Product Manual

ThermaBlock™ Vaporizer

Models TBV, TBP, TBT, TBC

Designed and Built by:

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Contents

Revision Log

Revision Level	Date	Description
A	01/28/21	Manual Creation
B	01/20/22	Updated model info, specifications and drawings
C	12/16/2022	Updated Manual
D	04/27/2023	Content Changes & Updated Cover Photo

Preface

General

The ThermaBlock™ product line is a series of powered vaporizers and trim heaters for use in a wide range of applications. The simple, modular design allows for greater flexibility in applications and the ability to size the unit exactly to the end-users needs. The small footprint and multiple mounting options allow the ThermaBlock™ to be retrofitted into existing installations and eliminates the need for bulky ambient vaporizers. Through its intelligent thermal design and minimalist control structure, the ThermaBlock™ achieves maximum efficient performance while maintaining the durability and life cycle required by the most demanding applications.

Product Highlights

- Powered vaporizers allow for better process control without the factors of ambient effects
- Multiple design variations based on the application
  - Process Vaporizer (TBV models)
  - Pressure Building (TBP models)
  - Trim Heaters (TBT models)
  - Combo Vaporizers (TBC models)
- Modular design based on the performance required
  - No one size fits all heaters
  - Versions from 9kW to 60 kW
- Different voltage options available
  - 480 VAC 3 phase
  - 208 VAC 3 phase
- Simplified control structure for ease of use and maximum durability
- Small footprint for flexibility in installation
- Minimal required preventative maintenance

Product Manual

This manual contains information regarding the safe installation, operation, and troubleshooting of all the current ThermaBlock™ line of electric vaporizers. It should be thoroughly read and understood by anyone that operates this equipment.

The safety requirements for the storage, handling, and transporting extremely cold liquid products are shown in the Safety section of this manual. This section also explains the hazards of oxygen deficient atmospheres, oxygen enrichment, and other general safety practices when working around industrial gases.

The introduction section discusses the general features of the various models of ThermaBlock™ vaporizers and gives detailed specifications for each.

The installation section gives detailed instructions on the installation and start up of each different model of vaporizer to include anchoring, plumbing, wiring, and purging of the vaporizer.

The operation section goes into greater detail on the initial startup, function testing, and final adjustments. Differences in operation for the various models is called out in this section.

The troubleshooting and preventative maintenance sections of this manual should aid in answering common questions about problems with the operation of the vaporizer and maintenance requirements. Part numbers are also available for ease of ordering spare or repair parts.

The various appendices contain drawings of each model of vaporizer and electrical schematics.

Terms

Throughout this manual safety precautions will be designated as follows:

Warning! Description of a condition that can result in personal injury or death.

Caution! Description of a condition that can result in equipment or component damage.

Note: *A statement that contains information that is important enough to emphasize or repeat.*

Acronyms / Abbreviations

The following acronyms / abbreviations are used throughout this manual:

BAR	Pressure (Metric)
CGA	Compressed Gas Association
HTLS	High Temperature Limit Switch
IAW	In Accordance With
LAR	Liquid Argon
LIN	Liquid Nitrogen
LOX	Liquid Oxygen
LTCO	Low Temperature Cutoff
MAOP	Maximum Allowable Operating Pressure
MAWP	Maximum Allowable Working Pressure
MPT	Male Pipe Thread
NFPA	National Fire Protection Association
PB	Pressure Builder
PLC	Programmable Logic Controller
PN	Part Number
PSI	Pounds per Square Inch
PSIG	Pounds per Square Inch (Gauge)
SCFH	Standard Cubic Feet Hour
TBC	ThermaBlock™ Combination Vaporizer
TBP	ThermaBlock™ Pressure Build
TBT	ThermaBlock™ Trim Heater
TBV	ThermaBlock™ Vaporizer
VAC	Voltage-Alternating Current

Safety

General

All operators should have full and complete understanding of the content of this manual before operating the equipment described. The manual is intended to describe the operation of the equipment and not intended to supersede any site-specific standards.

Warning! As with any cryogenic or electrical vaporization system, it should be observed that any non-insulated piping or casting can get extremely hot or cold and should not be touched by exposed skin. If the system requires maintenance, it should be shut down and allowed to either cool down or warm-up to ambient conditions.

If any maintenance is to be done on the system, such as changing out electric heating elements or replacing other components, it is extremely important that all sources of energy be properly isolated. Maintenance personnel should follow lock out/tag out procedures as dictated by either their employer or specific requirements of the end use customer.

Safety Summary

Strict compliance with proper safety and handling practices is necessary when using a cryogenic system. We recommend that all our customers re-emphasize safety and safe handling practices to all their employees and customers.
While safety features have been designed into the unit and safe operations are anticipated, it is essential that the user of the cryogenic system carefully read to fully understand all WARNINGS and CAUTION notes listed in this safety summary and enumerated below.

Warning! In oxygen enriched atmospheres flammable items burn vigorously and could explode.

Warning! Do not permit smoking or open flame in any area where oxygen is stored, handled, or used. Failure to comply with this warning may result in serious personal injury.

Warning! This equipment is intended for outdoor use. Before installing indoors, ensure that the installation is IAW all local codes and regulations

Excess accumulation of oxygen creates an oxygen-enriched atmosphere (defined by the Compressed Gas Association as an oxygen concentration above 23%). Certain items considered non-combustible in air may burn rapidly in such an environment. Keep all organic materials and other flammable substances away from possible contact with oxygen; particularly oil, grease, kerosene, cloth, wood, paint, tar, coal, dust, and dirt which may contain oil or grease.

Warning! Nitrogen and argon vapors in air may dilute the concentration of oxygen necessary to support or sustain life.

Exposure to such an oxygen deficient atmosphere can lead to unconsciousness and serious injury, including death.

Warning! Before removing any parts or loosening fittings, empty the cryogenic container of liquid contents and release any vapor pressure in a safe manner.

External valves and fittings can become extremely cold and may cause painful burns to personnel unless properly protected. Personnel must wear protective gloves and eye protection whenever removing parts or loosening fittings. Failure to do so may result in personal injury due to the extreme cold and pressure in the tank.

Warning! Accidental contact of liquid gases with skin or eyes may cause a freezing injury similar to a burn.

Handle liquid so that it will not splash or spill. Protect your eyes and cover skin where the possibility of contact with liquid, cold pipes and equipment, or cold gas exists. Safety goggles or a face shield should be worn if liquid ejection or splashing may occur or cold gas may issue forcefully from equipment. Clean, insulated gloves that can be easily removed and long sleeves are recommended for arm protection. Cuffless trousers should be worn over the shoes to shed spilled liquid.

Warning! If clothing is splashed with liquid oxygen, it will become highly flammable and easily ignited while concentrated oxygen remains.

Such clothing must be aired out immediately, removing the clothing if possible, and should not be considered safe for at least 30 minutes.

Caution! Use only replacement parts that are compatible with liquid oxygen and have been cleaned for oxygen use.

Do not use regulators, fittings, hoses, etc., which have been previously used in a compressed air environment. And do not use oxygen equipment for compressed air. Failure to comply with these instructions may result in serious damage to the container.

Caution! Before locating oxygen equipment, become familiar with the relevant EU Directives or National Fire Protection Association (NFPA) standards for "Bulk Oxygen Systems at Customer Sites", and with all local safety codes.

For installation on oxygen handling systems refer to CGA pamphlets G-4.1, G-4.2, G-4.4 and NFPA 50.

For installation on all cryogenic systems refer to CGA pamphlets P-18, P-56, and NFPA 55.

Caution! Electrical connections and startup should be performed by a licensed electrician in accordance with the National Electric Code, NFPA 70, and any applicable local codes and/or regulations.

Oxygen Deficient Atmospheres

The normal oxygen content of air is approximately 21%. Depletion of oxygen content in air, either by combustion or by displacement with inert gas, is a potential hazard and users should exercise suitable precautions.

One aspect of this possible hazard is the response of humans when exposed to an atmosphere containing only 8 to 12% oxygen. In this environment, unconsciousness can be immediate with virtually no warning.

When the oxygen content of air is reduced to about 15 or 16%, the flame of ordinary combustible materials, including those commonly used as fuel for heat or light, may be extinguished. Somewhat below this concentration, an individual breathing the air is mentally incapable of diagnosing the situation.

The onset of symptoms such as sleepiness, fatigue, lassitude, loss of coordination, errors in judgment and confusion can be masked by a state of euphoria, leaving the victim with a false sense of security and well-being.

Human exposure to atmosphere containing 12% or less oxygen leads to rapid unconsciousness. Unconsciousness can occur so rapidly that the user is rendered essentially helpless. This can occur if the condition is reached by immediate change of environment, or through the gradual depletion of oxygen.

Most individuals working in or around oxygen deficient atmospheres rely on the "buddy system" for protection — obviously, the "buddy" is equally susceptible to asphyxiation if he or she enters the area to assist an unconscious partner unless equipped with a portable air supply.

Best protection is obtainable by equipping all individuals with a portable supply of respiratory air. Lifelines are acceptable only if the area is essentially free of obstructions and individuals can assist one another without constraint.

If an oxygen deficient atmosphere is suspected or known to exist:

- Use the "buddy system." Use more than one "buddy" if necessary to move a fellow worker in an emergency.
- Both the worker and "buddy" should be equipped with self-contained or airline breathing equipment.

Oxygen Enriched Atmospheres

An oxygen-enriched atmosphere occurs whenever the normal oxygen content of air is allowed to rise above 23%. While oxygen is non-flammable, ignition of combustible materials can occur more readily in an oxygen-rich atmosphere than in air; and combustion proceeds at a faster rate although no more total heat is released.

It is important to locate an oxygen system in a well-ventilated location since oxygen-rich atmospheres may collect temporarily in confined areas during the functioning of a safety relief device or leakage from the system.

Oxygen system components, including but not limited to, containers, valves, valve seats, lubricants, fittings, gaskets and interconnecting equipment including hoses, shall have adequate compatibility with oxygen under the conditions of temperature and pressure to which the components may be exposed in the containment and use of oxygen.

Easily ignitable materials shall be avoided unless they are parts of equipment or systems that are approved, listed, or proved suitable by tests or by past experience.

Compatibility involves both combustibility and ease of ignition. Materials that burn in air may burn violently in pure oxygen at normal pressure — and explosively in pressurized oxygen.

In addition, many materials that do not burn in air may do so in pure oxygen, particularly when under pressure. Metals for containers and piping must be carefully selected, depending on service conditions. The various steels are acceptable for many applications, but some service conditions may call for other materials (usually copper or its alloys) because of their greater resistance to ignition and lower rate of combustion.

Similarly, materials that can be ignited in air have lower ignition energies in oxygen. Many such materials may be ignited by friction at a valve seat or stem packing, or by adiabatic compression produced when oxygen at high pressure is rapidly introduced into a system initially at low pressure.

Nitrogen and Argon

Nitrogen and argon (inert gases) are simple asphyxiants. Neither gas will support or sustain life and can produce immediate hazardous conditions through the displacement of oxygen. Under high pressure these gases may produce narcosis even though an adequate oxygen supply, sufficient for life, is present.

Nitrogen and argon vapors in air dilute the concentration of oxygen necessary to support or sustain life. Inhalation of high concentrations of these gases can cause anoxia, resulting in dizziness, nausea, vomiting, or unconsciousness and possibly death.

Individuals should be prohibited from entering areas where the oxygen content is below 19% unless equipped with a self-contained breathing apparatus.

Unconsciousness and death may occur with virtually no warning if the oxygen concentration is below approximately 8%. Contact with cold nitrogen or argon gas or liquid can cause cryogenic (extreme low temperature) burns and freeze body tissue.

Persons suffering from lack of oxygen should be immediately moved to areas with normal atmospheres.

Caution! SELF-CONTAINED BREATHING APPARATUS MAY BE REQUIRED TO PREVENT ASPHYXIATION OF RESCUE WORKERS.

Assisted respiration and supplemental oxygen should be given if the victim is not breathing. If cryogenic liquid or cold boil-off gas contacts a worker's skin or eyes, the affected tissues should be promptly flooded or soaked with tepid water (105-115°F; 41-46°C).

DO NOT USE HOT WATER. Cryogenic burns, which result in blistering or deeper tissue freezing, should be examined promptly by a physician.

Carbon Dioxide

The system described in this manual has the ability to hold and dispense carbon dioxide (CO_2) gas under pressure.

Warning! Asphyxiation hazard. Carbon dioxide gas can cause serious injury or death. Do not breathe CO_2 gas. Avoid entering tank area if a leak is suspected and thoroughly ventilate area.

CO_2 gas is a colorless, odorless, tasteless gas that displaces oxygen and in certain percentages does not support life. The gas is difficult to detect without the assistance of special equipment. Avoid breathing or contacting CO_2 in gas, liquid or solid form.

Exposure to concentrations of less than 5% for less than 15 minutes can cause physical symptoms including unconsciousness, injuries or death. Even low concentrations of CO_2 can cause:

- Dizziness, headaches, nausea or disorientation
- Increased respiration or heart rate
- Shortness of breath or rapid suffocation

Warning! It is important to note that unlike nitrogen and argon, exposure to high concentrations of CO_2 can be deadly even when normal percentages of oxygen are present in the surrounding atmosphere.

CO_2 is heavier than air and can collect in low areas such as basements, stairwells, and confined spaces. Avoid entry into areas where CO_2 leaks or high concentrations of CO_2 are suspected. Enter those areas with caution only after they have been thoroughly ventilated.

This equipment should be installed and serviced only by professional agents who are qualified to work with CO_2. They should be familiar with all pertinent safety procedures.

Personal Protective Equipment (PPE)

The following personal protective equipment is recommended when working around cryogenic liquid:

- Safety glasses with side shields
- Chemical / Liquid resistant gloves to prevent burns on exposed hands
- Long sleeve shirts to protect the arms
- Cuffless trousers worn over closed shoes
- Appropriate “arc flash” protective equipment when working inside live electrical panels

Introduction

Product Description

ThermaBlock™ electric vaporizers are available in a wide range of outputs and voltages; ranging from 9kW to 60kW and available in 208V and 480V 3 Phase service. These vaporizers can be used for a variety of applications including process vaporization, pressure building and vapor warming (trim heating). ThermaBlock™ vaporizers are specifically designed for use with nitrogen, argon, oxygen and carbon dioxide. Below is a brief description of each type of vaporizer:

Process Vaporizer (TBV Models)

TBV model process vaporizers are used to convert cryogenic liquid into gas. These heaters are available in 9kW to 60kW outputs and can deliver as much as 17,000 scfh of nitrogen gas. Gas temperature is measured by a probe located in the gas outlet of the vaporizer. This temperature is relayed to an externally mounted, settable temperature controller which cycles the heating elements to achieve the set gas temperature. For installations where downstream process piping can be damaged by cold gas, resulting from overdrawing the electric process vaporizer, an optional low temperature shutdown device is available to be installed on the vaporizer. All units come standard mounted to a 36"x36" metal pallet base.

Figure 1 - TBV Model on Pallet Base

Pressure Build Vaporizer (TBP Models)

ThermaBlock™ pressure builders are primarily used to maintain head space pressure in CO2 bulk tanks. Although not a common application, they can also be used for PB service on LIN/LAR/LOX storage vessels. These vaporizers are specifically designed to mount underneath a bulk tank and provide constant pressure building capacity to allow for maximum performance (See Fig. 2). The standard pallet base stand is used for the new TBP models that are oriented in a vertical configuration (See Fig 3). Pressure is normally controlled with a pressure switch that monitors headspace of the vessel. It commonly controls a valve that opens when a drop in pressure is detected and routes liquid through the electric PB vaporizer. This electric actuated ball valve comes standard with the vaporizer and is ordered under Chart PN 21736270 (See Fig. 3B). TBP model pressure builders are available in 9kW, 18kW and 30kW outputs.

Figure 2 - TBP Model mounted on CO_2 tank

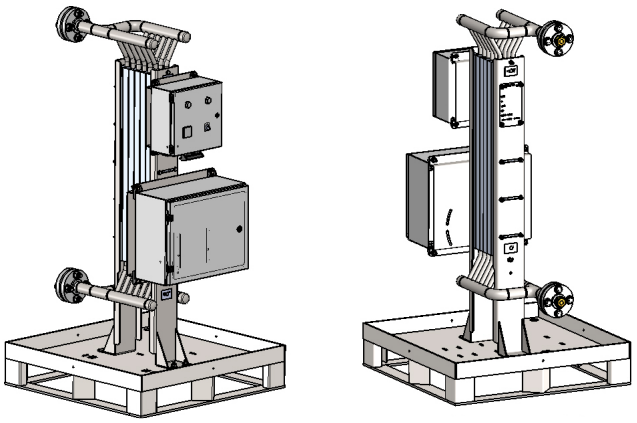


Figure 3 - Vertical design TBP PB vaporizer mtd. on pallet base

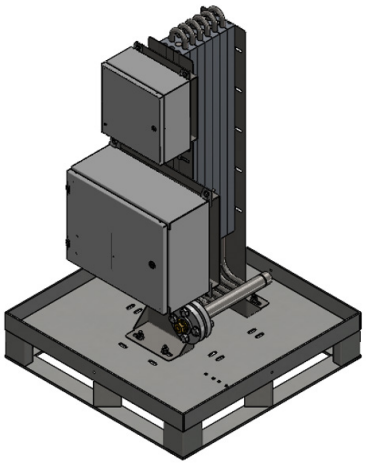


Figure 4 - TBT 30 Trim Heater

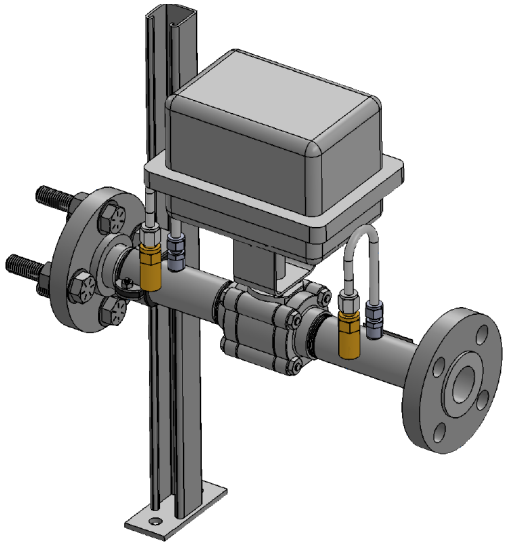


Figure 3B - PB electric actuated ball valve, PN 21736270

Trim Heater (TBT Models, See Fig. 4)

TBT model trim heaters are often used in conjunction with ambient or electric process vaporizers when warm gas is needed at the downstream usage point. ThermaBlock™ Trim Heaters are available in 9kW to 60kW outputs. Temperature is measured by a probe in the outlet gas stream and can be set by using the external temperature controller. ThermaBlock™ trim heaters can also be equipped with a low temperature cutoff device. All models come standard with flanged connections on the inlet and outlets and are mounted on a 36"x36" pallet base. Connections on the 40kW and 60kW models are 2" flanges. The 9kW, 15kW and 30 kW models have 1 1/2" flanges.

Combination Vaporizer (TBC Models, See Fig. 5)

Combination vaporizers are versatile heaters that provide process vaporization while dedicating a small portion of capacity to pressure building. TBC model ThermaBlock™s are often used in conjunction with Bulk or Microbulk tanks where a smaller pressure building capacity is needed. The process stream of these heaters is controlled by using a probe and temperature controller, similar to the TBV models. In addition, these units also have a small pressure building stream. This PB is controlled in the same way as the standard pressure build units; a pressure switch monitors head space in a tank and activates the heaters when a pressure drop is detected. Combo vaporizers are available in 20kW, 40kW and 60kW outputs. These vaporizers come standard with the PB electric actuated ball valve kit (PN 21736270). These vaporizers can also be equipped with an optional low temperature cutoff device (LTCO).

