Specification Sheet



TCR-109-41/42

MANUFACTURED BY

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UNIT INFORMATION

Construction	The TCR-109 is a refrigeration unit designed to provide high reliability in extreme ambient temperature. The refrigeration unit consists of compressor, refrigerant piping, condenser coil, thermal expansion valve, chiller, pump, condenser fan motor, electric control panel, and expansion tank. The electrical control panel and expansion tank are mounted separately. The refrigeration unit frame is constructed of aluminum (5052H32), treated to resist corrosion induced by salt spray atmosphere. All fasteners including bolts, screws, nuts, washers, hinges, are stainless steel. There are numerous options to accommodate tank types, food and hazardous cargoes, extreme conditions, et cetera. The specification here is for the single unit working at or near freezing point – the various options and customized features are listed at the end of this document. The machine is designed to work with the cooling coil system provided by the tank builder. Klinge will give advice on routing and venting pipes and heat calculations. Klinge may provide the air vents as part of the installation kit.
Equipment design	To withstand and operate satisfactorily under sea-going and environmental conditions including: Ocean environment: Salt-laden air, sea spray, high humidity and severe atmospheric conditions
Rolling:	Amplitude of 30 degrees on each side, period of 13 seconds
Pitching:	Amplitude of 6 degrees, period of 8 seconds
Permanent list:	20 degrees on each side
Shock:	Acceleration of 2 G in all directions
Vibrations:	Of the type encountered on ships or land vehicles and rails
Tank Unit Dimensions & Weight	See drawing, page 10
Control Box Dimensions & Weight	See drawing, page 11

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Power supply Main power Control circuit	 50 Hz; 360VAC min. - 460VAC max. 60 Hz; 400VAC min. - 500VAC max. The nominal frequencies of 50 Hz and 60 Hz shall have a tolerance of ± 2.5%. 14/24 Volts A/C
Paint	Powder coated White
Refrigerant TCR-109-41 TCR-109-42	 R-404A 2.2 kg [4.9 lbs] R-452A 2.5 kg [5.5 lbs]
Method of Heating	Electric resistance 6 kW or 12 kW (optional)

UNIT CAPACITY

Unit capacity 60 Hz	Net cooling capacity at 37.8°C (100°F) ambient temperature at 60 Hz power.	
	Return glycol temperature	**Net Capacity**
	-17.8°C / 0°F	2270 Kcal/h 2640 W
	1.7°C / 35°F	4200 Kcal/h 4885 W

STANDARD INFORMATION

The equipment is designed to withstand and operate satisfactorily under seagoing and environmental conditions as follows:
Machinery is designed to maintain cargo and cooling liquid temperatures in the following ranges: No Heat -29°C (-20°F) to +29°C (84°F) Heat: -29°C (-20°F) to +60°C (140°F) Extended: -33°C (-27°F) to +80°C (176°F) Requires Config Menu change

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Machinery will be in full functional operation and work satisfactorily in ambient temperature from -30°C (-22°F) to +52°C (125°F). Components are made to withstand temperature up to 70°C (158°F).
The unit is built to comply with standards and regulations of major Classification Societies such as: AHRI – test method for rating refrigerated equipment. Machinery complies with International Customs Regulations for Containers. Machinery complies with relevant ISO Recommendations. Machinery complies with rules of B.V., ABS and Lloyds Register, but is certified to ISO 1496-2. Unit complies with Australia and New Zealand Health Requirements.

UNIT INFORMATION, REFRIGERATION SYSTEM

COMPRESSOR/CONDENSER SECTION		
Compressor	**Type**	Hermetic Scroll
	Displacement	282 CFH
	Oil	Mobile EAL Arctic 22 cc Polyester Oil
	Protection	Automatic reset
Chiller	**Material**	Stainless Steel
	Type Construction	Brazed Plate
Condenser Coil	**Tube / Fin Material**	Copper / Aluminum
	Surface area	10 m^2
	Protection	Surface treated to resist corrosion induced by salt spray atmosphere.
Condenser Fan	**Type**	Blower (Forward Curved)
	Diameter	233 mm (9.2 inch)
	Blade Material	Aluminum
	Drive	Direct on motor Shaft
Condenser Fan Motor	**Nominal HP**	1.5
	Type	Totally Enclosed Air Over
	RPM	1750
	Degree of Protection	IP 66
	Insulation	Class F

