes, rinse immediately with plenty of water. Get medical attention if symptoms occur.

Skin Contact: Wash with soap and water. Get medical attention if symptoms occur.

Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms appear.

Ingestion: Do not induce vomiting. Never give anything by mouth to an unconscious person. Get medical attention if symptoms appear.

Protection of first-aiders: No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Notes to physician: No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled..

5. Fire-fighting measures

Flammability of the product: May be combustible at high temperature.

Extinguishing media

Suitable: Use dry chemical, C02, water spray (fog) or foam.

Not Suitable; None known

Hazardous thermal decomposition products: No specific data

Special protective equipment for fire-fighters: Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

6. Accidental release measures

Personal precautions: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see section 8).

Environmental precautions: Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods for cleaning up

Small spill: Stop leak if without risk. Move containers from spill area. Dispose of via a licensed waste disposal contractor.

Large spill: Stop leak if without risk. Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see section 1 for emergency contact information and section 13 for waste disposal

7. Handling and storage

Handling: Put on personal protective equipment (see section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Do not breathe vapor or mist. Do not ingest. Avoid contact with eyes, skin and clothing. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Empty containers retain product residue and can be hazardous. Do not reuse container.

Storage: Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section

10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

8. Exposure controls/personal protection

Consult local authorities for acceptable exposure limits.

Recommended monitoring procedures: If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.

Engineering measures: No special ventilation requirements. Good general ventilation should be sufficient to control worker exposure to airborne contaminants. If this product contains ingredients with exposure limits, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure below any recommended or statutory limits.

Hygiene measures: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing.

Personal protection

Eyes:	Safety glasses
Sn:	Labco
Respiratory:	A respirator is not needed under normal and intended conditions of use
Hands:	Natural rubber (latex)

Personal protective equipment (pictogra

HMIS Code/Personal protective equipment: B

Environmental exposure controls: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

9. Physical and chemical properties

Physical state:	Bright oily liquid
Flash Point:	230°C
Vapor pressure:	<.0001 Torr @25°C
Boiling point:	95°C @ .01 torr
Viscosity:	68 cSt @ 40°C
Solubility in water:	Nil
Appearance:	Clear to straw yellow viscous liquid with faint petroleum odor.

10. Stability and reactivity

Stability:	The product is stable
Hazardous polymerization:	Under normal conditions of storage and use, hazardous polymerization will not occur.
Conditions to avoid:	No specific data
Materials to avoid:	Reactive or incompatible with the following materials: oxidizing materials.
Hazardous decomposition products:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

11. Toxicological information

Acute toxicity

ProducUingredient name	Species	Dose	Result	Exposure
Base Oil	Rabbit	>2 g/kg	LD50 Dermal	
	Rat	>5 g/kg	LD50 Oral	

Inhalation: No known significant effects or critical hazards.
Ingestion: Aspiration hazard if swallowed. Can enter lungs and cause damage
Skin: Slightly irritating to the skin
Eyes: Slightly irritating to the eyes

12. Ecological information

Environmental effects: No known significant effects or critical hazards.

13. Disposal considerations

Waste disposal: The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Disposal should be in accordance with applicable regional, national and local laws and regulations.
Refer to section 7: Handling and storage and section 8: Exposure controls/personal protection for additional handling information and protection of employees.

14. Transport information

AERG: Not applicable
Regulatory information
DOT/IMDG/IATA: Not regulated

15. Regulatory information

United States
HCS Classification; Not regulated
U.S. Federal regulations: United States Inventory (TSCA 8b): All components are listed or exempted.
SARA 302/304/311 /312 extremely hazardous substance: No products were Found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: No products were found
SARA 311/312 MSDS distribution-chemical inventory-hazard identification: No products were found.
Clean Water Act (CWA) 307: No products were found.
Clean Water Act (CWA) 311: No products were found.
Clean Air Act (CAA) 112 accidental release prevention: No products were found.
Clean Air Act (CAA) 112 regulated flammable substances: No products were found.
Clean Air Act (CAA) 112 regulated toxic substances: No products were found.
State regulations: Connecticut Carcinogen Reporting: None of the components are listed.
Connecticut Hazardous Material Survey: None of the components are listed.
Florida substance: None of the components are listed.
Illinois Chemical Safety Act: None of the components are listed.
Illinois Toxic Substances Disclosure to Employee Act: None of the components are listed.
Louisiana Reporting: None of the components are listed.
Louisiana Spill: None of the components are listed.
Massachusetts Spill: None of the components are listed.

www.inlandvacuum.com

Michigan Critical Material: None of the components are listed.
Minnesota Hazardous Substances: None of the components are listed.
New Jersey Hazardous Substances: None of the components are listed.
New Jersey Spill: None of the components are listed.
New Jersey Toxic Catastrophe Prevention Act: None of the components are listed.
New York Acutely Hazardous Substances: None of the components are listed.
New York Toxic Chemical Release Reporting: None of the components are listed.
Pennsylvania RTK Hazardous Substances: None of the components are listed.
Rhode Island Hazardous Substances: None of the components are listed.

California Prop. 65: No products were found

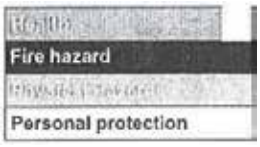
International regulations

International lists: This product, (and it ingredients) is (are) listed on national inventories, or is (are) exempted from being listed, in Australia (AICS), in Europe (EINECS/ELINCS), in Korea (TCCL), in Japan (METI), in the Philippines (RA6969).

16. Other information

Label requirements: May cause eye and skin irritation. Prolonged or repeated cont may dry skin and cause irritation. Harmful or fatal if swallowed. Can enter lungs and cause damage.

Hazardous Material Information System (U.S.A.);

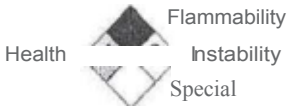


HAZARD RATINGS

4· Extreme
3· Serious
2· Moderate
1Slight
0-MInimal
Sea section 8 for more detailed
Information on 1>9rsonal protection.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.):



The information on this form is furnished solely for the purpose of compliance with the OSHA Act, and shall not be used for any other purpose. The information herein is given in good faith and is based on data considered accurate. However, no warranty, expressed or implied, is made regarding the accuracy of these data or the results to be obtained from the use thereof.

5000 Renaissance Drive, New Freedom, Pennsylvania USA 17349
800-861-1001
www.johnsoncontrols.com

Form 155.31-ICOM2.EN.CE/GB (318)
Issue Date: March 29, 2018
Supersedes 155.31-ICOM2.EN.CE/GB (1117)