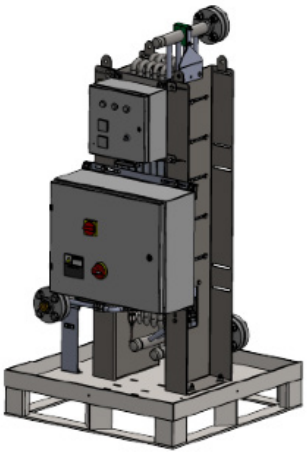


Figure 5 - TBC 20 Combination Vaporizer

Low Temperature Cutoff Kit (LTCO)

All TBV, TBT and TBC models of ThermaBlock™ vaporizers can be ordered with an optional low temperature cutoff kit. This kit consists of an appropriately sized, normally closed (NC) solenoid valve with manual override (See Fig. 6). The solenoid valve is powered open during normal operation. When the outlet gas temperature drops below the alarm setpoint, or there is a total loss of power, the LTCO will de-energize and shutoff to process gas stream. If required, this valve can be manually opened. All TBV, TBT and TBC control panels are pre-wired to accept a LTCO when specified.

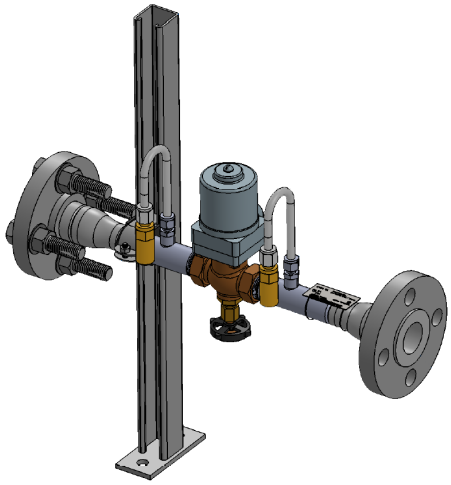


Figure 6 - Low Temp Cutoff Valve with manual override (for models with 1 1/2" flanged outlet connection) Chart PN 21694128.

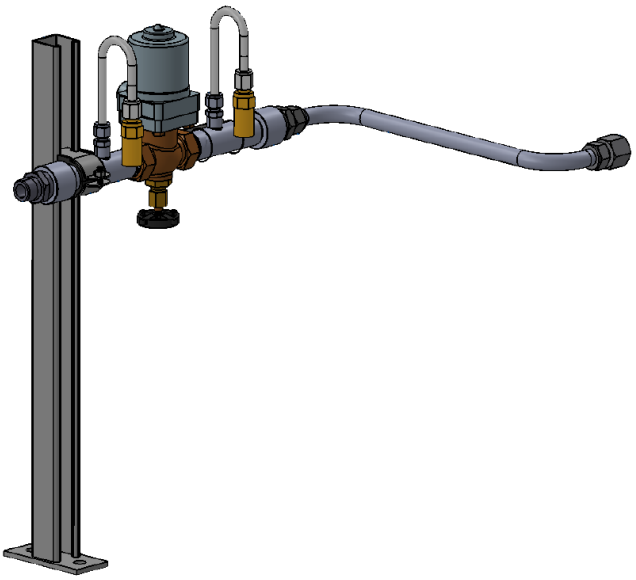


Figure 6A - Low Temp Cutoff Valve for models TBV 9-30. Chart PN 21756637

ThermaBlock™ Models and Performance

Table 1 shows all models and specifications for each category of electric vaporizer to include voltage options and capacities.

PROCESS VAPORIZERS					
Model	Nominal Power (KW)	Voltage		N2/O2 Capacity (SCFH)	CO2 Capacity (lbs/hr)
		208	480		
		Amps			
TBV9	9	25	11	2600	185
TBV15	15	42	19	4400	300
TBV30	30	83	37	8850	600
TBV40	40		49	11,800	800
TBV60	60		73	17,750	1200
COMBO VAPORIZERS					
Model	Nominal Power (KW)	Voltage		N2/O2 Capacity (SCFH)	CO2 Capacity (lbs/hr)
		208	480		
		Amps			
TBC20	20	56	25	4400	300
TBC40	40		49	8850	600
TBC60	60		73	14,750	1000
TRIM HEATERS					
Model	Nominal Power (KW)	Voltage		N2/O2 Capacity (SCFH)	
		208	480		
		Amps			
TBT9	9	25	11	12,000	
TBT15	15	42	19	20,000	
TBT30	30	83	37	40,000	
TBT40	40		49	53,450	
TBT60	60		73	80,300	
PRESSURE BUILDERS					
Model	Nominal Power (KW)	Voltage		N2/O2 Capacity (SCFH)	CO2 Capacity (lbs/hr)
		208	480		
		Amps			
TBP9	9	25	11	2600	180
TBP18	18	50	22	5200	360
TBP30	30	83	37	8850	600
TBPTR20	20	N/A	25	N/A	N/A*

* For use with Trifectas only

Table 1 - Performance Data

Vaporizer Part Numbers (VAC - 3 Phase)		
Size	**480**	**208**
TBV 9	21553455	21562050
TBV 15	21547647	21562051
TBV 30	21553456	21562052
TBV 40	21553457	
TBV 60	21553458	
TBT 9	21553459	21562060
TBT 15	21553460	21562061
TBT 30	21553461	21562062
TBT 40	21553462	
TBT 60	21553463	
TBP 9	21553467	21562063
TBP 18	21553468	21562064
TBP 30	21553469	21562065
TBC 20	21553464	21563474
TBC 40	21553465	
TBC 60	21553466	
TBP 9 Standalone	21702514	21702513
TBP 18 Standalone	21702517	21702516
TBP 30 Standalone	21702520	21702519
TBPTR 20	21873660	N/A

Table 2 - Vaporizer PNs

LTCO/PB Valve PNs	
Part	**Item Number**
LTCO (1" flanged) TBV 40-60kW - All Voltages	21694128
LTCO (1" threaded) TBV 9-30kW - All Voltages	21756637
LTCO (2" flanged) TBT 60 - All Voltages	21594519
PB Valve Kit (TBP) - All Sizes, All Voltages	21736270

Table 3 - LTCO/PN Valve PNs

Installation

Initial Inspection

Receiving inspection is a very important part of the initial installation. Inspect the unit for obvious shipping damage such as bent piping, stress cracks, gouges, and/or crushed areas before accepting shipment. If shipping damage is found, document with photos, fill out a shipping damage claim form, submit the form to carrier and notify Chart Inc. Look at the data plate of the equipment and ensure the model and voltage match what was actually ordered.

Anchoring Requirements

All models of the ThermaBlock™ electric vaporizer may be placed and anchored on either a poured in place or precast concrete foundation.

All vaporizers are anchored to a 36”x36” pallet base. Anchoring hole dimensions for the pallet base is 1 inch and can be anchored using four (4) 3/4 inch galvanized wedge anchors or equivalent (check local codes for use of wedge anchors). Embedment should be at least 4” or as dictated by local codes. Ensure that the proper clearances are provided around the vaporizer and electrical panel as required by local codes.

Electrical Service

1. See Table 1 for the recommended electrical service amperage requirements for all the various size ThermaBlock™ vaporizers. Find the total KW rating of the vaporizer being installed and look under the voltage column to find the load amperes. A qualified electrician must size the main breaker supplying the vaporizer(s) IAW the National Electric Code, NFPA 70 and any applicable local codes and/or regulations.
2. Locate the cable harness for connecting the high voltage panel to the low voltage panel (typically located inside the high voltage panel). Connect the cable harness to both panels, lock in place.
3. Run the service power feed into the main control panel, ensuring that it matches the nameplate voltage on the vaporizer. The supply breach circuit should be appropriately sized for the rated current shown in Table 1 and include an equipment grounding conductor in compliance with all electrical codes and regulations. A 120V VAC control power is provided from the control transformer.
4. Re-torque all electrical connections including terminals and lugs as some connections may become loose during shipment.
5. Ground electrical cabinet and vaporizer body.
6. Conduct Megohm checks of each of 3 power phases versus ground to verify resistance to ground of power distribution circuit and heater rods.
7. Ensure the thermocouple cable is connected securely to both the high voltage panel and the connection on the outlet plumbing (for applicable models). Some models ship with the M12 cable located inside panel door.

Piping Connections

1. Customer run inlet and outlet piping should be sized according to calculated flowrates. For pressure build vaporizers, it is extremely important to minimize pressure drop through the piping system in order for the vaporizer to function properly.
2. The inlet and outlet piping should be independently supported and should not exert undue loads on the units inlet and outlet connection points.
3. It is recommended that lines that carry a cryogenic fluid to the inlet side of the vaporizer should be insulated. This avoids large amounts of ice buildup on the pipe that could lead to support issues and heaving.
4. Ensure that all inlet and outlet piping stay clean and free of debris while being assembled. Purge lines to ensure they are free of all contaminants before connecting to the ThermaBlock™ vaporizer.
5. Connect the liquid inlet and gas discharge lines to the appropriate connection points on the vaporizer. See Appendix 5 for specific model vaporizer.
6. Multiple process vaporizers should have inlet and outlet pipes plumbed in parallel. Normally, trim heaters (TBT) are piped in series with another process vaporizer.

Caution: Chart ThermaBlock™ units are typically supplied without in/out valving and are typically furnished without pressure relief ports or relief devices. The installer must provide a suitable pressure relief device or combination of such devices within an overall assembly per applicable codes to protect equipment in case rated pressure limits are exceeded.

Caution: If downstream components, materials, or processes are incompatible with low temperatures, a failsafe Low Temperature Cutoff (LTCO) device needs to be installed to automatically throttle down or shut off the flow of the process fluid before fluid temperature below the accepted range is reached. It is the responsibility of the vaporizer owner, user, and operator to see that a failsafe LTCO mechanism is properly installed, tested, and maintained. Control panels on TBV, TBT and TBC vaporizers are already wired to accept an electric LTCO device, if installed.

7. TBP stand alone pressure build vaporizers and TBC vaporizers should come standard with an electric valve for controlling PB flows to the tank. The 1 1/2” PB valve with electric actuator kit can also be purchased separately. The PB valve install kit and all mounting hardware is shipped loose. For ease of mounting, the kit should be bolted onto the PB inlet on either the TBP or TBC vaporizer. A pipe support is also included and should be attached between the two flanges and anchored to the ground. Ensure that the spool piece is properly oriented by verifying the flow arrow on the valve is pointing in the direction of flow. See Appendix 2 for wiring schematic that shows where wires from the electric PB valve should land in the control panel. PB valve kit sold seperately is P/N 21736270.

Purging/Pressure Testing

After making all final connections to the ThermaBlock™ unit, purge all connected plumbing and vaporizer through an open port downstream of the vaporizer. After purging, pressurize and leak check all connections. Pressure testing should be conducted according to local requirements or your companies internal SOPs.

Operation (Units w/ Watlow Controller)

The second generation of ThermaBlock™ electric vaporizers have had both the high voltage and low voltage panels redesigned. The new design can be quickly identified where the high voltage panel will have a disconnect switch for both the heater block and the main power (see Fig 15). The low voltage panel will have a Watlow controller/s vs Red Lion. Details of these newly designed panels for the various models of vaporizers are summarized on the following pages.

Electrical Enclosure Description (Model TBT & TBV)

The second generation of electrical controls for models TBV and TBT electric vaporizers consist of a high voltage panel (208 VAC or 480 VAC) and a low voltage panel (120 VAC) See Fig 15 - 18. The two panels are connected electrically using an electrical conduit with 18 pin Phoenix connectors on each end. (See Fig 19) One or both of these electric panels can be remotely mounted. The interconnecting conduit may need to be extended. The Watlow controller on the low voltage panel reacts to exit gas temperature. The low voltage panel is also wired to control an optional low temperature shutdown valve (See Fig 6, pg 9). If the exit gas temperature drops below the programmed value, an automatic shutdown valve can be wired into the control panel. A thermocouple integral to one of the heater rods provides for a high temperature shutdown (350 F). Updated electrical schematics can be found in Appendix 1 under the latest revisions.

Figure 15 - High Voltage Panel (Exterior)

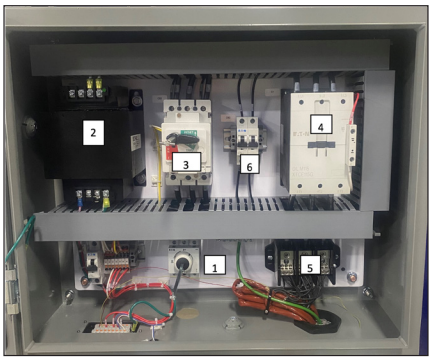


Figure 16 - High Voltage Panel TBV & TBT (Interior)

v	Description
1	Main circuit breaker disconnect
2	Transformer
3	Heater Relay Circuit Breaker/ Shunt Trip
4	Heater Contactor
5	Power Distribution Block
6	Circuit Breakers

Figure 17 - Low Voltage Panel (Exterior)

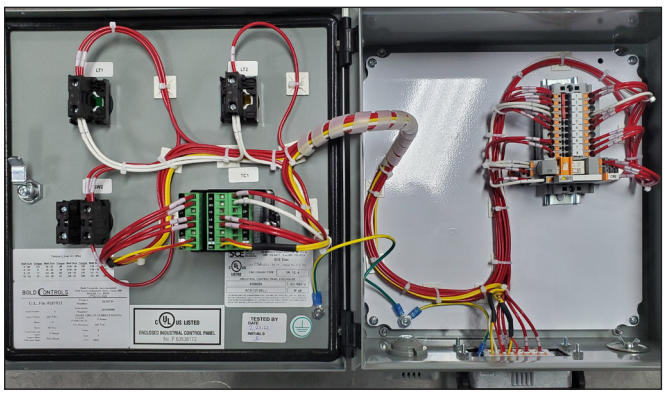


Figure 18 - TBV, TBT Low Voltage Panel (Interior)

Figure 19 - 16-Pin Interconnecting Conduit

Item Number	Description
1	Heater on light
2	Power on light
3	Watlow process temperature controller
4	Main power ON/OFF switch
5	Low Temp Relay
6	Shunt Trip Relay
7	16-Pin Phoenix Connector

Electrical Enclosure Description (Model TBP)

Much like the electrical controls on the TBV and TBT models, the controls on the TBP model also consist of the same high voltage panel (208 VAC or 480 VAC) (see fig 15 and 16) and a low voltage panel (120 VAC) that utilizes a different control scheme than the TBV or TBT vaporizers described in the previous section. The two panels are connected electrically using 16 pin Phoenix connectors. The TBP low voltage panel includes the addition of a pressure switch (see Fig 20, Item3) for controlling the standard electric actuated ball valve on the pressure build circuit. The Watlow controller in the TBP low voltage panel controls heater block temperature based on input from a thermocouple integral to one of the heater rods. A second heater rod thermocouple provides for a high temperature shutdown (350°F). Updated electrical schematics can be found in Appendix 2 under the latest revision.

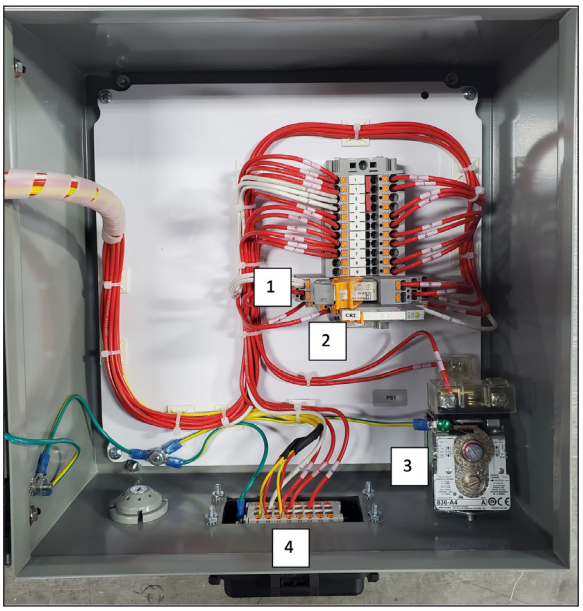


Figure 20 - Low Voltage Panel TBP with Pressure Switch

Item Number	Description
1	Pressure Build Relay
2	Shunt Trip Relay
3	Pressure Switch
4	16-Pin Phoenix Connector

Electrical Enclosure Description (Model TBC)

The electrical controls for the ThermaBlock™ combination vaporizer consist of a high voltage panel (208 VAC or 480 VAC) and a low voltage panel (120 VAC). The two panels are connected electrically by a flexible conduit with 16 pin Phoenix connectors on each end. The high voltage panel contains contactors and circuit breakers to provide for separate control of the Pressure Build heater block and the process heater block. (See fig 21 & 22) The low voltage panel contains two Watlow controllers (See Fig 23 & 26). One unit controls the pressure build heater based on heater rod temperature and the other unit controls the process gas heater based on exit gas temperature. Both controllers also have an independent heater rod thermocouple that provides for a high temperature shutdown. The low voltage panel also has connections for the electric PB valve and an optional low temperature shutdown valve (see Fig 6, pg 9). Terminal connections are called out on the wiring schematic in App. 4.

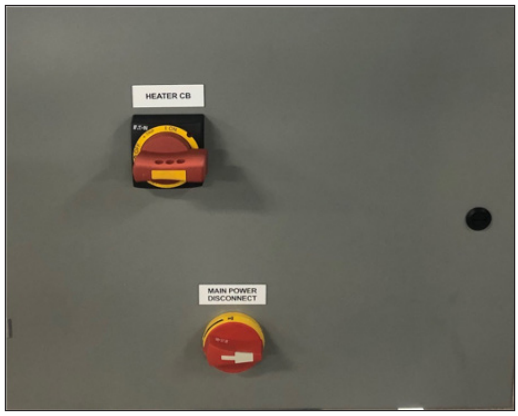


Figure 21 - High Voltage Panel for TBC (Exterior)

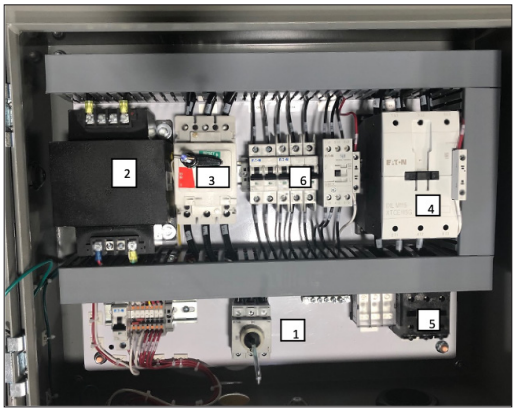


Figure 22 - High Voltage Panel for TBC (Interior)

Figure 23 - Low Voltage Panel for TBC (Exterior)

Item Number	Description
1	Process Heater on light
2	PB Heater Light
3	Power On Light
4	Process Heater Controller
5	PB Heater Controller
6	Main Power ON/OFF Switch

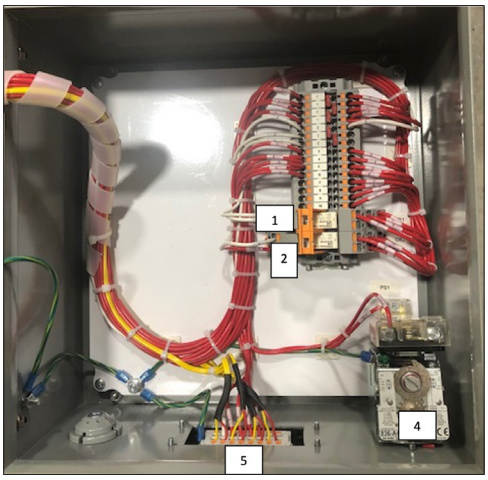


Figure 24 - Low Voltage Panel for TBC (Interior)

Item Number	Description
1	Low Temp Relay
2	PB Relay
3	Shunt Trip Relay x2
4	Pressure Switch
5	16-Pin Phoenix Controller

Start Up (TBV & TBT)

Note: Instructions below often refer to the Watlow operations manual. This manual can be found on the Watlow website at www.watlow.com.