REFRIGERATION SYSTEM			
TX Valve	1-2 tons	**Suction Pressure Regulating Valve**	15 psig

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Filter Drier		**Moisture Indicator**	
Heat Exchanger	450 psig	**Pump**	1/2 Hp
Shut Off Valve	Liquid line hand valve (1/2" OD)	**Discharge Temperature Control Valve**	
REFRIGERATION SAFETY CONTROLS			
High Pressure Switch (normally closed)	Opens at 31 bar (450 psi) Closes at 21 bar (300 psi)	**Fusible Plug (on Receiver)**	Blow temperature 100°C (212°F)
ELECTRIC SAFETY CONTROLS			
Compressor, Condenser Motor and Pump:		Internal automatic reset overloads	

UNIT INFORMATION, ELECTRICAL SYSTEM

ELECTRIC SAFETY CONTROLS			
Main Circuit Breaker		13A (w/optional heater 25A) adjustable	
Control Circuit Breaker (24VAC)		4A	
Control Circuit Breaker (12VAC)		4A	
INTERNAL ELECTRIC PANEL COMPONENTS			
Contactors		Compressor, Condenser Motor, Pump, Heater (optional)	
Display panel LED's		LED indicators on thermostat	
Circuit Breakers		Main Power C.B. Control Circuit C.B.	
Control Transformer		Primary 400 Volts, Secondary 14/24 Volts	
EXTERNAL ELECTRIC PANEL COMPONENTS			
Switch		Unit On-Off	
Switch		Function Test/Glycol Temp	
Circuit Breaker		Control Circuit Reset 12V	
Circuit Breaker		Control Circuit Reset 24V	
POWER PLUG			
Storage for power cable provided by others- built into the tank frame by the tank builder or at time of installation			
Length	18m (58.5 ft)	**Cable**	S.O. 10/4
Temperature Range	-50°C to 70°C	**Color**	Yellow or black

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GLYCOL EXPANSION TANK

A small expansion tank must be fitted to the system. There are two options, a simple atmospheric tank or a pressurized system.

The simple atmospheric tank can be fabricated as part of the container structure, a proprietary tank usually a plastic tank or an aluminum pipe tank made by Klinge. This separate item is located at a convenient high point on the tank framework.

DATA LOGGER

An optional, self-contained electronic data logger, with independent sensors for up to 6 channels of temperature recording, housed in its own enclosure is available. The logger may be programmed to record trip data and can either print out reports or download the data to a laptop type computer.

The six channels could be used for

Cargo temperature

Glycol temperature

Ambient air temperature

As a spare or other function

This unit has set points and temperature limits that can be integrated into the control of the machine as a back-up or fallback alarm.

HEAT TRANSFER FLUIDS

The unit can handle a wide range of transfer fluids

1. For chemical cargoes at near freezing point of water temperature, a standard 50/50 ethylene-based glycol is used.
2. For food cargoes at near freezing point of water temperatures, a standard 50/50 propylene-based glycol is used.
3. For higher temperature operations, the glycol is substituted with synthetic oil.
4. For cargo temperatures less than -12°C (10°F) a synthetic compound is used.

The glycols have built-in corrosion inhibitors and low viscosity in water solutions.

The oils are not corrosive.

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The very low temperature compounds are very viscous and tend to attack natural and synthetic rubber. To accommodate this, threaded joints must be eliminated or sealed, and flexible hoses reduced to the minimum.

CONTROL SYSTEM

Control Information

The control system is an electronic solid-state device consisting of three parts:

1. The microprocessor thermostat
2. Temperature sensing probes
3. Display panel /Temperature selector

These parts are contained in the control box except the cargo and glycol temperature probes, which are mounted in thermal wells in the tank container and glycol piping.