1. Turn Power ON-OFF switch on low voltage panel to OFF
2. Ensure that high voltage cabinet door is closed. Turn handle of main power breaker/disconnect switch door interlock to on.
3. Turn low voltage panel ON-Off switch to ON. “POWER ON” light should illuminate. Watlow controller should light up and show the process gas temperature and set point. Heater contactor should pull in and “HEATER ON” light should illuminate if the process value (PV) temperature is below the active setpoint (SP) temperature. Under certain conditions, such as a hot day where the ambient air temperature is much greater than the SP temperature, a small flow of product can be introduced to the unit in order to cool down the process thermocouple. Once the PV drops below the SP, the heater contactor should pull in and the “HEATER ON” light should illuminate.
4. Wait 3-4 seconds after turning on low voltage panel and turn “HEATER CB” switch to ON. If “HEATER ON” light is on but heaters are not heating, reset the “HEATER CB” by turning the switch all the way to OFF and back to the ON position.
5. With power ON, gradually open liquid line and admit fluid to unit. As the gas discharge temperature drops to the control range (70°F), the contactor pulls in, turning heaters ON. Depending on the thru-put and/or controller settings, contactor will cycle OFF and ON to keep gas discharge temperature at or near the set point. The typical operating temperature for the controller deadband is + 3F when programmed using an ON/OFF control scheme. This can be increased by changing the hysteresis value on the controller (See Watlow controller parameters in App 8). Detailed instructions can be found in the Watlow operations manual.
6. If the installation requires a low temperature shutdown, a normally closed solenoid valve or an actuated ball valve is recommended (See fig 6, pg 9). In the event of a low temperature alarm, as programmed into the Watlow controller, the process gas coming out of the vaporizer will be stopped. The alarm is programmed where a low temperature shutdown requires a manual reset. Press the home key button on the Watlow controller (See fig 25 & 26). (See Watlow controller manual for detailed instructions on how to program low temp. alarm). The low temp shutoff valve should be wired into the proper terminal blocks in the 120 VAC control panel. (See TBV/TBT electrical schematic in App.3)

Start Up (TBP)

1. Normally, a separate actuated ball valve or solenoid valve is used to control the flow of gas into the head space of the tank for pressure building purposes. A sensing tube from the headspace of the tank should be connected to the pressure switch connection at the bottom of the 120 VAC control panel (See Fig 20, Item 3). The pressure switch connection is a 7/16-20 SAE 45° flare.
2. Actuator on the ball valve or solenoid valve should be wired into the proper terminal strip numbers in the 120 VAC control panel (see Watlow TBP electrical schematic in App. 2).
3. Set pressure switch for the designated tank operating pressure. See pressure switch instructions in App. 6. Pressure switch is factory set at 300 psig.
4. Turn Power ON-OFF switch on low voltage panel to OFF
5. Ensure that high voltage cabinet door is closed. Turn handle of main power breaker/disconnect switch door interlock to on.
6. Turn low voltage panel ON-Off switch to ON. "POWER ON" light should illuminate. Watlow controller should light up and show the heater rod temperature and set point (125 F). Heater contactor should pull in and "HEATER ON" light should illuminate if the process value (PV) temperature is below the active setpoint (SP) temperature and the tank pressure is below the setting of the pressure switch located in the low voltage panel. Keep in mind that the hysteresis value on the Watlow controller is set at 30 so there might be a -30 F difference between the control temp and the setpoint.
7. Wait 3-4 seconds after turning on low voltage panel and turn "HEATER CB" switch to ON. If "HEATER ON" light is on but heaters are not heating, reset the "HEATER CB" by turning the switch all the way to OFF and back to the ON position.
8. Insure the tank pressure is below the pressure switch setting and with power ON, gradually open both the liquid line and vapor return line to admit fluid to unit.
9. Verify that the valve controlling the pressure in the tank is closing once the tank gets to the designated operating pressure. Make adjustments to the pressure switch to fine tune the control of the tank pressure. (See troubleshooting section if there are issues with controlling tank pressure).
10. High temperature alarm is set at 350F on the Watlow controller and is controlled by a second heater rod located in the heater block. If heater rod temperature exceeds 400F, this condition will trip the shunt on the heater block breaker and shut down the heater.

Start Up (TBC)

1. The ThermaBlock™ combination vaporizer (TBC) basically contains all the controls found in both the TBV/ TBT and TBP electric vaporizers.
2. Ensure that a pressure sensing line from the headspace of the storage tank is connected to the pressure switch located at the bottom of the 120 VAC control panel. An adapter for this connection should have been included.
3. Ensure that the actuator on the ball valve or solenoid valve is wired to the proper terminal strip numbers in the 120 VAC control panel (see TBC electrical schematic in App. 4)
4. Set the pressure switch for the designated tank operating pressure. (See pressure switch instructions in Appendix 6)
5. Turn Power ON-OFF switch on low voltage panel to OFF
6. Ensure that high voltage cabinet door is closed. Turn handle of main power breaker/disconnect switch door interlock to on.
7. Turn low voltage panel ON-Off switch to ON. "POWER ON" light should illuminate. Both Watlow controllers should light up and show the heater rod temperature and set point (125 F) on the PB Temp controller and the process gas temperature and setpoint (75F) on the Process Temp controller. For the PB temperature controller, the heater contactor should pull in and "PB HEATER ON" light should illuminate if the process value (PV) temperature is below the active setpoint (SP) temperature and the tank pressure is below the setting of the pressure switch located in the low voltage panel. Keep in mind that the hysteresis value on the Watlow controller is set at 30 so there might be a -30 F difference between the control temp. and the setpoint. For the process heater, heater contactor should pull in and "HEATER ON" light should illuminate if the process value (PV) temperature is below the active setpoint (SP) temperature. Under certain conditions, such as a hot day where the ambient air temperature is much greater than the SP temperature, a small flow of product can be introduced to the unit in order to cool down the process thermocouple, Once the PV drops below the SP, the heater contactor should pull in and the "HEATER ON" light should illuminate.
8. Wait 3-4 seconds after turning on low voltage panel and turn "HEATER CB" switch to ON. If "HEATER ON" light is on but heaters are not heating, reset the "HEATER CB" by turning the switch all the way to OFF and back to the ON position.
9. Ensure the tank pressure is below the pressure switch setting and with power ON, gradually open the valve that feeds liquid to the vaporizer and the outlet line to the PB return.

10. Verify that the valve controlling the pressure in the tank is closing once the tank gets to the designated operating pressure. Make adjustments to the pressure switch to fine tune the control of the tank pressure. (See troubleshooting section if there are issues with controlling tank pressure).

11. High temperature alarm is set at 350F on the Watlow controller and is controlled by a second heater rod located in the heater block. If heater rod temperature exceeds 400F, this condition will trip the shunt on the heater block breaker and shut down the heater.

12. Once the tank is at the proper pressure, open up the valve feeding the process gas line allowing product to start flowing through the vaporizer. As the gas discharge temperature drops to the control range (70F), the process heater contactor pulls in, turning heaters ON. Depending on the thru-put and/or controller settings, contactor will cycle OFF and ON to keep gas discharge temperature at or near the set point. The typical operating temperature for the controller deadband is -3F when programmed using an ON/OFF control scheme. This can be increased by changing the hysteresis value on the controller (See Watlow controller operating manual)

13. If the installation requires a low temperature shutdown, a normally closed solenoid valve or an actuated ball valve is recommended (see Fig 6, pg 9). In the event of a low temperature alarm, as programmed into the Watlow controller, the process gas coming out of the vaporizer will be stopped. The alarm is programmed where a low temperature shutdown requires a manual reset. Press the home key button on the Watlow controller (See fig 25). (See Watlow controller manual for detailed instructions on how to program low temp. alarm). The low temp shutoff valve should be wired into the proper terminal blocks in the 120 VAC control panel. (See TBC electrical schematic in App.4).

Operation (TBV & TBT)

1. The unit is automatic. Unit should be left on at all times. The thermal ballast provided by the aluminum extrusions provides several minutes margin for start-ups and shutdown. Under no-flow conditions, the unit tends to run warmer, thus initial gas flow outlet temperature can be 30F or more above set point for several minutes.

2. When flow is stopped, the unit will maintain the gas inside the process piping at the SP temperature by cycling the heaters very infrequently.

Note: *In most cases, the SP temperature is factory set for 70F gas outlet temperature on the Watlow controller and the heat exchange block high temperature limit alarm is set at 350 F in the Watlow controller and is controlled by one of the heater rods in the block.*

Operation (TBP)

1. The unit is automatic. Unit should be left on at all times. The thermal ballast provided by the aluminum extrusions provides several minutes margin for starts and stops. Under no-flow conditions when the tank pressure is at or above set point, the heater block will be totally off. It will come on when the tank pressure drops and the pressure switch transfers and opens the PB valve. Block temperature will then be held at the setpoint of the controller (125 F).

2. High temperature alarm is set at 350F on the Watlow controller and is controlled by a second heater rod located in the heater block. If heater rod temperature exceeds 400F, this condition will trip the shunt on the heater block breaker and shut down the heater.

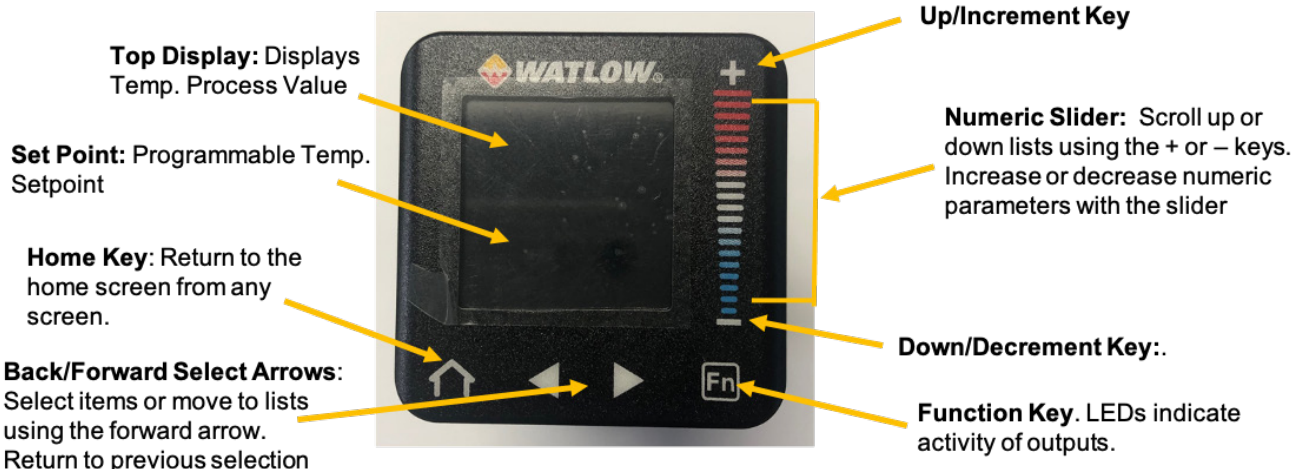
Operation (TBC)

1. The unit is automatic. Unit should be left on at all times. The thermal ballast provided by the aluminum extrusions provides several minutes margin for starts and stops. For the PB vaporizer, under no-flow conditions when the tank pressure is at or above set point, the heater block will be totally off. It will come on when the tank pressure drops and the pressure switch transfers and opens the PB valve. Block temperature will then be held at the setpoint of the controller (125 F + 30F). The process vaporizer tends to run warmer under low flow or no flow conditions, thus initial gas flow outlet temperature can be 30F or above set point for several minutes once flow picks back up. The unit will keep the gas inside the process piping at the SP temperature by cycling the heaters very infrequently.

2. High temperature alarm is set at 350F for both the PB and Process vaporizers on the Watlow controllers and is controlled by a second heater rod located in the heater block. If heater rod temperature exceeds 400F, this condition will trip the shunt on the heater block breaker and shut down the heater. The low voltage panel still remains energized, but the power to the heater block is cut off until the heater circuit breaker on the door of the high voltage panel is manually reset. You can tell which controller shut down the unit for high temperature by looking on the controller and a Limit Hi (LiHi) message will be shown on the top display and (Attn) will be shown on the bottom display.

Watlow Controller

The Watlow controller takes the place of the Red Lion controller that was previously found on the earlier manufactured ThermaBlock™ vaporizers (See Fig 3, Item 3). In addition, the Watlow controller has the added functionality of an EZ-LINK mobile app that allows users to easily set up, monitor, and adjust the controller via Bluetooth wireless technology. See App.10 for detailed instructions on how download and use the Watlow EZ-LINK app. Key information on the face of the controller is summarized in Fig 25 below. Detailed programming information and default settings can be found in Appendix 8.



- Figure 25

Preventive Maintenance

Procedure

In the event a heating element fails during service, contact Chart to obtain a replacement heater. Heaters may be replaced in the field; however, the unit must be shut down and isolated from service during the replacement process.

1. Before attempting to do any type of maintenance on the unit, turn the power switch on both the low voltage panel and the high voltage panel to the "OFF" position. Ensure that the main service breaker the feeds power to the unit is switched "OFF" and is locked out using standard Lockout/Tagout procedures. Check main power leads on primary breaker inside of the high voltage panel with a meter to ensure that all electrical power has been removed from the unit and is safely locked out.

2. Once verified that electrical power has been removed from the unit, isolate the unit from its pressure source, and vent any remaining pressure to atmosphere. Ensure area is well ventilated during this procedure and follow all standard safety precautions as outlined in the 'SAFETY' section of the manual.

    a. For a unit in CO2 service, ensure there is no liquid present in the piping before venting to atmosphere to prevent the formation of dry ice.

3. Open the high voltage panel and remove heater wiring from the distribution blocks.

4. Measure the resistance of each heater and compare to values listed in the table below (Table 1) to identify a faulty heater. If the resistance falls outside of the listed range, the heater is faulty and needs to be replaced.

    a. The heater closest to the outlet piping has an internal thermocouple wired into the control panel. If this heater is faulty and needs to be replaced, ensure the thermocouple wire on the new heater is wired back into position in the '7' (+ yellow) and '8' (- red) pins of the connector.

5. If a heater needs to be replaced, physically disconnect the power coming into the unit so that the unit can be turned on its side.

6. Remove inlet and outlet piping. If the unit has flanged manifolds, these can also be removed to allow vaporizer to be laid on its side.

7. Remove mounting hardware to free the unit from any anchoring connections.

8. Place straps through the U-bend piping at the top of the unit and ensure it is securely held to a lift/hoist system.

9. Tip the unit onto its side ensuring the control panels are facing upwards, and slowly lower the lift/hoist until unit is positioned horizontally on the ground. For some of the larger process vaporizers, it may be easier to lay the unit so that the control panels are on one side or the other and the clamping bolts running between the two stands have the nuts and lock washers facing up. (See Fig. 17).

10. To remove a heater from the unit, the clamping bolts must be loosened, but do not have to be fully removed. The heater retaining rods running across the rows of heaters on the top and bottom will also need to be removed. For the TBV units, where U tubes need to be removed to provide clearance to remove heater rods, remove the top stand plate to gain easier access for removing the U tubes. (See Fig. 18). Depending on which heater rod needs to be removed will determine what side and how many stacks of aluminum extrusions need to be removed to access the heater rod. (See Figs. 19 & 20). By removing the stand plate, the Swagelok fittings can be removed much easier. Heater rods wires will need to be disconnected from the distribution block and removed from the panel so that heater rods can be easily removed as each aluminum block is removed.

11. Once all clamping bolts are loosened, for units where heater rods have clearance to be pushed out through the top or bottom, identify which heater needs to be removed. Remove wires for heater from the distribution block in the high voltage panel and remove wire from electrical box before attempting to push out heater rod from aluminum block. Use a flathead screwdriver to pry apart the blocks surrounding the faulty heater.

12. Once the blocks have been loosened, tap on the top or bottom of the heater rod to remove the faulty heater from the unit.

13. Insert the new heater into the open heater channel. If heater rod had to be accessed by removing one of the stand plates, reassemble the heater rods, aluminum blocks, and U tubes from the bottom to the top of the stack insuring that the Swagelok fittings are properly tightened as each layer is completed. Replace that stand plate and reattach washers and nuts to each of the clamping bolts.

14. Re-tighten all bolts to 20 ft-lbs starting with the inner most bolts moving outwards, alternating sides. This pattern may have to be repeated multiple times to ensure all bolts are fully tightened.

15. Insert the wires from the new heater or any other heater that had to be removed into the high voltage enclosure via the appropriate cord grip.

16. Wire the heaters back into the distribution block as they were before, ensuring that all electrical connections are tightened to the correct torques as noted by the manufacturer, and tighten the previously loosened cord grip. Each of the three wires on the heater rod should be connected to different phases on the distribution block. Once all heaters are terminated on the block, check the total resistance between phases on the block and compare readings to those found in Table 2 of this manual.
17. Close and lock the high voltage panel.
18. Using the lift/hoist system, raise the unit into its upright position. Locate and anchor the unit to its original anchoring position.
19. Reconnect all inlet and outlet plumbing to include flanged distribution headers if so equipped.
20. Reconnect all electrical power and remove Lockout/Tagout equipment.
21. Turn the main power disconnect to the “ON” position, and turn the main power switch on the low voltage panel to the “ON” position, confirm the “POWER ON” light it illuminated the temperature controller/s is functioning.
22. With the outlet isolation valve closed, slowly open the inlet isolation valve to introduce pressure to the system.
23. Check for leaks and all inlet/outlet connections.
24. Open the outlet isolation valve and resume normal operation.