Display Panel General Description

The display panel consists of three membrane switches and a three digit alpha-numeric LED display**.** The display indicates cargo temperature as derived from the cargo probe.

Temperature, Selection

Once a set point is entered, the thermostat controls the actions of the TCR-109.

Indicator LEDs are mounted on the thermostat, visible from the front of the electric control panel.
These indicator LEDs are provided to determine correct functions and as an aid to servicing the unit.
When the unit **ON/OFF** switch is in the **ON** position, the display panel will show cargo probe temperature.
The set point is entered using the membrane switches on the display panel.
The set point is stored in a nonvolatile memory and will always be intact - even in case of power failure.
In order to prevent false entry or changes of values, both selector buttons have to be depressed simultaneously for a new set point to be entered into the memory.

Temperature Sensing Probes:

Proper functionality of the unit depends on proper probe location and mounting.

The system is adaptable to customer requirements. The location of the thermo-well is determined by the customer, but in general, for tanks designed to carry full loads, is 1/3rd up the height of the liquid and some distance from any heating or cooling coils.

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The thermostat allows for two control probes, one in the cargo and one in the cooling / heating medium. The heat transfer medium, by definition, must be higher or lower in temperature than the cargo. The temperature of the cargo may be varied by raising or lowering the temperature of the glycol. Locally sub-cooling or locally overheating the cargo at the point at which the glycol first comes in contact with the tank may be a problem with some cargoes. This is particularly true when the cargo temperature is near the freezing point of the cargo. The glycol limit setting prevents this local under cooling or over heating of sensitive cargo.

Inputs

Input signals to the thermostat consist of:

1. Cargo temperature probe
2. Glycol temperature probe
3. Set point as entered from display panel
4. Glycol Limit as entered from display panel
5. Signal to initiate function test

Outputs

Output signals from the thermostat are by means of eight relays. Four relays are single pole single throw normally open and four are single pole double throw.

Outputs used in this system are:

1. Compressor On (Cooling)
2. Condenser Fan On
3. Glycol Pump On
4. Heat (Optional)

Each output relay has a red LED mounted on the circuit board adjacent to the relay to indicate if that relay is energized.

Microprocessor Thermostat Functions:

Temperature Falling

1. Compressor cycles off at set point
2. Heat cycles ON at 0.5°C (0.9°F) below set point (Optional).

Temperature Rising

1. Heat cycles OFF at set point (Optional)
2. Compressor cycles on at 0.6°C (0.9°F) above set point. There is a one-minute OFF delay of the compressor before it can cycle on again, regardless of the temperature rise.

Alarm Codes

The TCR-109 microprocessor thermostat logic is designed to show alarm codes on the display panel in the event of the system not operating properly.

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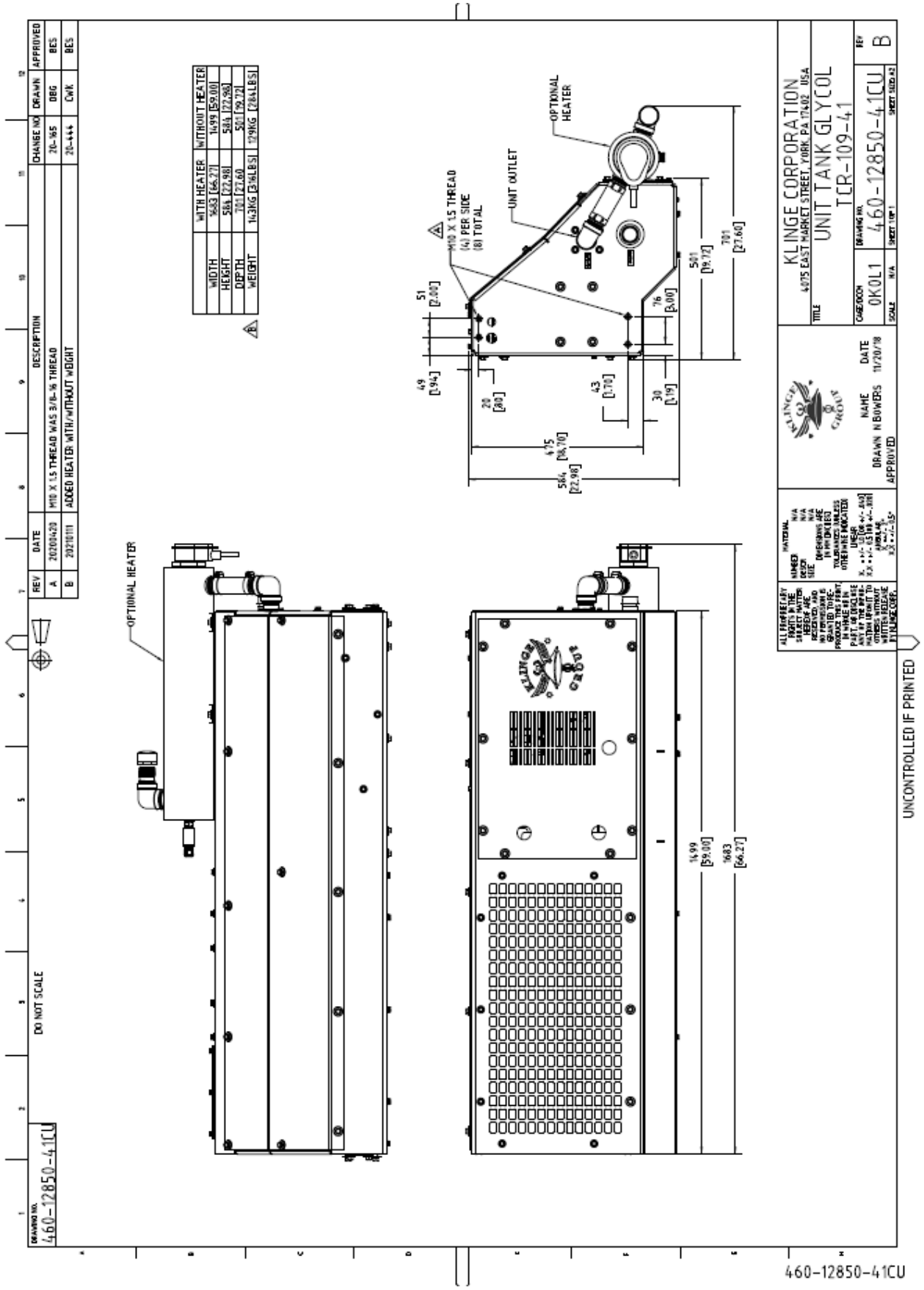
For example: If the temperature pull-down rate or rate of rise (heating) is less than 0.06°C (0.18°F) per hour the alarm LED will light, the temperature failure LED will flash and the display panel will also show an A30 (container temperature too low) or an A31 (container temperature too high) alarm code.