Figure 27

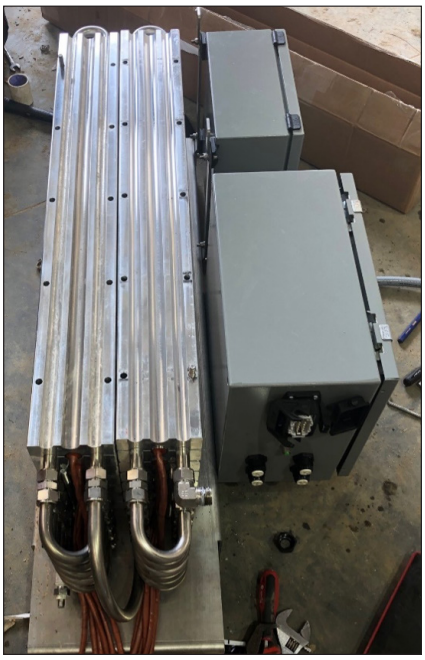


Figure 28

Figure 29

Figure 30

Heater/Chart PN	Nom. Resistance (Ohms)	Max. Resistance (Ohms)	Min. Resistance (Ohms)
480V 5000W / 21491387	87.6	96.3	83.2
480V 3000W / 21491386	145.9	160.5	138.6
208V 5000W 21562209	16.4	18.1	15.6
208V 3000W 21562207	27.4	30.1	26.0

Table 3 - Single Heater Resistance Values

Size (KW)	Number of Heaters	480 VAC	3000 WATT	5000 WATT	208 VAC	3000 WATT	5000 WATT
TBV 9	3	21553455	46.21-53.50		21562050	8.68-10.05	
TBV 15	3	21547647		27.72-32.10	21562051		5.21-6.03
TBV 30	6	21553456		13.86-16.05	21562052		2.60-3.01
TBV 40	8	21553457		10.40-12.04			1.95-2.26
TBV60	12	21553458		6.93-8.03			1.30-1.51
TBT 9	3	21553459	46.21-53.50		21562060	8.68-10.05	
TBT 15	3	21553460		27.72-32.10	21562061		5.21-6.03
TBT 30	6	21553461		13.86-16.05	21562062		2.60-3.01
TBT 40	8	21553462		10.40-12.04			1.95-2.26
TBT 60	12	21553463		6.93-8.03			1.30-1.51
TBP 9	3	21553467	46.21-53.50		21562063	8.68-10.05	
TBP 9 SA	3	21702514	46.21-53.50		21702513	8.68-10.05	
TBP 18	6	21553468	23.10-26.75		21562064	4.34-5.02	
TBP 18 SA	6	21702517	23.10-26.75		21702516	4.34-5.02	
TBP 30	6	21553469		13.86-16.05	21562065		2.60-3.01
TBP 30 SA	6	21702520		13.86-16.05	21702519		2.60-3.01
	Total Heaters		**5000 Watt Process ***	**5000 Watt PB ***		**5000 Watt Process***	**5000 Watt PB***
TBC 20	4	21553464	27.72-32.10 (3)	83.17-96.31 (1)	21563474	5.21-6.03 (3)	15.62-18.08 (1)
TBC 40	8	21553465	13.86-16.05 (6)	41.59-48.15 (2)			
TBC 60	12	21553466	8.32-9.63 (10)	41.59-48.15 (2)			
* number of heaters shown in ()							

Table 4 - Resistance Values

Spare Parts List

Chart PN	Description	Manufacturer PN
21670881	CARTRIDGE HEATER 3000 W 480 VAC	1" X 36" PHOENIX W/156" LEADS
21670882	CARTRIDGE HEATER 5000 W 480 VAC	1" X 36" PHOENIX W/156" LEADS
21757496	CARTRIDGE HEATER 3000 W 208 VAC	1" X 36" PHOENIX W/156" LEADS
21757497	CARTRIDGE HEATER 5000 W 208 VAC	1" X 36" PHOENIX W/156" LEADS
21559939	M12 CONN TYPE K THERMOCOUPLE	OMEGA M12CM-EXTT-K-SF-SM-1.5
21497406	THERMOCOUPLE PROBE 6 IN.	OMEGA M12KIN-1/8-U-6_B
H3-0003	PRESSURE SWITCH - ALLEN BRADLEY	ALB-836-A4
H3-0003-001	PRESSURE SWITCH ADAPTER 1/4" NPT	ABS-836-N1
P1-0002-053	WATLOW TEMP CONTROLLER	PM PLUS
TBD	EATON CONTACTOR	XTCE080FS1A
TBD	EATON 80A 3 POLE CB	PDG13C0080TFFJ
TBD	EATON 500 VA CONTROL TRANSFORMER	C0500E2AFB
TBD	C-H GREEN PILOT LIGHT	M22-L-G-230G
TBD	EATON YELLOW LED 22MM	M22-L_Y-230W
TBD	EATON 2 POSITION SEL SWITCH	M22-WRK-K11
TBD	FERRAZ 1/2 A FUSE (50 VA TRANSFORMER)	
TBD	FERRAX 2A FUSE (50 VA TRANSFORMER)	
21721329	LITTELFUSE KLDR 4A (500 VA TRANSFORMER)	KLDR-004
21721328	EATON 5A FUSE (500 VA TRANSFORMER)	KLM-5
TBD	EATON SHUNT TRIP	SNT120CPK
TBD	PHOENIX PRE-ASSEMBLED RELAY	2903332
TBD	SCHNEIDER TIMER RELAY	RE17RAMU
TBD	M12 CONNECTOR	7231-13561-9720100
TBD	PHOENIX HOUSING	1407626
TBD	PHOENIX BASE	1407633
TBD	PHOENIX CONNECTOR	1407730
TBD	3 HOLE CORD GRIP	7807K45 MCMASTER CARR
21698111	CABLE HARNESS, 10 PIN, 3 FT	
21700473	CABLE HARNESS, 10 PIN, 6 FT	
21742237	CABLE HARNESS, 16 PIN, 5 FT	
21742238	CABLE HARNESS, 16 PIN, 6 FT	
21836963	CABLE HARNESS, 10 PIN / 16 PIN, 5 FT	

Accessories

Chart PN	Description	Manufacturer PN
21694128	LOW TEMP CUTOFF KIT, FLANGED CONN.	FOR TBV 40-60 AND TBT 9-30
21756637	LOW TEMP CUTOFF KIT, THREADED CONN.	FOR TBV 9-30 KW
21736270	PB VALVE KIT, CO2 ONLY	FOR TBP STANDALONE MODELS

Troubleshooting

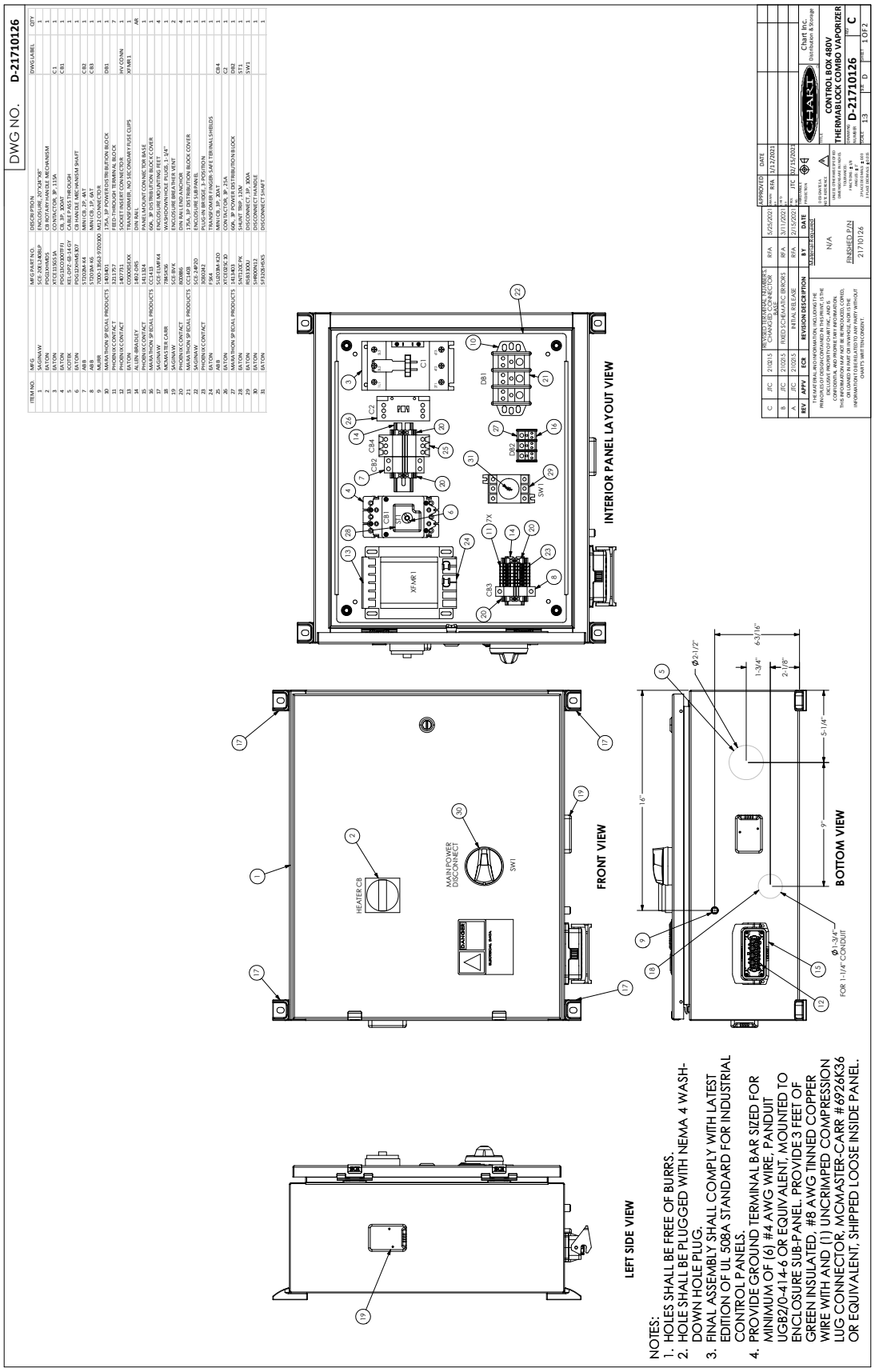
If the regular maintenance procedure is followed, troubleshooting should not be necessary. If problems do occur, the following is a step-by-step troubleshooting guide.

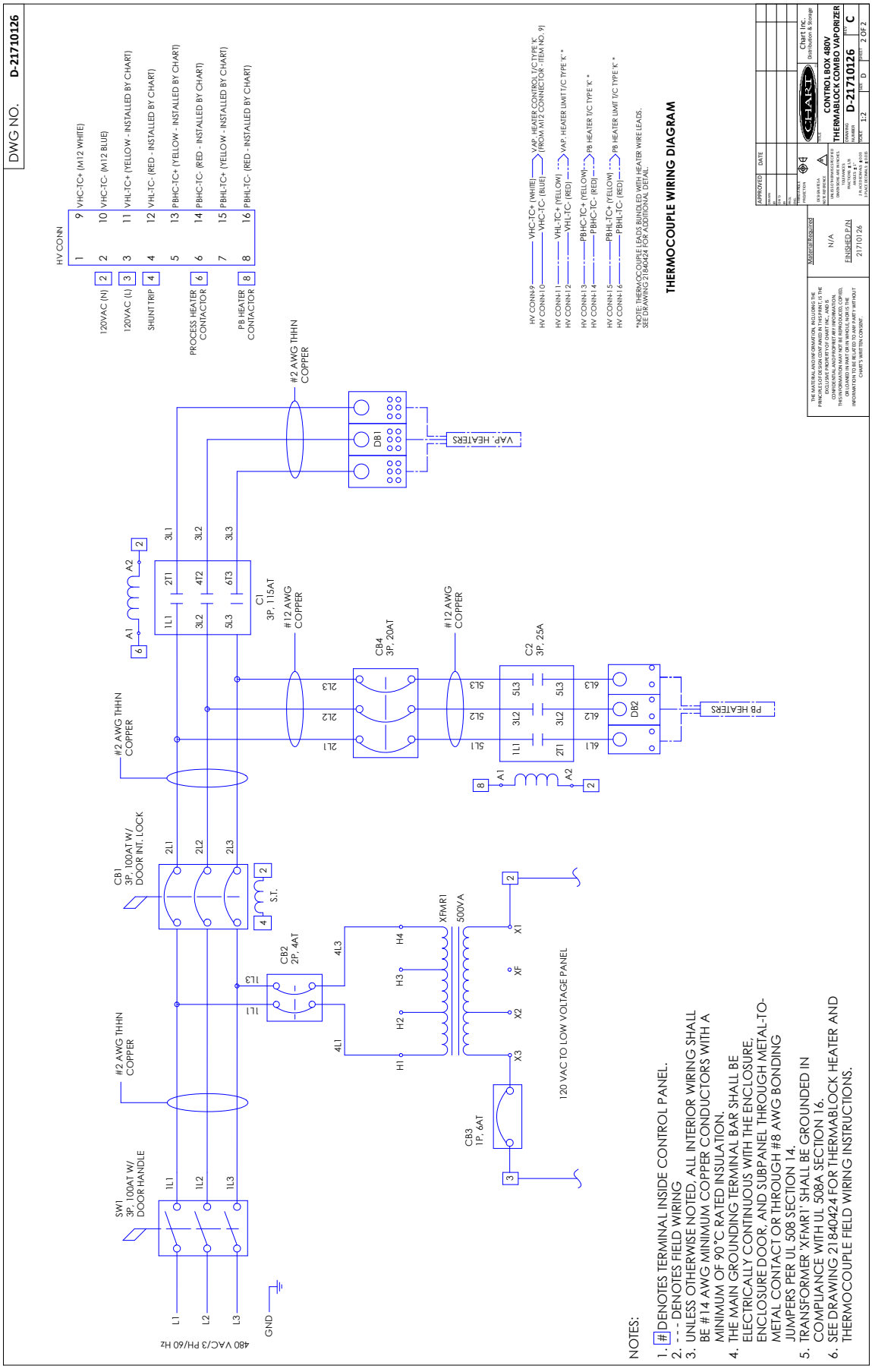
Problem	Item	Action
Unit will not heat	No power	Check voltage to unit
	No power to contactor	Check terminals, fuses, breakers
	No power to controls	Check control transformer and fuses, connecting cable
	Faulty on-off switch	Check control circuit
	Temperature control satisfied	See Operating Temperature Controller operation pamphlet. Increase setpoint to see if unit will come on. If so, decrease gradually to discharge temperature or block temperature . At new setting, unit should cycle normally
	High Temp. Limit Switch	The high temperature limit switch was triggered causing the breaker to trip. The Watlow controller acts as the high temperature limit switch and should reset once the temperature has fallen below the set point temperature. To reset the circuit breaker, turn the main disconnect handle from “TRIP” position to “RESET” position and back to “ON”. Reasons for high temperature limit switch activation may include: 1.Process temperature set point too high, lower process temperature set point (TBV, TBT, TBC). On PB Vaps, lower heater block temperature. 2.Heater contactor fused shut, contact Chart Industries for replacement/warranty info 3.Watlow temperature controller failure, check relay output for correct functionality (see Watlow manual) 4.Open thermocouple on Watlow high temp relay, check thermocouple connection and replace heater if necessary
	Open Thermocouple	If the process thermocouple fails or loosens from its terminals, the main heater contactor will remain open. In this case check and tighten the thermocouple connections into the controller or replace the thermocouple if broken. If the high temperature limit thermocouple (heater thermocouple) fails or loosens from its terminals, the main circuit breaker will trip. In this case, check and tighten the thermocouple connections into the controller and reset the breaker. If the thermocouple is broke, the associated heater will have to be replaced. For later model TBP vaporizers, one heater is used for control and a different heater is used for high temperature shutdown.
High Temp Shutdown Tripping Frequently	High Temp Thermocouple	Ensure thermocouple contacts are connected securely inside the panel.
	Active Setpoint temperature on Watlow Controller	Reduce active setpoint temp. as low as possible to avoid overheating the heater block.

Problem	Item	Action
Erratic temperature Control	Temperature Controller Deadband	Check to ensure all Watlow Controller parameters are correct (See App. 8) Check operating temperature controller output relay for chatter and/or excessive cycling. Increase differential (deadband) to decrease cycling. Refer to temperature controller manual.
	Temperature controller output	Check operating temperature controller output relay for chatter, bounce and or erratic make and break of electrical contacts. Replace plug in outlet relay module.
	Thermocouple (temperature controller sensor) inoperative	Replace thermocouple probe.
Low Temp Cutoff Closed If equipped with LTCO	Unit has been overdrawn. (Alarm 1 output)	Leave vaporizer on, heat from casting will gradually warm LTCO probe. Push home key on Watlow to reset.
	No power to SOV	Check relay on LTCO temperature controller.
	Wrong setpoint on Controller	Check the low temp shutdown alarm setting on the Watlow Controller. (See App. 8)
Low Heat Output	Check flow rate	Adjust flow as required.
	Check voltage	A 10% reduction in voltage reduces capacity 20%.
	Check amperage	Low amp reading indicates some heaters may not be functioning. Check for loose connections, worn/corroded terminals. Finally, check for open heaters by removing terminals and checking across terminal for open and/or grounded heaters. Replace with spares. Unit may be operated at reduced heat capacity once circuit is cleared to ground.
Tank will not build pressure	Check Liquid Level of Tank	Ensure that there is sufficient product in the tank for pressure build circuit to properly function (greater than 20-30%).
	Check PB Isolation Valves	Ensure that PB inlet and outlet valves on the tank going to the vaporizer are open.
	Check Pressure Switch	Ensure that tank headspace pressure sensing line is connected to the pressure switch fitting on the bottom of the control panel.
		Check adjustment of the pressure switch and ensure that contacts are changing once pressure drops below the setpoint.
	Check Flow Rates	Ensure that customer flowrates are not exceeding the pressure build capacity of the vaporizer.
	Check PB Control Valve	Ensure that the electric valve is getting power and properly opening and closing. (See wiring schematic in App. 2) PB Solenoid coil or actuator may need replacement.
	Heater is Inoperable	See “Unit will not heat” troubleshooting steps in table above.
Pressure in tank is too high	Check Pressure Switch	Ensure that tank headspace pressure sensing line is connected to the pressure switch fitting on the bottom of the control panel. Check adjustment of the pressure switch and ensure that contacts are changing once pressure rises above the setpoint.
	Check PB Control Switch	Ensure that the electric valve is closing properly and not leaking by.
	Bad Vacuum on Tank	Troubleshoot tank for vacuum issues by recording pressure rise in tank over several 24 hour periods. Call Chart technical service for further details.
	Low Customer Usage	Customer average product usage does not exceed the daily Normal Evaporation Rate (NER) of tank.