OPTIONS

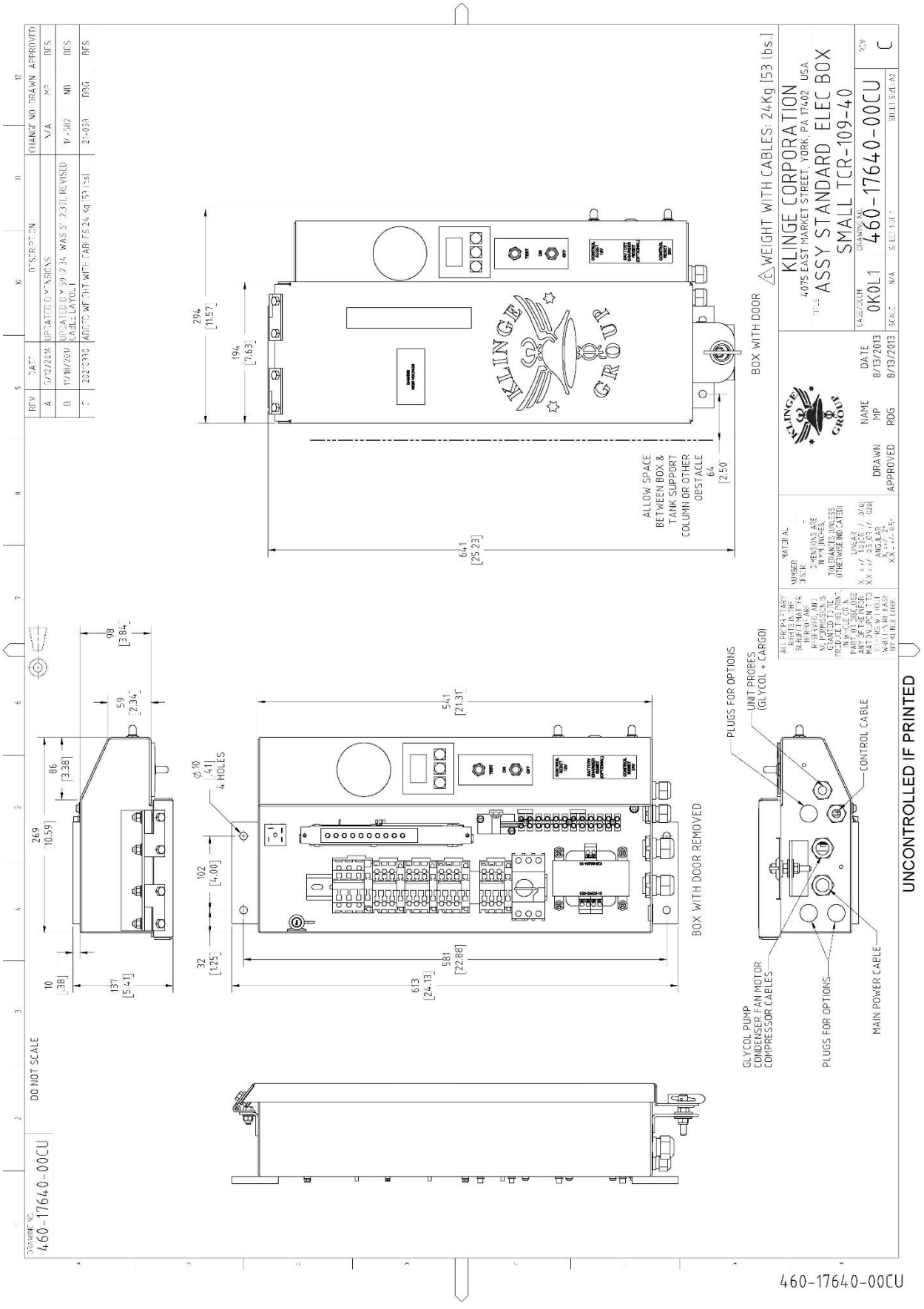
Data logger	A self-contained 6 channel electronic data logger with printer, housed in its own enclosure, with or without the temperature limits integrated into the alarm system that can be printed out or downloaded.
6 kW or 12 kW heater	This is normally bolted to the rear of the unit and hard piped to the inlet of the pump within the machine. However, it may be remotely located if the space below the tank is not convenient.
Horn	An additional horn may be added to the outside, connected to the thermostat and will sound when an alarm condition arises.
Frame or beam tank mounting	The machine is designed to mount on ether the bottom rail of the tank or to be suspended from the stiffening rings of a beam tank.
Satellite communication and / or GSM	Retrofitted or fitted as original equipment the machine can be fitted with a satellite transponder and transmit both location and a combination of 3 signals.
Dual system	For high hazardous cargoes two machines may be fitted to one tank giving a 100% redundancy of parts – in the event of one unit failing or under reporting the appropriate alarm will sound and the machine automatically hands control over to the other machine to maintain the temperature.

Other options have been arranged and can be considered – whatever combination of features is selected, the operating instructions on the outside of the control box are customized accordingly as are the circuit diagram and troubleshooting information inside the control box door.