Appendix 4 (TBC Low and High Voltage Panels)

Low Voltage

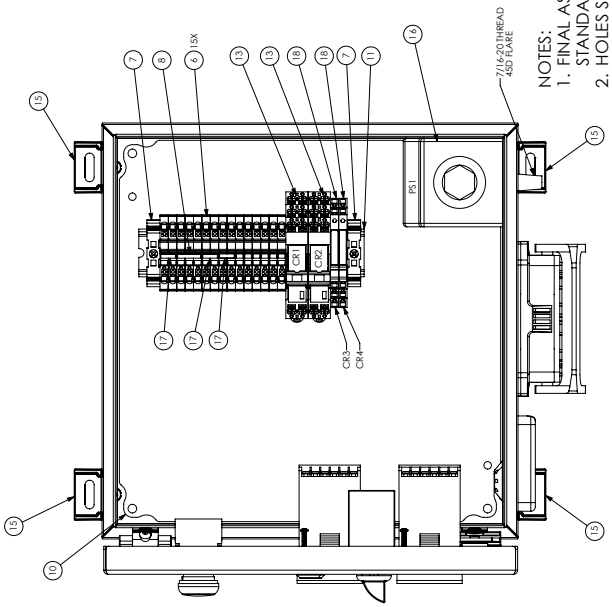



DWG NO. D-21710126
THERMOCOUPLE WIRING DIAGRAM
HV CONN
120VAC (N)
120VAC (L)
SHUNT TRIP
PROCESS HEATER CONTACTOR
PB HEATER CONTACTOR
VHC-TC+ (M12 WHITE)
VHC-TC- (M12 BLUE)
VHL-TC+ (YELLOW - INSTALLED BY CHART)
VHL-TC- (RED - INSTALLED BY CHART)
PBHC-TC+ (YELLOW - INSTALLED BY CHART)
PBHC-TC- (RED - INSTALLED BY CHART)
PBHL-TC+ (YELLOW - INSTALLED BY CHART)
PBHL-TC- (RED - INSTALLED BY CHART)
VAP. HEATER CONTROL T/C TYPE 'K' (FROM M12 CONNECTOR - ITEM NO. 9)
VAP. HEATER LIMIT T/C TYPE 'K' *
PB HEATER T/C TYPE 'K' *
PB HEATER LIMIT T/C TYPE 'K' *
*NOTE: THERMOCOUPLE LEADS BUNDLED WITH HEATER WIRE LEADS. SEE DRAWING 21840424 FOR ADDITIONAL DETAIL.
480 VAC/3 PH/60 Hz
L1
L2
L3
GND
SW1 3P, 100AT W/ DOOR HANDLE
CB1 3P, 100AT W/ DOOR INT. LOCK
S.T.
CB2 2P, 4AT
CB3 1P, 6AT
CB4 3P, 20AT
C1 3P, 115AT
C2 3P, 25A
XFMR1 500VA
#2 AWG THHN COPPER
#12 AWG COPPER
VAP. HEATERS
PB HEATERS
120 VAC TO LOW VOLTAGE PANEL
NOTES:
1. # DENOTES TERMINAL INSIDE CONTROL PANEL.
2. - - DENOTES FIELD WIRING
3. UNLESS OTHERWISE NOTED, ALL INTERIOR WIRING SHALL BE #14 AWG MINIMUM COPPER CONDUCTORS WITH A MINIMUM OF 90°C RATED INSULATION.
4. THE MAIN GROUNDING TERMINAL BAR SHALL BE ELECTRICALLY CONTINUOUS WITH THE ENCLOSURE, ENCLOSURE DOOR, AND SUBPANEL THROUGH METAL-TO-METAL CONTACT OR THROUGH #8 AWG BONDING JUMPERS PER UL 508 SECTION 14.
5. TRANSFORMER 'XFMR1' SHALL BE GROUNDED IN COMPLIANCE WITH UL 508A SECTION 16.
6. SEE DRAWING 21840424 FOR THERMABLOCK HEATER AND THERMOCOUPLE FIELD WIRING INSTRUCTIONS.
CONTROL BOX 480V THERMABLOCK COMBO VAPORIZER
D-21710126
Chart Inc. Distribution & Storage

High Voltage

DWG NO. **D-21708968**

ITEM NO.	MFG	MFG PART NO.	DESCRIPTION	DWG LABEL	QTY
1	SAGINAW	SCE-1212ELI	ENCLOSURE 12X12X6		1
2	WATLOW	PM6C2EJ-BLCIDAA	PID TEMPERATURE CONTROLLER	TC1, TC2	2
3	EATON	M22-L-G-230G	LED LIGHT GREEN	LT1	1
4	EATON	M22-L-Y-230W	LED LIGHT YELLOW	LT2, LT3	2
5	EATON	M22-WRK-K11	2-POSITION SELECTOR SWITCH	SW2	1
6	PHOENIX CONTACT	3211757	FEED-THROUGH TERMINAL BLOCK		15
7	PHOENIX CONTACT	800886	DIN RAIL END ANCHOR		2
8	PHOENIX CONTACT	3030242	PLUG-IN BRIDGE, 3-POSITION		1
9	PHOENIX CONTACT	1407732	CONTACT INSERT CONNECTOR		1
10	SAGINAW	SCE-12P12	ENCLOSURE SUBPANEL		1
11	ALLEN-BRADLEY	1492-DR5	DIN RAIL		AR
12	SAGINAW	SCE-BVK	ENCLOSURE BREATHER VENT		1
13	PHOENIX CONTACT	2903332	PRE-ASSEMBLED POWER RELAY	CR1,CR2	2
14	PHOENIX CONTACT	1411324	PANEL MOUNT CONNECTOR BASE		1
15	SAGINAW	SCE-ELIMFK	ENCLOSURE MOUNTING FEET		4
16	ALLEN-BRADLEY	836-A4	PRESSURE SWITCH	PS1	1
17	PHOENIX CONTACT	3030336	PLUG-IN BRIDGE, 2-POSITION		4
18	PHOENIX CONTACT	2900304	RELAY MODULE	CR3,CR4	2
19	MCMASTER-CARR	7845K54	WASHDOWN HOLE PLUG 3/4"		1



INTERIOR PANEL LAYOUT VIEW

NOTES:
1. FINAL ASSEMBLY SHALL COMPLY WITH LATEST EDITION OF UL 508A STANDARD FOR INDUSTRIAL CONTROL PANELS.
2. HOLES SHALL BE PLUGGED WITH NEMA 4 WASHDOWN HOLE PLUGS.

REV	APV	ECR	REVISION DESCRIPTION	BY	DATE
C	JTC	210215	CHANGED CONNECTOR	RFA	9/30/2021
B	JTC	210215	ADD RELAYS FOR TEMP LIMIT	RFA	2/19/2020
A	JTC	210215	INITIAL RELEASE	RFA	2/13/2020

APPROVED RFA 1/12/2020 — DRAWN JTC 2/13/2020 — CHECKED

Material: Textured — N/A — FINISHED P/N 21708968

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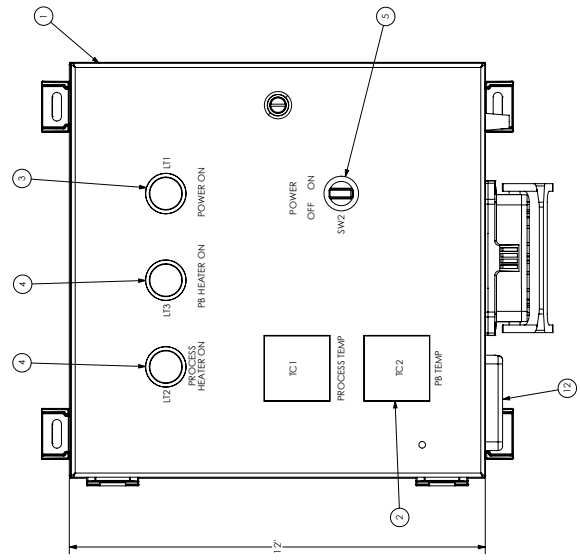
CHART

Chart Inc.
Distribution & Storage

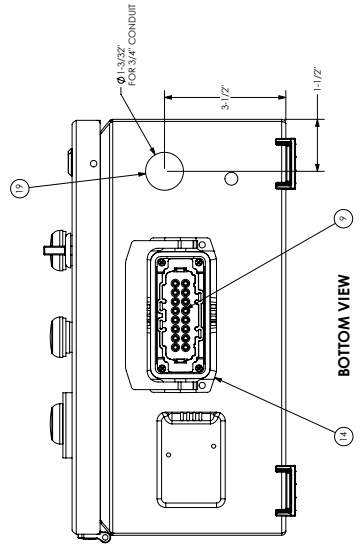
TITLE: CONTROL BOX 120VAC TBC W/ LTCO AND PRESSURE SWITCH

DRAWING NUMBER: D-21708968 — REV: C

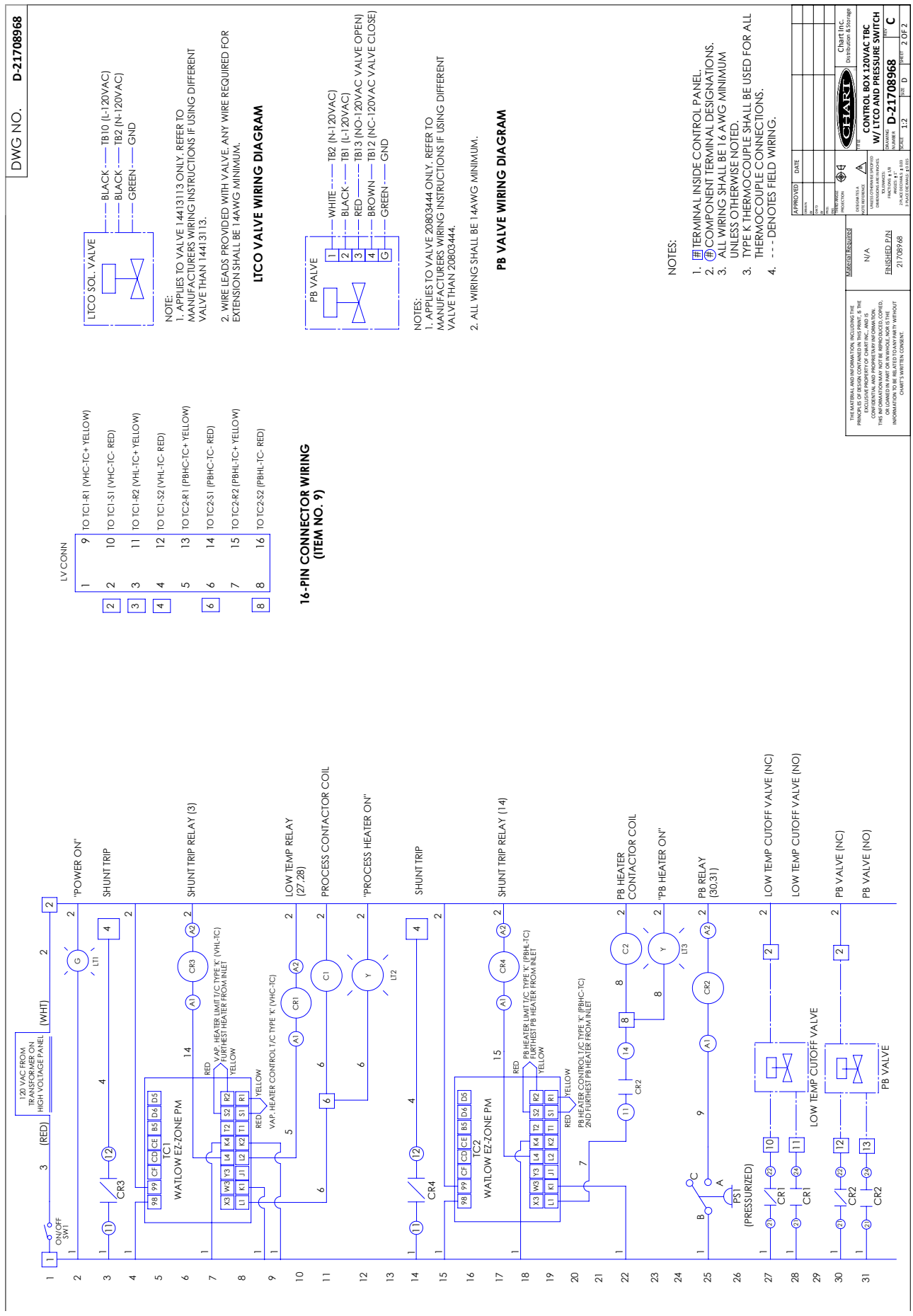
SCALE: 5.8 — SIZE: D — SHEET 1 OF 2



FRONT VIEW



BOTTOM VIEW


DWG NO. D-21708968
LTCO SOL. VALVE
BLACK — TB10 (L-120VAC)
BLACK — TB2 (N-120VAC)
GREEN — GND
NOTE:
1. APPLIES TO VALVE 14413113 ONLY. REFER TO MANUFACTURERS WIRING INSTRUCTIONS IF USING DIFFERENT VALVE THAN 14413113.
2. WIRE LEADS PROVIDED WITH VALVE. ANY WIRE REQUIRED FOR EXTENSION SHALL BE 14AWG MINIMUM.
LTCO VALVE WIRING DIAGRAM
PB VALVE
WHITE — TB2 (N-120VAC)
BLACK — TB1 (L-120VAC)
RED — TB13 (NO-120VAC VALVE OPEN)
BROWN — TB12 (NC-120VAC VALVE CLOSE)
GREEN — GND
NOTES:
1. APPLIES TO VALVE 20803444 ONLY. REFER TO MANUFACTURERS WIRING INSTRUCTIONS IF USING DIFFERENT VALVE THAN 20803444.
2. ALL WIRING SHALL BE 14AWG MINIMUM.
PB VALVE WIRING DIAGRAM
LV CONN
TO TC1-R1 (VHC-TC+ YELLOW)
TO TC1-S1 (VHC-TC- RED)
TO TC1-R2 (VHL-TC+ YELLOW)
TO TC1-S2 (VHL-TC- RED)
TO TC2-R1 (PBHC-TC+ YELLOW)
TO TC2-S1 (PBHC-TC- RED)
TO TC2-R2 (PBHL-TC+ YELLOW)
TO TC2-S2 (PBHL-TC- RED)
16-PIN CONNECTOR WIRING (ITEM NO. 9)
120 VAC FROM TRANSFORMER ON HIGH VOLTAGE PANEL
(WHT)
(RED)
ON/OFF SW1
"POWER ON"
SHUNT TRIP
CR3
TC1 WATLOW EZ-ZONE PM
SHUNT TRIP RELAY (3)
VAP. HEATER LIMIT T/C TYPE 'K' (VHL-TC) FURTHEST HEATER FROM INLET
VAP. HEATER CONTROL T/C TYPE 'K' (VHC-TC)
LOW TEMP RELAY (27,28)
PROCESS CONTACTOR COIL
"PROCESS HEATER ON"
SHUNT TRIP
CR4
TC2 WATLOW EZ-ZONE PM
SHUNT TRIP RELAY (14)
PB HEATER LIMIT T/C TYPE K" (PBHL-TC) FURTHEST PB HEATER FROM INLET
PB HEATER CONTROL T/C TYPE 'K' (PBHC-TC) 2ND FURTHEST PB HEATER FROM INLET
PB HEATER CONTACTOR COIL
"PB HEATER ON"
PB RELAY (30,31)
PS1 (PRESSURIZED)
LOW TEMP CUTOFF VALVE
LOW TEMP CUTOFF VALVE (NC)
LOW TEMP CUTOFF VALVE (NO)
PB VALVE
PB VALVE (NC)
PB VALVE (NO)
NOTES:
1. # TERMINAL INSIDE CONTROL PANEL.
2. # COMPONENT TERMINAL DESIGNATIONS.
3. ALL WIRING SHALL BE 16 AWG MINIMUM UNLESS OTHERWISE NOTED.
3. TYPE K THERMOCOUPLE SHALL BE USED FOR ALL THERMOCOUPLE CONNECTIONS.
4. - - - DENOTES FIELD WIRING.
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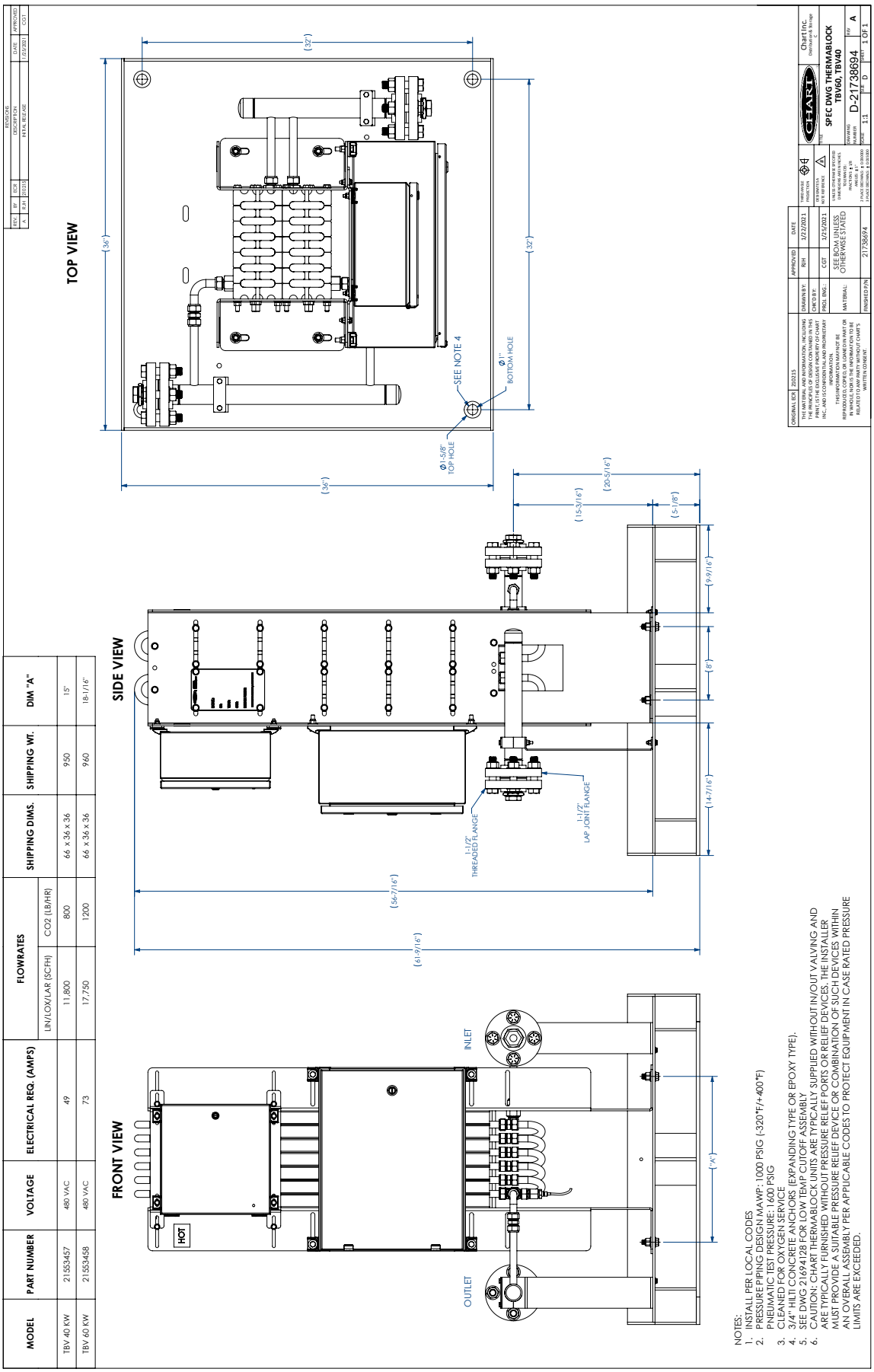
Material Required
N/A
FINISHED P/N
21708968
APPROVED
DATE
DESIGNATES A KEY REFERENCE DIMENSION
TOLERANCES, UNLESS OTHERWISE SPECIFIED: FRACTIONS ± 1/64 ANGLES ± 1° DECIMALS .X ± 0.03 .XX ± 0.010 .XXX ± 0.005
THIRD ANGLE PROJECTION
CHART
Chart Inc. Distribution & Storage
TITLE
CONTROL BOX 120VAC TBC W/ LTCO AND PRESSURE SWITCH
DRAWING NUMBER D-21708968
REV C
SCALE 1/2
SIZE D
SHEET 2 OF 2

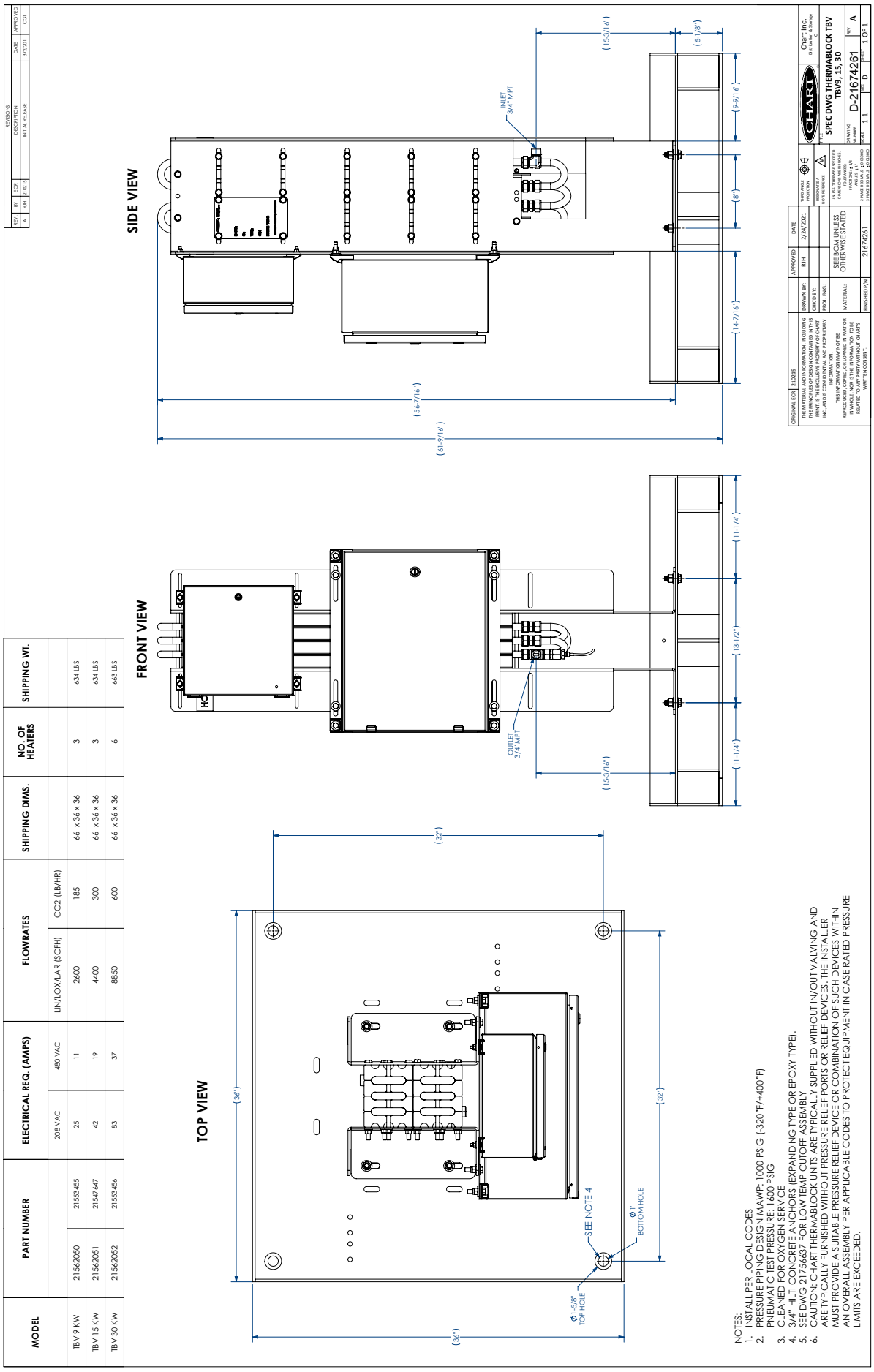
Appendix 5 (ThermaBlock™ Vaporizer Spec Drawings)

TBV Models



MODEL	PART NUMBER	VOLTAGE	ELECTRICAL REQ. (AMPS)	FLOWRATES		SHIPPING DIMS.	SHIPPING WT.	DIM "A"
				LIN/LOX/LAR (SCFH)	CO2 (LB/HR)			
TBV 40 KW	21553457	480 VAC	49	11,800	800	66 x 36 x 36	950	15"
TBV 60 KW	21553458	480 VAC	73	17,750	1200	66 x 36 x 36	960	18-1/16"

NOTES:
1. INSTALL PER LOCAL CODES
2. PRESSURE PIPING DESIGN MAWP: 1,000 PSIG (-320°F/+400°F)
3. PNEUMATIC TEST PRESSURE: 1,600 PSIG
4. CLEANED FOR OXYGEN SERVICE
5. 3/4" HILTI CONCRETE ANCHORS (EXPANDING TYPE OR EPOXY TYPE).
6. SEE DWG 21694128 FOR LOW TEMP CUTOFF ASSEMBLY
7. CAUTION: CHART THERMABLOCK UNITS ARE TYPICALLY SUPPLIED WITHOUT IN/OUT VALVING AND ARE TYPICALLY FURNISHED WITHOUT PRESSURE RELIEF PORTS OR RELIEF DEVICES. THE INSTALLER MUST PROVIDE A SUITABLE PRESSURE RELIEF DEVICE OR COMBINATION OF SUCH DEVICES WITHIN AN OVERALL ASSEMBLY PER APPLICABLE CODES TO PROTECT EQUIPMENT IN CASE RATED PRESSURE LIMITS ARE EXCEEDED.

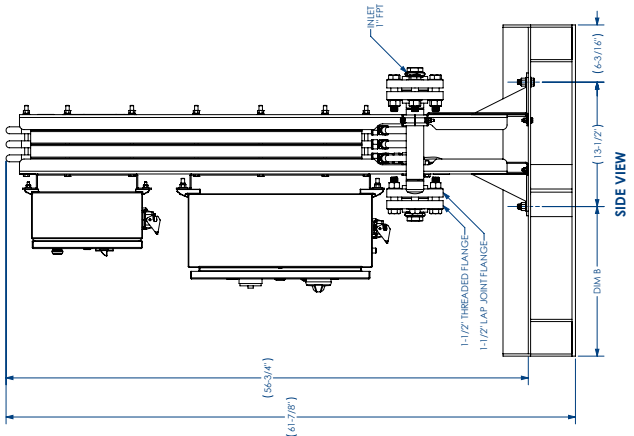


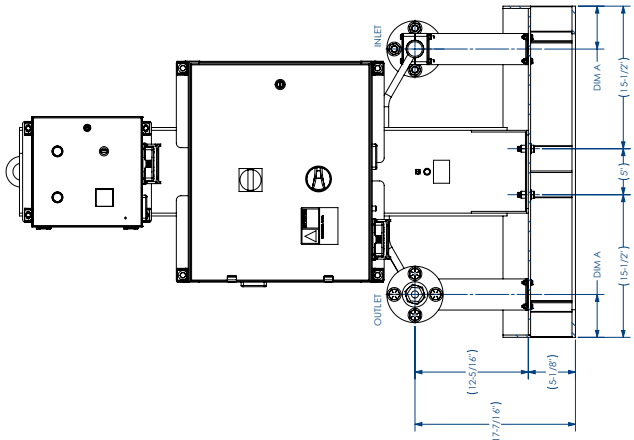
MODEL	PART NUMBER		ELECTRICAL REQ. (AMPS)		FLOWRATES		SHIPPING DIMS.	NO. OF HEATERS	SHIPPING WT.
			208 VAC	480 VAC	LIN/LOX/LAR (SCFH)	CO2 (LB/HR)			
TBV 9 KW	21562050	21553455	25	11	2600	185	66 x 36 x 36	3	634 LBS
TBV 15 KW	21562051	21547447	42	19	4400	300	66 x 36 x 36	3	634 LBS
TBV 30 KW	21562052	21553456	83	37	8850	600	66 x 36 x 36	6	663 LBS

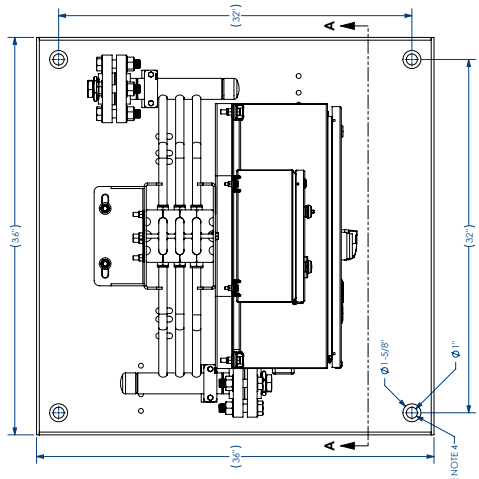
NOTES:
1. INSTALL PER LOCAL CODES
2. PRESSURE PIPING DESIGN MAWP: 1000 PSIG (-320°F/+400°F)
3. PNEUMATIC TEST PRESSURE: 1600 PSIG
4. CLEANED FOR OXYGEN SERVICE
5. 3/4" HILTI CONCRETE ANCHORS (EXPANDING TYPE OR EPOXY TYPE).
6. SEE DWG 21756437 FOR LOW TEMP CUTOFF ASSEMBLY
7. CAUTION: CHART THERMABLOCK UNITS ARE TYPICALLY SUPPLIED WITHOUT IN/OUT VALVING AND ARE TYPICALLY FURNISHED WITHOUT PRESSURE RELIEF PORTS OR RELIEF DEVICES. THE INSTALLER MUST PROVIDE A SUITABLE PRESSURE RELIEF DEVICE OR COMBINATION OF SUCH DEVICES WITHIN AN OVERALL ASSEMBLY PER APPLICABLE CODES TO PROTECT EQUIPMENT IN CASE RATED PRESSURE LIMITS ARE EXCEEDED.

TBT Models

MODEL	PART NUMBER & ELECTRICAL REQ. (AMPS)				FLOWRATES		SHIPPING DIMS (IN)	NO. OF HEATERS	SHIPPING WT. (lbs)	DIM A	DIM B
	208 VAC	AMPS	480 VAC	AMPS	LIN/LOX/LAR (SCFH)	CO2 (LB/HR)					
TBT 9 KW	21562060	25	21553459	11	12,000		62 x 36 x 36	3	TBD	4-11/16"	16-1/4"
TBT 15 KW	21562061	42	21553460	19	20,000	-	62 x 36 x 36	3	TBD	4-11/16"	16-1/4"
TBT 30 KW	21562062	83	21553461	37	40,000	-	62 x 36 x 36	6	TBD	4-11/16"	11-11/16"
TBT 40 KW	N/A	-	21553462	49	53,450	-	62 x 36 x 36	8	TBD	4-11/16"	8-5/8"
TBT 60 KW	N/A	-	21553463	73	80,300	-	62 x 36 x 42	12	811	4-7/16"	5-1/4"







NOTES:
1. INSTALL PER LOCAL CODES
2. PRESSURE PIPING DESIGN MAWP: 1000 PSIG (-320 F/+400 F)
   PNEUMATIC TEST PRESSURE: 1600 PSIG
3. CLEANED FOR OXYGEN SERVICE
4. 3/4" HILTI CONCRETE ANCHORS (EXPANDING TYPE OR EPOXY TYPE).
5. SEE DWG 21694128 FOR LOW TEMP CUTOFF ASSEMBLY
6. CAUTION: CHART THERMABLOCK UNITS ARE TYPICALLY SUPPLIED WITHOUT IN/OUT VALVING AND ARE TYPICALLY FURNISHED WITHOUT PRESSURE RELIEF PORTS OR RELIEF DEVICES. THE INSTALLER MUST PROVIDE A SUITABLE PRESSURE RELIEF DEVICE OR COMBINATION OF SUCH DEVICES WITHIN AN OVERALL ASSEMBLY PER APPLICABLE CODES TO PROTECT EQUIPMENT IN CASE RATED PRESSURE LIMITS ARE EXCEEDED.

REV	APPV	ECR	DESCRIPTION	BY	DATE
A	CDT	21582	INITIAL RELEASE	ZMB	8/3/2021

APPROVED ZMB DATE 7/12/2021
211162 ORIGINAL ECR:

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Material: Reference

SEE BOM UNLESS OTHERWISE STATED

FINISH P/N: SEE TABLE

DESIGN PER A REFERENCE

TOLERANCES: FRACTIONAL ± 1/64 ANGLES: ± 1/2 DECIMALS: X ± 0.1 DECIMALS: XX ± 0.01 DECIMALS: XXX ± 0.005

TITLE: SPEC DWG THERMABLOCK TBT TBT 9, 15, 30, 40, 60

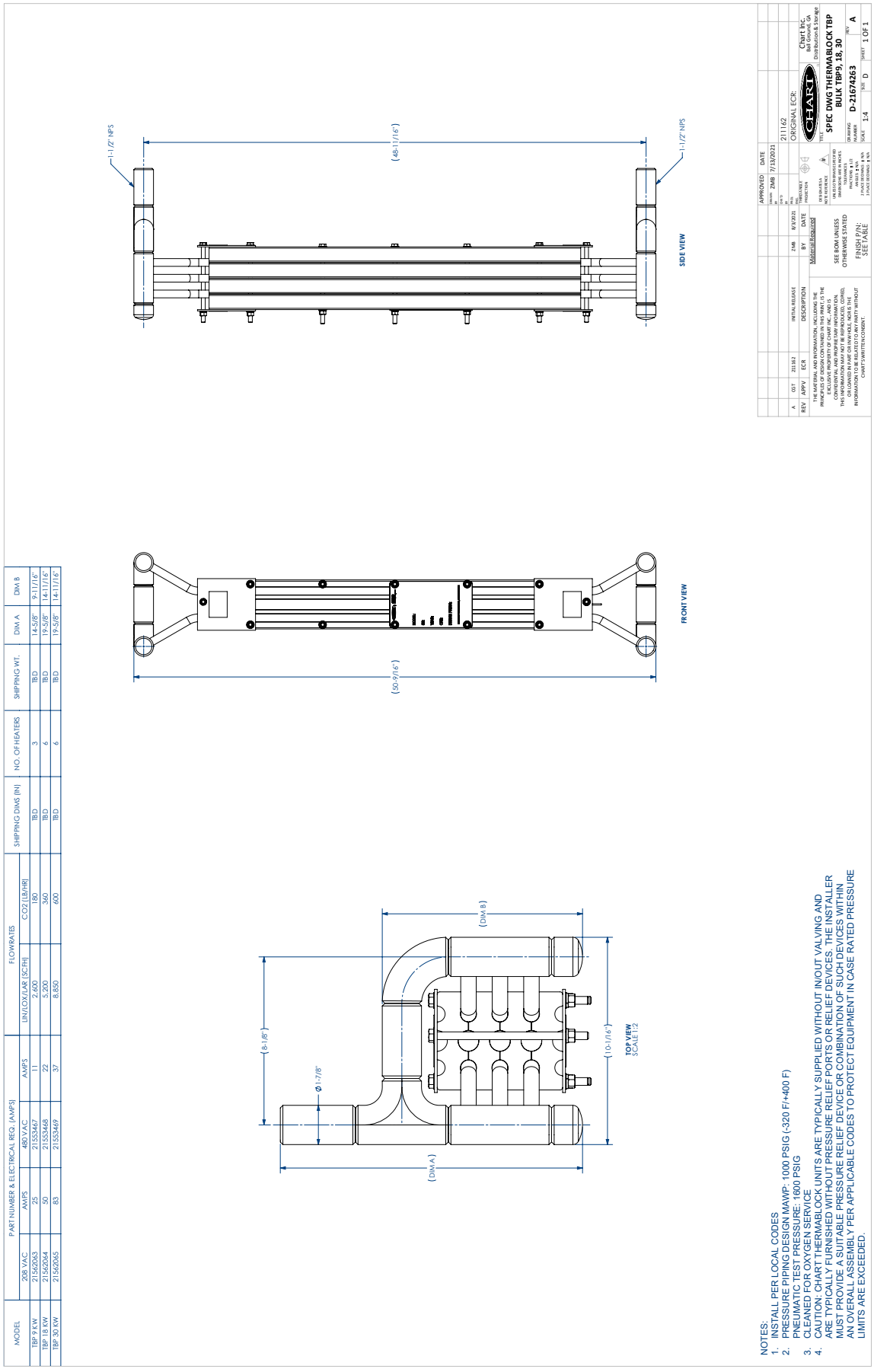
DRAWING NUMBER: D-21674262

REV: A

SCALE: 1:6 SIZE: D SHEET 1 OF 1

CHART Chart Inc. Ball Ground, GA Distribution & Storage

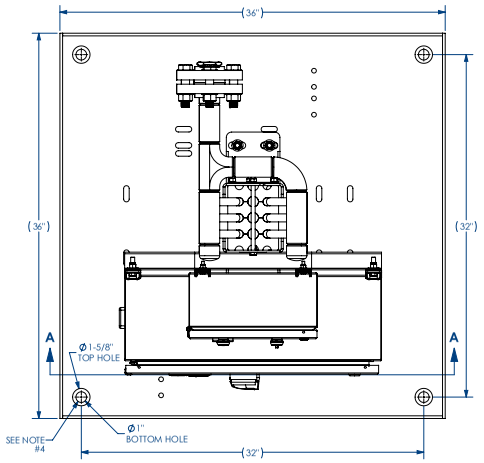
TBP Models



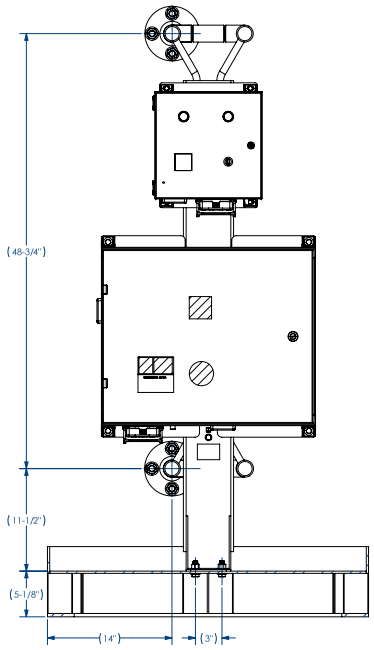
MODEL	PART NUMBER & ELECTRICAL REQ. (AMPS)			FLOWRATES		SHIPPING DIMS (IN)	NO. OF HEATERS	SHIPPING WT.	DIM A	DIM B
	208 VAC	AMPS	480 VAC	AMPS	LIN/LOX/LAR (SCFH)	CO2 (LB/HR)				
TBP 9 KW	21562063	25	21553467	11	2,600	180	TBD	3	TBD	14-5/8"	9-11/16"
TBP 18 KW	21562064	50	21553468	22	5,200	360	TBD	6	TBD	19-5/8"	14-11/16"
TBP 30 KW	21562065	83	21553469	37	8,850	600	TBD	6	TBD	19-5/8"	14-11/16"

NOTES:
1. INSTALL PER LOCAL CODES
2. PRESSURE PIPING DESIGN MAWP: 1000 PSIG (-320 F/+400 F)
3. PNEUMATIC TEST PRESSURE: 1600 PSIG
4. CLEANED FOR OXYGEN SERVICE
5. CAUTION: CHART THERMABLOCK UNITS ARE TYPICALLY SUPPLIED WITHOUT IN/OUT VALVING AND ARE TYPICALLY FURNISHED WITHOUT PRESSURE RELIEF PORTS OR RELIEF DEVICES. THE INSTALLER MUST PROVIDE A SUITABLE PRESSURE RELIEF DEVICE OR COMBINATION OF SUCH DEVICES WITHIN AN OVERALL ASSEMBLY PER APPLICABLE CODES TO PROTECT EQUIPMENT IN CASE RATED PRESSURE LIMITS ARE EXCEEDED.