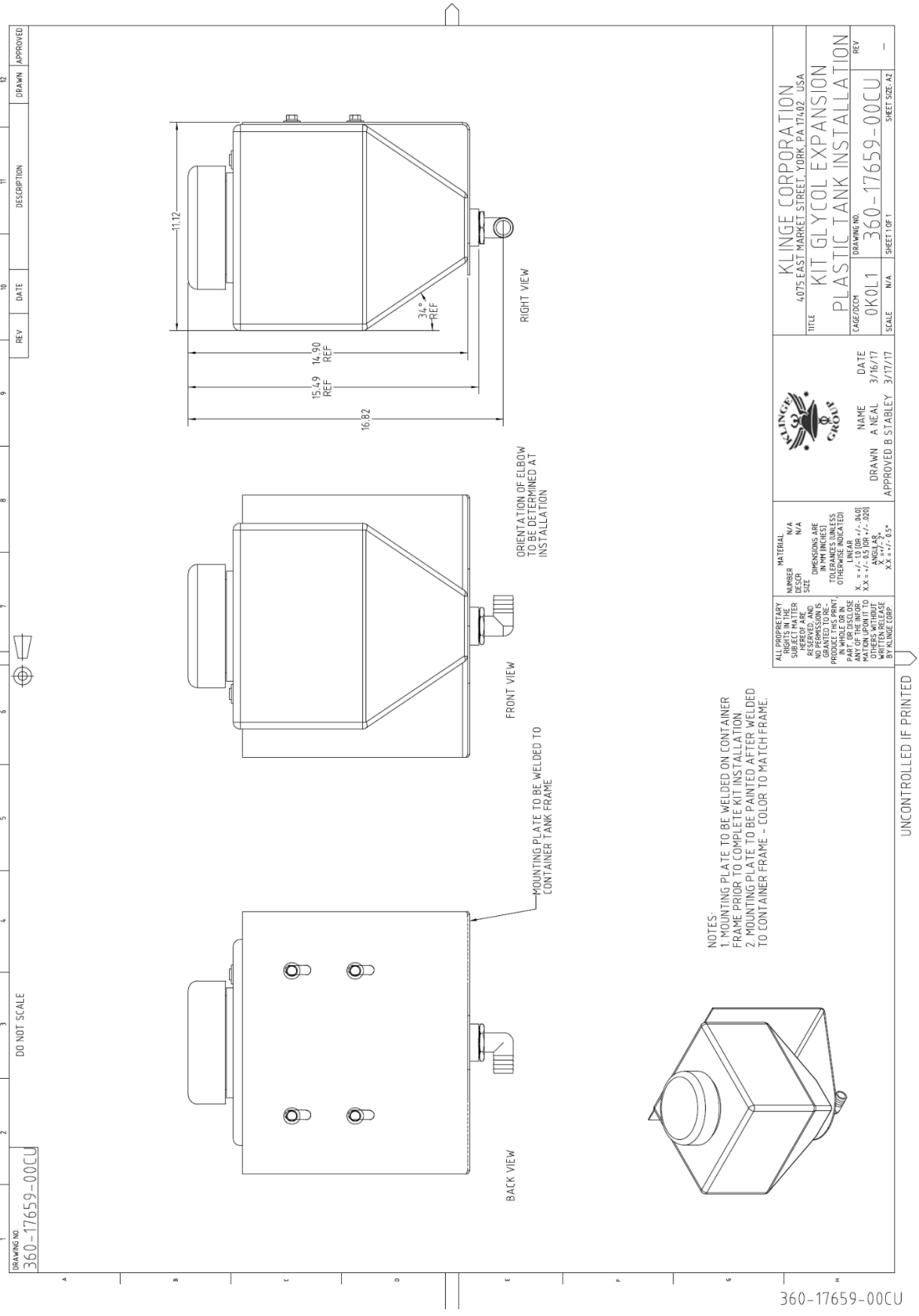
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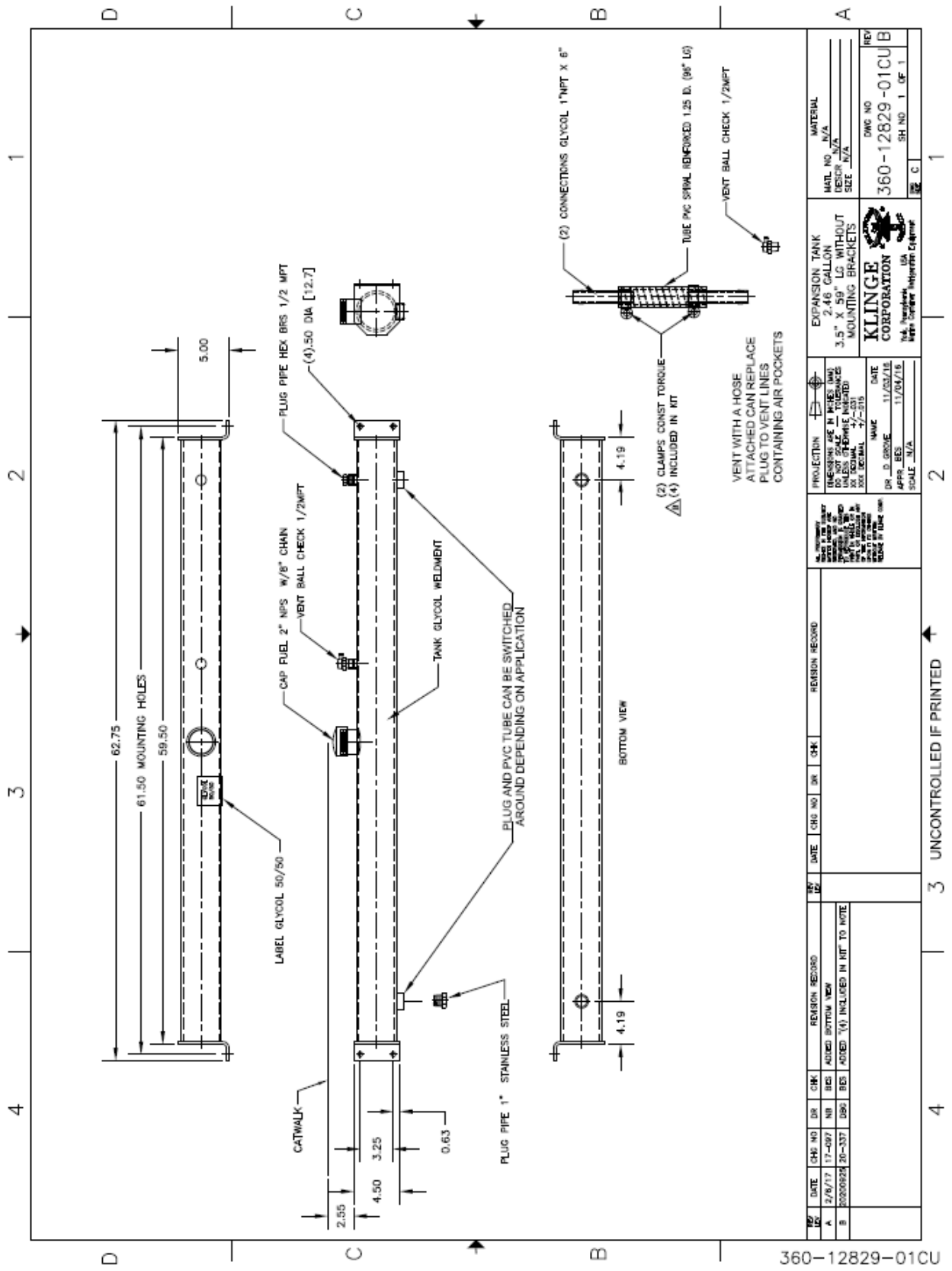
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REVISION RECORD

Rev	Description	Date	Approved
A	Corrected unit model at Refrigerant R-404A in Unit Information chart (pg 3)	2020/09/09	BES
B	Updated Unit and Control Box drawings	2021/04/01	BES
C	Added refrigerant charge	2021/04/22	BES
D	Changed UNIT CAPACITY, “Air” to “Glycol”, updated 360-12829-01CU	2023/01/16	BES
E	Corrected °F range (pg 4)	2023-10-09	BES
F	Updated operating temperature ranges	2024-01-15	BES

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