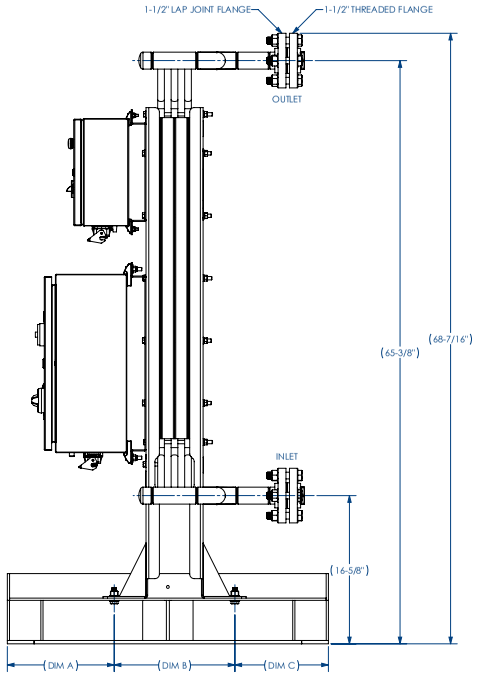
MODEL	PART NUMBER & ELECTRICAL REQ. (AMPS)				FLOWRATES		SHIPPING DIMS (IN)	NO. OF HEATERS	SHIPPING WT. (lbs)	DIM A	DIM B	DIM C
	208 VAC	AMPS	480 VAC	AMPS	LIN/LOX/LAR (SCFH)	CO2 (LB/HR)						
TBP 9 KW	21702513	25	21702514	11	2,600	180	73 x 52 x 25	3	TBD	12"	13-1/2"	10-1/2"
TBP 18 KW	21702516	50	21702517	22	5,200	360	73 x 52 x 25	6	TBD	8-7/8"	18-1/8"	9"
TBP 30 KW	21702519	83	21702520	37	8,850	600	73 x 52 x 25	6	TBD	8-7/8"	18-1/8"	9"



TOP VIEW
SCALE 1:5



SECTION A-A
SCALE 1:6



NOTES:
1. INSTALL PER LOCAL CODES
2. PRESSURE PIPING DESIGN MAWP: 1000 PSIG (-320 F/+400 F)
   PNEUMATIC TEST PRESSURE: 1600 PSIG
3. CLEANED FOR OXYGEN SERVICE
4. 3/4" HILTI CONCRETE ANCHORS (EXPANDING TYPE OR EPOXY TYPE).
5. SEE DWG 21694128 FOR LOW TEMP CUTOFF ASSEMBLY
6. CAUTION: CHART THERMABLOCK UNITS ARE TYPICALLY SUPPLIED WITHOUT IN/OUT VALVING AND ARE TYPICALLY FURNISHED WITHOUT PRESSURE RELIEF PORTS OR RELIEF DEVICES. THE INSTALLER MUST PROVIDE A SUITABLE PRESSURE RELIEF DEVICE OR COMBINATION OF SUCH DEVICES WITHIN AN OVERALL ASSEMBLY PER APPLICABLE CODES TO PROTECT EQUIPMENT IN CASE RATED PRESSURE LIMITS ARE EXCEEDED.

REV	APPV	ECR	DESCRIPTION	BY	DATE
A	CGT	211162	INITIAL RELEASE	ZMB	8/3/2021

APPROVED DATE
DRAWN ZMB 7/13/2021
CHKD
ENG
MFG
211162
ORIGINAL ECR:

THIRD ANGLE PROJECTION

CHART — Chart Inc., Ball Ground, GA, Distribution & Storage

TITLE: SPEC DWG THERMABLOCK TBP STAND ALONE TBP9, 18, 30

DRAWING NUMBER: D-21871001 REV: A

SCALE: 1:6 SIZE: D SHEET: 1 OF 1

Material Required

SEE BOM UNLESS OTHERWISE STATED

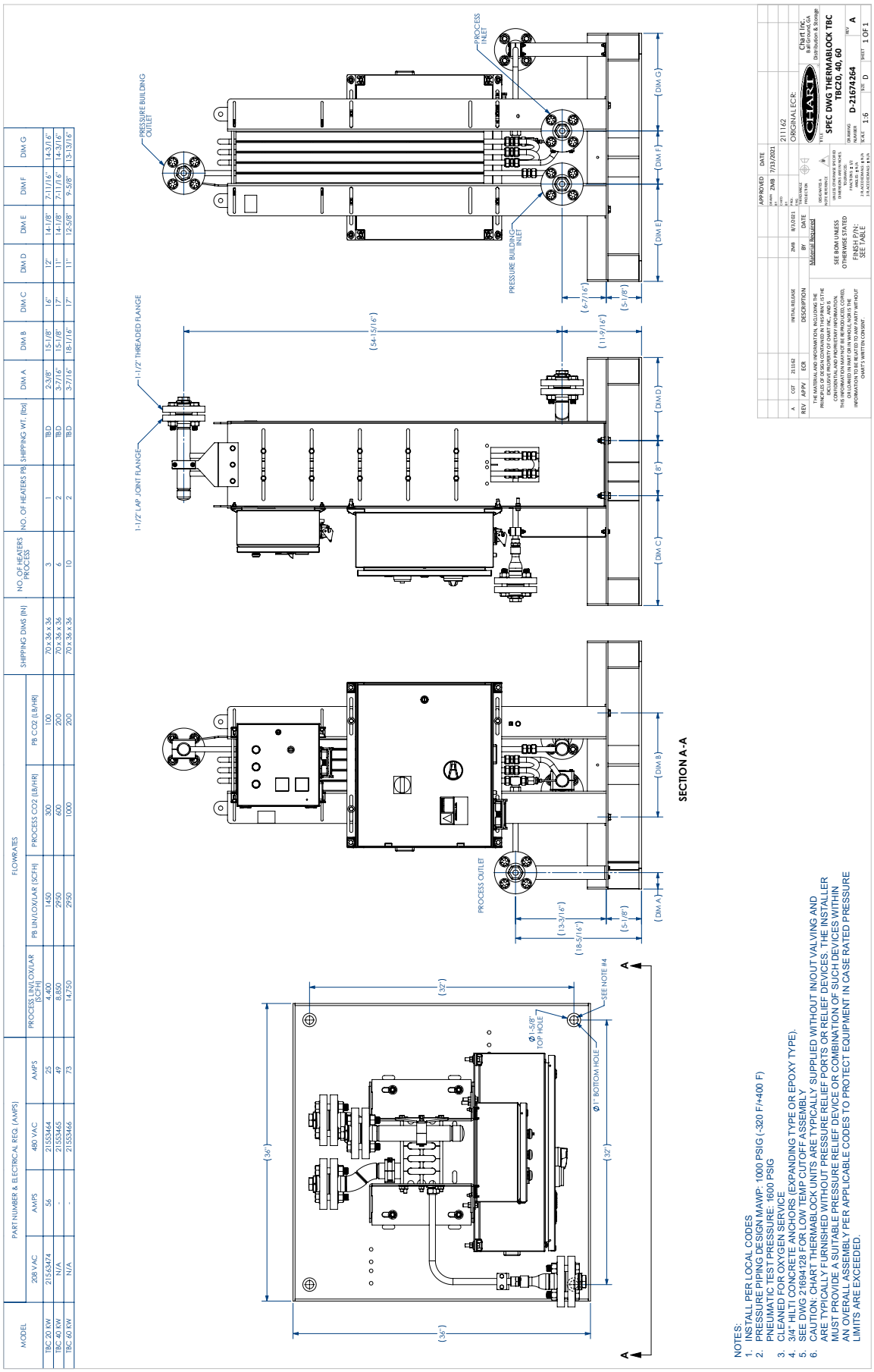
FINISH P/N: SEE TABLE

DESIGN AS A NOTE/REFERENCE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCE
FRACTIONS ± 1/2
ANGLES ± N/A
2 PLACE DECIMALS ± N/A
3 PLACE DECIMALS ± N/A

TBC Models

MODEL	PART NUMBER & ELECTRICAL REQ. (AMPS)				FLOWRATES				SHIPPING DIMS (IN)	NO. OF HEATERS PROCESS	NO. OF HEATERS PB	SHIPPING WT. (lbs)	DIM A	DIM B	DIM C	DIM D	DIM E	DIM F	DIM G
	208 VAC	AMPS	480 VAC	AMPS	PROCESS LIN/LOX/LAR (SCFH)	PB LIN/LOX/LAR (SCFH)	PROCESS CO2 (LB/HR)	PB CO2 (LB/HR)											
TBC-20 KW	21563474	56	21553464	25	4,400	1450	300	100	70 x 36 x 36	3	1	TBD	2-3/8"	15-1/8"	16"	12"	14-1/8"	7-11/16"	14-3/16"
TBC-40 KW	N/A	-	21553465	49	8,850	2950	600	200	70 x 36 x 36	6	2	TBD	3-7/16"	15-1/8"	17"	11"	14-1/8"	7-11/16"	14-3/16"
TBC-60 KW	N/A	-	21553466	73	14,750	2950	1000	200	70 x 36 x 36	10	2	TBD	3-7/16"	18-1/16"	17"	11"	12-5/8"	9-5/8"	13-13/16"



NOTES:
1. INSTALL PER LOCAL CODES
2. PRESSURE PIPING DESIGN MAWP: 1000 PSIG (-320 F/+400 F)
3. PNEUMATIC TEST PRESSURE: 1600 PSIG
4. CLEANED FOR OXYGEN SERVICE
5. 3/4" HILTI CONCRETE ANCHORS (EXPANDING TYPE OR EPOXY TYPE).
6. SEE DWG 21694128 FOR LOW TEMP CUTOFF ASSEMBLY
7. CAUTION: CHART THERMABLOCK UNITS ARE TYPICALLY SUPPLIED WITHOUT IN/OUT VALVING AND ARE TYPICALLY FURNISHED WITHOUT PRESSURE RELIEF PORTS OR RELIEF DEVICES. THE INSTALLER MUST PROVIDE A SUITABLE PRESSURE RELIEF DEVICE OR COMBINATION OF SUCH DEVICES WITHIN AN OVERALL ASSEMBLY PER APPLICABLE CODES TO PROTECT EQUIPMENT IN CASE RATED PRESSURE LIMITS ARE EXCEEDED.

REV	APPV	ECR	DESCRIPTION	BY	DATE
A	CGT	21162	INITIAL RELEASE	ZMB	8/1/2021

APPROVED DATE
DRAWN ZMB 7/13/2021
CHECKED
ENGINEER
ORIGINAL ECR: 21162
MFG APPROVAL
TITLE: SPEC DWG THERMABLOCK TBC TBC20, 40, 60
DRAWING NUMBER: D-21674264 REV: A
SCALE: 1:6 SIZE: D SHEET: 1 OF 1

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SEE BOM UNLESS OTHERWISE STATED
FINISH P/N: SEE TABLE

DIMENSIONS ARE INCHES UNLESS OTHERWISE SPECIFIED
TOLERANCES ARE: FRACTIONS ± 1/2 .X ± 0.1 .XX ± 0.01 ANGULAR ± 1/2°
DO NOT SCALE DRAWING
MATERIAL REQUIRED

Chart Inc. Ball Ground, GA Distribution & Storage

Appendix 6 (Allen Bradley Pressure Switch)

Bulletin 836

Pressure Controls

Product Overview

Bulletin 836 — Pressure Controls, General Industrial

- Operating ranges from 30 in. Hg vacuum…900 psi
- Independently adjustable range and differential
- Copper alloy and stainless steel bellows
- 7/16-20 S.A.E. and 1/4 in. N.P.T. connections
- Variety of contact blocks available
- Open Type, Type 1, Type 4&13, Type 4X and Type 7&9 and 4&13 combination enclosures

Standards Compliance

UL 508
UL 698 (Haz. Loc.)
UL 1604 (Haz. Loc.)
CSA 22.2 No. 14
NEMA ICS-2
IEC 529/IP2X

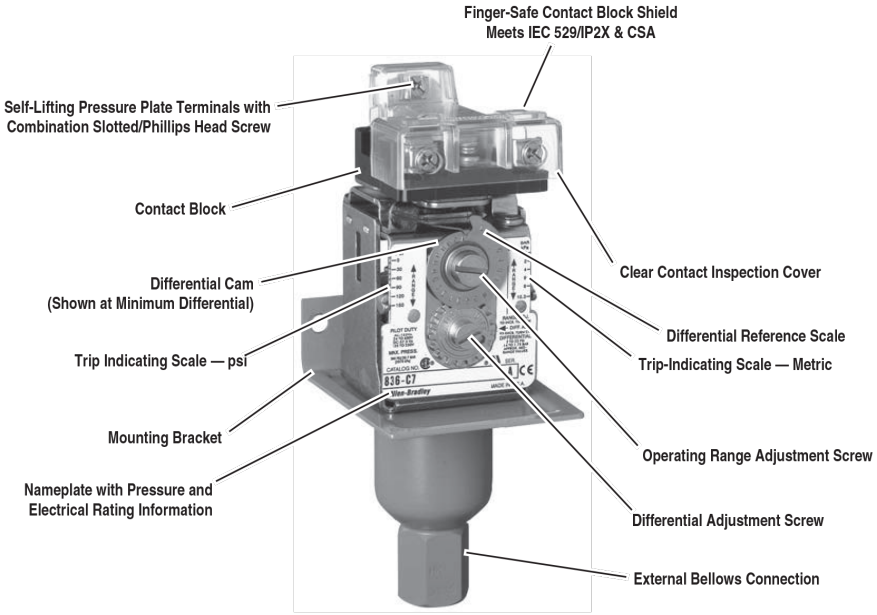
Certifications

(For file and guide numbers, see the table below)

Table of Contents

File and Guide Numbers

	UL		CSA	
	File Number	Guide Number	File Number	Class
Bulletin 836	E14842	NKPZ	LR1234	3211-03
	E53048 (Haz. Loc.)	NOWT	LR11924 (Haz. Loc.)	3218-05
	Hazardous Location Enclosure not CE compliant. All other enclosed devices are CE compliant			



Bulletin 836
Pressure Controls
Product Overview

Description

Bulletin 836 Pressure Controls are designed for general industrial use to control and detect pressure. Allen-Bradley Bulletin 836 Pressure Controls can be used in pneumatic and hydraulic systems. Pressure controls use copper alloy or stainless steel bellows. The design and high-quality components provide long life operation with air, water, oil, non-corrosive liquids, vapors, gases, and some corrosive liquids and gases.

Pressure controls feature snap-action precision switches equipped with silver contacts. The straight in-line and relatively friction-free construction provides accurate and consistent operation regardless of the angle at which the controls are mounted. Pressure controls are designed for easy adjustment of both trip and reset pressures.

Allen-Bradley Bulletin 836 Pressure Controls are used in many types of industries and applications. They can be used to control pneumatic systems, maintaining preset pressures between two values. Pressure controls can be used to detect overpressures of gases or liquids to protect machines, processes, and personnel. They can also be used to detect low pressures to protect equipment from loss of coolants and lubrication.

Bulletin 836 Pressure Controls are offered in a variety of styles to meet a wide range of applications. The devices are available in Type 1, 4 & 13, 4X, 7 & 9, and 4 & 13 combined and open type without enclosure for panel mounting. Pressure controls have a wide variety of contact modifications to meet most control circuit requirements. The controls have adjustable pressure ranges from 30 in. Hg vacuum…900 psi with corresponding differentials. Accessories and modifications are available to tailor the device to meet most application requirements.

Style A — Small Size, Internal Copper Alloy Bellows

Style A

- Independently adjustable range and differential
- 7/16-20 SAE flare for 1/4 in. copper tubing connection
- Adjustable operating range — 30 in. Hg vacuum…375 psi
- Maximum line pressure — up to 750 psi
- Occasional surge pressure — up to 850 psi

Style C — Wider Ranges, External Bellows

Style C

- Independently adjustable range and differential
- 1/4 in N.P.T. female pipe connection
- 3/8 in N.P.T. female pipe connection (836-C1 and 836-C1A only)

Copper Alloy Bellows

- Adjustable operating range — 30 in. Hg vacuum…900 psi
- Maximum line pressure — up to 1300 psi
- Occasional surge pressure — up to 1600 psi

Type 316 Stainless Steel Bellows

- Adjustable operating range — 30 in. Hg vacuum…375 psi
- Maximum line pressure — up to 650 psi
- Occasional surge pressure — up to 650 psi

Refrigeration Controls - See page 13-19

Style H

- High-pressure refrigeration controls

Style L

- Low-pressure refrigeration controls

Style P

- High-pressure definite purpose controls

Bulletin 836

Pressure Controls

Technical Data

Technical Terms

Adjustable operating range — Total span within which the contacts can be adjusted to trip and reset.

Trip setting — Higher pressure setting at which value the contacts transfer from their normal state to a changed state.

Reset setting — Lower pressure setting at which value the contacts return to their normal state.

Adjustable differential — Difference between the trip and reset values.

Minimum differential — When the differential is set to the lowest pressure difference between trip and reset.

Maximum differential — When the differential is set to the widest pressure difference between trip and reset.

Maximum occasional surge pressure — Maximum surge pressure that can be applied to the actuator. Surges or transients can occur during startup and shutdown of a machine or system. Expressed in milliseconds, complex electronic instrumentation is required to measure the varying amplitude, frequency, and duration of this wave form. Extreme surges that occur approximately eight times in a 24-hour period are negligible.

Maximum line pressure — Maximum sustained pressure that can be applied to the bellows without permanent damage. The control should not be cycled at this pressure.

Positive pressure — Any pressure more than 0 psi. See Figure 2.

- **Trip setting —** Increasing pressure setting when contacts change state.
- **Reset setting —** Decreasing pressure setting when contacts return to their normal state.

Vacuum (negative pressure) — Any pressure less than 0 psi, inches of Hg vacuum. See Figure 2.

- **Trip setting —** Decreasing vacuum setting when contacts change state.
- **Reset setting —** Increasing vacuum setting when contacts return to their normal state.

psi — Pounds per square inch. Devices listed are in gauge pressure units which use atmospheric pressure as a reference. Atmospheric pressure at sea level is approximately 14.7 psi or 30 in. Hg.

Operating range adjustment acrew — This screw is used to adjust the trip setting by varying the force of the main spring.

Differential adjustment screw — This screw is used to adjust reset setting by varying the force of the differential blade spring.

Pressure media — There are many types of pressure media that are controlled. Examples include air, water, hydraulic fluids and other types of gases and liquids. The type of media and maximum system pressure will determine the type of actuator used for the pressure control application. See page 13-9.

Pressure connection — Common types of pressure connections used in control systems are 1/4 in. and 3/8 in. female pipe threads, and 7/16 in. — 20 SAE copper tubing.

Contact configuration — There are many types of contact configurations available. Bulletin 836 Style A and C pressure controls offer a wide variety of contact configurations for both automatic operation and manual reset. See page 13-14.

Figure 1
Graphics to illustrate technical terms

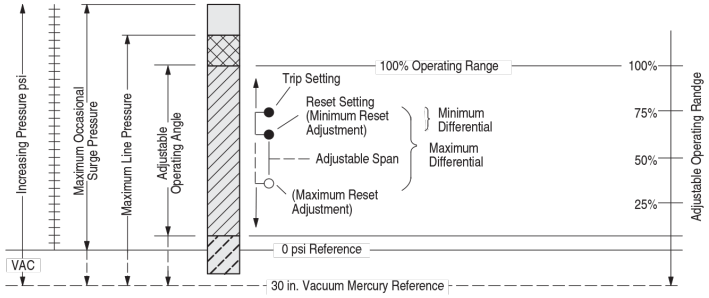
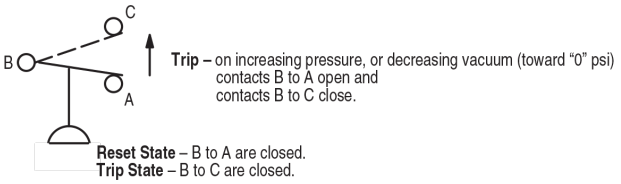


Figure 2
Positive pressure or vacuum



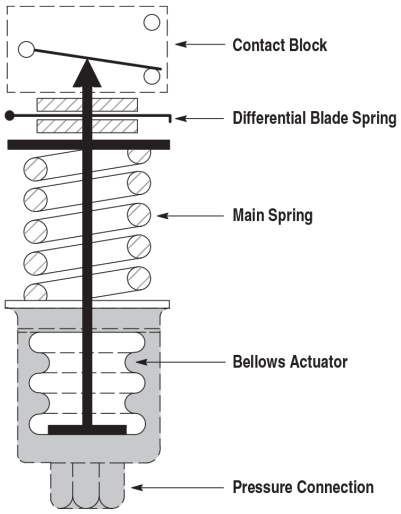
Theory of Operation

Bulletin 836 Pressure Controls are designed to open or close electrical circuits in response to changes in pneumatic (air or gas) or hydraulic (water or oil) pressure. Figure 3 is a simplified drawing of a pressure control.

The system pressure is connected to the control at the pressure connection. The system pressure is applied directly to the bellows. As pressure rises, the bellows exerts force on the main spring. When the threshold force of the main spring is overcome, it transfers the motion to the contact block, causing the contacts to actuate — this is referred to as the trip setting. As pressure decreases, the main spring will retract, causing the secondary differential blade spring to activate and return the contacts to their normal state — this is referred to as reset setting.

Varying the force of the main spring (by turning the operating range adjustment screw) determines where the contacts will trip. Varying the force of the secondary differential blade spring (by turning the differential adjustment screw) determines where the contacts will reset.

Figure 3
Basic mechanical structure



Applications for Control

Pressure controls can be used to either control or monitor a machine or process. Figure 4 shows a typical control application. Here, pressure is controlled within predetermined high and low values. Figure 5 shows a typical monitoring application. Here, pressure is monitored between a high and low value, signaling when a preset limit has been exceeded.

Figure 4
Typical control application

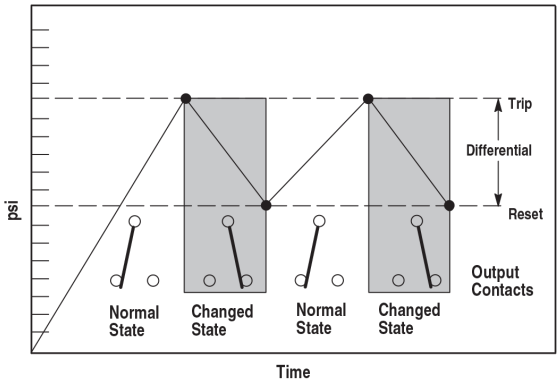
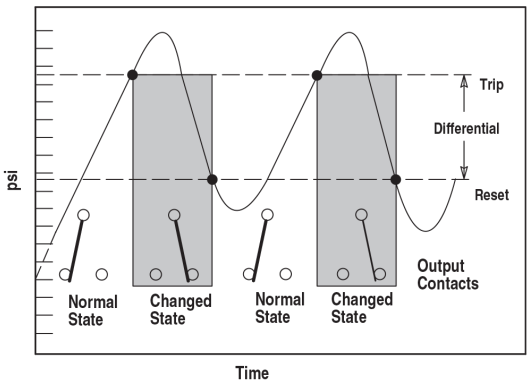


Figure 5
Typical monitoring application



13

Bulletin 836

Pressure Controls

Technical Data

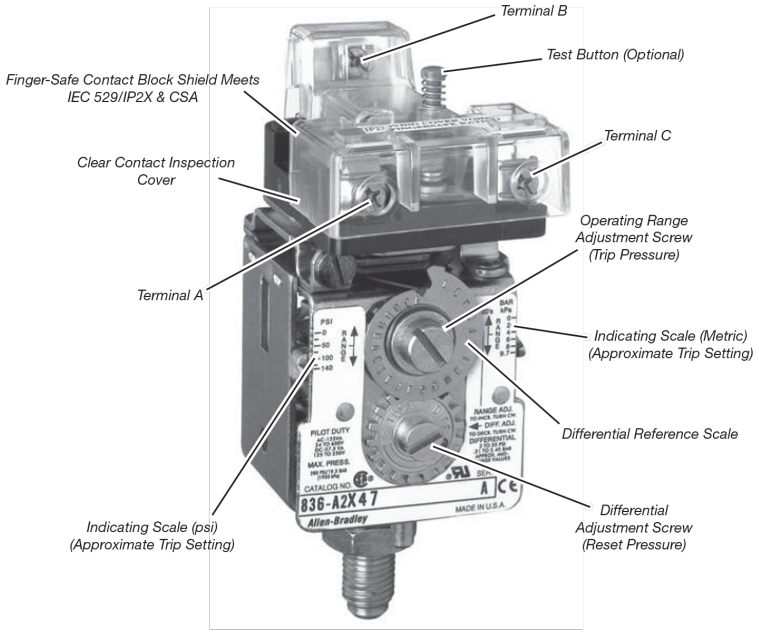
Control Settings

Allen-Bradley controls are designed for ease of setting to help minimize installation time. Standard controls shipped from the factory are set at the maximum operating range and minimum differential. By following this simple two-step process, the control can be set to the specific requirements for each application. See Figure 6.

Step 1 — Adjust trip setting
The trip setting is achieved by turning the operating range adjustment screw. Turn the range screw counterclockwise to lower the trip setting, or clockwise to raise the trip setting. The approximate trip setting is shown on the indicating scale.
Note: Turning the operating range adjustment screw will change both the trip and reset settings in virtually equal increments.

Step 2 — Adjust reset setting
The reset setting is achieved by turning the differential adjustment screw counterclockwise to increase the differential, or clockwise to decrease the differential.
Note: Adjusting the differential has little or no affect upon the trip setting.

Figure 6
Trip and reset adjustment

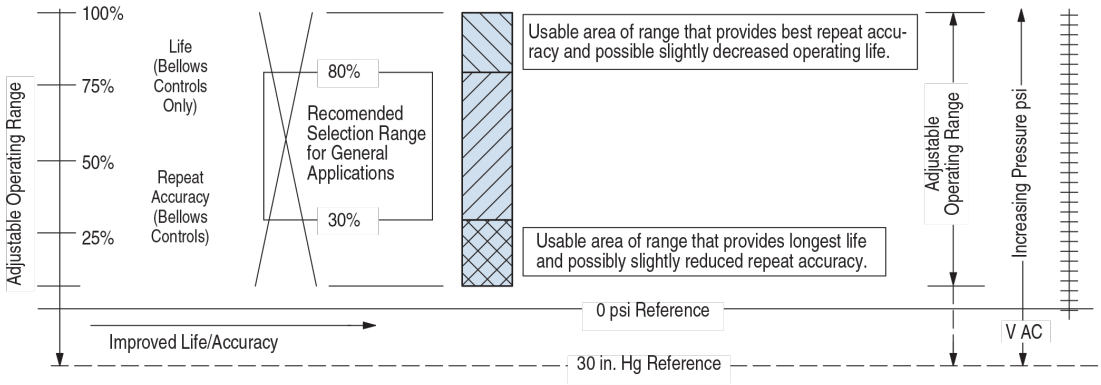


Repeat Accuracy and Mechanical Life

The design and construction of Bulletin 836 Styles A and C controls provide a typical repeat accuracy of + 0.5% or better. Repeat accuracy is based on percent of maximum range, evaluated from test data and calculated using the formula per ICS 2-225 standards.

Repeat accuracy and mechanical life of bellows type controls is graphically illustrated in Figure 7. For general applications, controls selected where the contacts operate between 30…80% of the operating range and where the maximum line and surge pressures do not exceed the specified values will provide excellent life and repeat accuracy. For more specific applications, it is important to note that the controls are designed to operate **below** or **above** these values. However, there may be a small trade-off between the factors of repeat accuracy and mechanical life.

Figure 7
Repeat accuracy versus mechanical life graph



Bulletin 836
Pressure Controls
Technical Data

Standard Contacts

Snap-action contact operation
Contact blocks are single-pole, double-throw and can be wired to open or close on increasing or decreasing pressures.

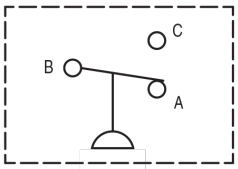
Non-inductive ratings
5 A, 240V
3 A, 600V

Control circuit ratings
AC - 125 VA, 24…600V
DC - 57.5 VA, 115…230V

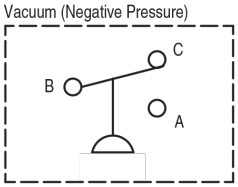
Standard Contact Wiring Configurations

Single-pole double throw

Positive Pressure



Vacuum (Negative Pressure)



Note: NEMA does not rate contacts to switch low voltage and current.
Bulletin 836 Styles A and C Pressure Controls are supplied with silver contacts. The devices are designed to deliver high-force snap action to the contacts. This provides exceptional contact fidelity at 24V DC I/O card current level entry when the control is protected in a suitable enclosure for the surrounding environment.

Special Controls

A large number of unlisted catalog modifications and complete devices are available for specific and OEM applications.

Special controls and modification service is available to meet many applications unique to the OEM market.

Please contact your local Rockwell Automation sales office or Allen-Bradley distributor for assistance with specific modified controls and accessories.

Temperature Range

Temperature range at +32 °F (0 °C) or below is based on the absence of freezing moisture, water, or other fluids that may solidify and impede operation of the control. Temperature ratings are as follows:

Operating:	–22… +150 °F (–30…+66 °C)
Storage:	–22…+200 °F (–30…+93 °C)

Factory-Set Pressure Controls

Rockwell Automation will factory set pressure controls to customer-specified values. Unspecified pressure controls shipped from the factory are set at the maximum operating range and minimum differential. See Factory Options.

Pressure Control Selection

The selection table below is an overview of the three types of Allen-Bradley Bulletin 836 Pressure Controls. Each type of control is suitable for use on many types of applications. Pressure ranges, pressure connections, enclosure types, and the compatibility of the actuator with different types of pressure media are given to assist in the selection of which type of control to use.

	836 Style A	836 Style C	836 Style C
Actuator Type	Internal Bellows, Copper Alloy	External Bellows, Copper Alloy	External Bellows, Stainless Steel Type 316
Adjustable Operating Ranges	30 in. Hg Vacuum…375 psi	30 in. Hg Vacuum…900 psi	30 in. Hg Vacuum…375 psi
Adjustable Differentials	2…95 psi	0.2…125 psi	0.4…80 psi
Maximum Line Pressures	up to 750 psi	up to 1300 psi	up to 650 psi
Occasional Surge Pressures	up to 850 psi	up to 1600 psi	up to 650 psi
Pressure Media			
Air	•	•	•
Water	•	•	•
Hydraulic Fluids	•	•	•
Liquids: Corrosive∗			•
Non-Corrosive	•	•	•
Gases: Corrosive∗			•
Non-Corrosive	•	•	•
Enclosures			
Open Type	•	•	•
Type 1	•	•	•
Type 4 & 13	•	•	•
Type 4X		•	•
Type 7 & 9 and 4 & 13	•	•	•
Pipe Connections			
Pressure Connection	7/16 in.-20 SAE Flare for 1/4 in. Copper Tubing	1/4 in. N.P.T. Female Pipe Thread or 3/8 in. N.P.S. Female Pipe connection (**836-C1** and **836-C1A** only)	1/4 in. N.P.T. Female Pipe Thread

∗ Corrosive liquids and gases compatible with Type 316 Stainless Steel.

Appendix 7 (EZ-LINK Quick Start Guide - Watlow)

WATLOW

QUICK START GUIDE
EZ-LINK™ APP for EZ-ZONE® PM

For Part Numbers:
PM6_ _ _ _-(B,E,F,G,H,J,K,)_ _ _ _ _ _

WATLOW
Set up your new Watlow EZ-ZONE® PM the easy way with our EZ-LINK™ mobile app!
Google play | App Store

For assistance contact Watlow: www.watlow.com
1-800-WATLOW2 (1-800-928-5692)
wintechsupport@watlow.com
http://www.watlow.com/EZLINK

1952-8909 Rev B | March 2018

1. Identify a Bluetooth®-Enabled Unit (P/N or Display)

PM 6 _ _ _ _ **-B** _ _ _ _ _ _ _ _

The EZ-ZONE® PM controller or limit controller includes Bluetooth® wireless technology when:

- Part number includes one of the following designations: B,E,F,G,H,J or K
- The display indicates bttH is on or oFF as shown at the left when you turn power on to the EZ-ZONE PM immediately after displaying the firmware version.

Note:
If Bluetooth® is off, see section 2 to turn it on.

2. Turn Bluetooth® On/Off in the Controller

Starting at the Home Page:

1. To enter the setup page press and hold ▲ and ▼ until SEt appears in lower display. (LoC will appear for PM Express)
2. Press ▲ several times until 9LbL appears in the upper display. (skip this step for PM Express)
3. To enter the global menu press ⊙. (skip this step for PM Express)
4. Press ⊙ several times until bttH appears in the lower display.
5. Press ▲ to turn Bluetooth® on or oFF.
6. To exit the setup page press ∞ or RESET twice.

3. Connect to a Controller with the App

Note:
When more than one controller is installed nearby, use the device view in the app to give each controller a unique name to make it easy to find the right one.

1. Download EZ-LINK™ from the app store for your mobile device and open it.
2. If more than one controller is in range, tap one of the **PING** buttons to identify the controllers. Otherwise tap the name of the controller to connect.
3. If the controller displaying the pinging animation is the one you want, tap **CONNECT**. Otherwise, tap **DONE** and try another.

4. Limiting EZ-LINK™ User's Access

Use the EZ-ZONE PM controller's security lock features to determine which parameters users can access.

To allow user's to read but not change parameters:

- On the controller's factory page, in the lock menu, set the write security parameter to zero (0).

To prevent user's from accessing the Setup Page via the All Parameters link in the app:

- On the controller's factory page, in the lock menu, change the password enable to on and set the locked access level to three (3) or less.

To change which parameters are listed on the controller's home page and on the dashboard in EZ-LINK:

- On the controller's factory page, in the custom setup menu, select the parameters you want to appear for as many of the custom setup menu options (1 to 20) as needed.
- Set unneeded menus to ***None***.

Hints:

- The settings discussed above affect both the EZ-ZONE PM's built-in user interface and the EZ-LINK app.
- When password protection is enabled, the password must be entered via the EZ-ZONE PM's built-in user interface or using Watlow COMPOSER® software in order to access the protected items.
- Change and make note of the user and administrator passwords so that you can access these features via the controller's user interface or Watlow COMPOSER software in the future.
- COMPOSER software offers an easier-to-use and more flexible way to edit what is listed on the EZ-ZONE PM controller's home page.

FCC Compliance

The transmitter module is mounted on the top of the display PC board partially under the LED display module and is visible when display removed from bezel.

Module FCC ID: VPYLBZY Part 15C 2.

Unit is assembled from tested components, complete system not tested.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Compliance Information

Bluetooth® Enabled Product

Models PM6_ _ _ _ _-(B,E,F,G,H,J or K)_ _ _ _ _ _ _ contain an embedded Bluetooth® module.
Output Power: Frequency Range 2402.0 MHz - 2480.0 MHz Output Power 0.001 Watts
Antenna Gain: -0.6 dBi PCB antenna

Industry Canada

Contains IC: **772C-LBZY**
Specification: **RSS210**

Japan

Japanese Radio Law 日本電波法
Type Certification 工事設計認証 R001-P00500

CE See current Declaration of Conformity for full details.

2014/53/EU Radio Equipment Directive (RED)

EN 61010-1:2010	Article 3.1(a) Safety Requirements
EN 61326-1:2013	EMC requirements (Industrial Immunity, Class A Emissions).
EN 301 489-1 V2.1.1	Article 3.1(b)
EN 301 489-17 V3.1.1	Article 3.1(b)
EN 300 328 V1.9.1	Article 3.2 of the R&TTE Directive
EN 300 328 V2.1.1	Additional receiver blocking test to cover requirements for 2014/53/EU

Bluetooth® Declaration ID 38479

Controls are Class A industrial emissions. Not for use in commercial or residential application without further filtering.

Appendix 8 (Setting Parameters on Watlow Controller)

Note: *Do not open either control panel while either panel is connected to AC power. Only open panels once all external power has been removed.*

1. Program the Watlow PM Plus controller
    a. Press > arrow to enter menu
    b. Press – until “Setup” is selected
    c. Press – until “Analog Input”
    d. Press > with “Analog Input 1” selected to enter this menu
    e. Press > with “Sensor Type” selected to enter this menu
    f. Press – or + until “Thermocouple” is selected
    g. Press < to return to the previous menu
    h. Press – until “TC Linearization” is selected and press > key to enter this menu
    i. Press – or + until “K” is selected
    j. Repeat these steps for the remaining parameters shown in Table 2
    k. Press < several times or press the home button to return to the main screen

Watlow Controller Parameters Table

Parameter	Value for 21548880 (TBV/TBT)	Value for 21679954 (TBP)	Value for 21708968 (TBC Process Control)	Value for 21708968 (TBC PB Control)	Parameter Path (Bluetooth)	PMP Integrated Parameter Path*	PM Plus 6 Parameter Path
Active Set Point	70	125	70	125	Main screen	C.SP	Set Point (home screen)
Sensor Type	Thermocouple	Thermocouple	Thermocouple	Thermocouple	Analog Input 1	A1 > SEn > tC	Setup > Analog Input 1 > Sensor Type
TC Linearization	K	K	K	K	Analog Input 1	A1 > L in > H	Setup > Analog Input 1 > TC Linearization
Sensor Type	Thermocouple	Thermocouple	Thermocouple	Thermocouple	Analog Input 2	A1 > Sen > tC	Setup > Analog Input 2 > Sensor Type
TC Linearization	K	K	K	K	Analog Input 2	A1 > L in > H	Setup > Analog Input 2 > TC Linearization
Sides	High	High	High	High	Limit	LiM > L.Sd > hi9h	Setup > Limit > Sides
Maximum Set Point	400°F	400°F	400°F	400°F	Limit	LiM > SP.Lh > 400°F	Setup > Limit > Maximum Set Point
High Limit Set Point	350°F	350°F	350°F	350°F	Limit	LiM > Lh.S1 > 350°F	Setup > Limit > High Limit Set Point
Integrate with System	Yes	Yes	Yes	Yes	Limit	LiM > L.it > yES	Setup > Limit > Integrate w/ System
Heat Algorithm	On/Off	On/Off	On/Off	On/Off	Control Loop	LooP > h.A9 > on.oF	Setup > Control Loop > Heat Algorithm
On/Off Heat Hysteresis	3°F	30°F	3°F	30°F	Control Loop	LooP > h.hY > 3°F or 30°F	Setup > Control Loop > On/Off Heat Hyster.
Minimum Set Point	0°F	0°F	0°F	0°F	Control Loop	LooP > L.SP > 0°F	Setup > Control Loop > Minimum Set Point
Maximum Set Point	250°F	250°F	250°F	250°F	Control Loop	LooP > h.SP > 250°F	Setup > Control Loop > Maximum Set Point
Function	Heat**	Heat**	Heat**	Heat**	Output 1	otPt >1 > Fn > hEAt	Setup > Output > Output 1 > Function
Function Instance	1**	1**	1**	1**	Output 1	otPt > Fi > 1	N/A
Alarm 1 Type	Process Alarm	Off	Process Alarm	Off	Alarm 1	ALM > A.tY > Pr.AL	Setup > Alarm > Alarm 1 > Type
Alarm 1 Source	Analog Input**	N/A	Analog Input**	N/A	Alarm 1	ALM > Sr.A > Ai	Setup > Alarm > Alarm 1 > Alarm Source
Alarm Source Instance	1**	N/A	1**	N/A	Alarm 1	ALM > iS.A > 1	Setup > Alarm > Alarm 1 > Alarm Source Instance
Alarm 1 Logic	Close On Alarm	N/A	Close On Alarm	N/A	Alarm 1	ALM > A.L9 > AL C	Setup > Alarm > Alarm 1 > Logic
Alarm 1 Sides	Low	N/A	Low	N/A	Alarm 1	ALM > A.Sd > LoW	Setup > Alarm > Alarm 1 > Sides
Alarm 1 Low Set Point	-20°F	N/A	-20°F	N/A	Alarm 1	ALM > A.Lo > -20°F	Setup > Alarm > Alarm 1 > Low Set Point
Alarm 1 Latching	Latching	N/A	Latching	N/A	Alarm 1	ALM > A.LA > LAt	Setup > Alarm > Alarm 1 > Latching

**Default value **Default value **Default value **Default value *See EZ-ZONE PM User's Guide for Integrated Controlller Models for details