

TankerTherm 123 Coolant Heater

Thermex Systems

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About this manual



PLC-controlled TankerTherm 123 Coolant Heater — SKUs `20-TTDNH00-03` (480 VAC 3-phase) and `20-TTDNH00-06` (600 VAC 3-phase).

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Chapter 1. TankerTherm 123

Circulating electric glycol heater with onboard day tank for bulk tanker heating.



Figure 1. TankerTherm 123 — manifold panel with the supply-side valves in front, the cabinet vent on the left side

1.1. Overview

The TankerTherm Bulk Tank Heating System is a recirculating glycol heating system capable of filling up to four tanker heating jackets in succession, then heating them simultaneously.

The system centrifugal pump is supplied with a positive head of flooded suction from the internal glycol storage tank, which is vented to atmosphere. The pump provides **20 GPM of glycol flow** through the electric

boiler and out the distribution manifold at pressures ranging from **5 to 20 PSI** depending on the number of connected tanker heating jackets and their accompanying piping resistance.

Under deadhead conditions at the distribution manifold, the pump continues to circulate at 20 PSI through a bypass orifice which returns to the atmospheric storage tank. A **30 PSI pressure relief valve** is installed at the boiler, protecting the system from any excess pressure condition.

1.2. Glycol storage and refill

The internal 10-gallon storage tank is drawn down by 3 to 5 gallons of glycol per connected tanker. When the tank glycol volume drops below the 50% level, a positive displacement refill pump is energized, drawing replacement glycol from the adjacent 55-gallon supply drum and pumping it into the storage tank at **4 GPM**.

When tank volume recovers to 95%, the refill pump deactivates. The remaining 5% capacity accommodates system expansion as the heating glycol rises to the **190°F design operating temperature**.

The storage tank is vented to atmosphere through a red hose that drains back into the supply drum, so any overflow expansion is entirely recovered.

1.3. Major components

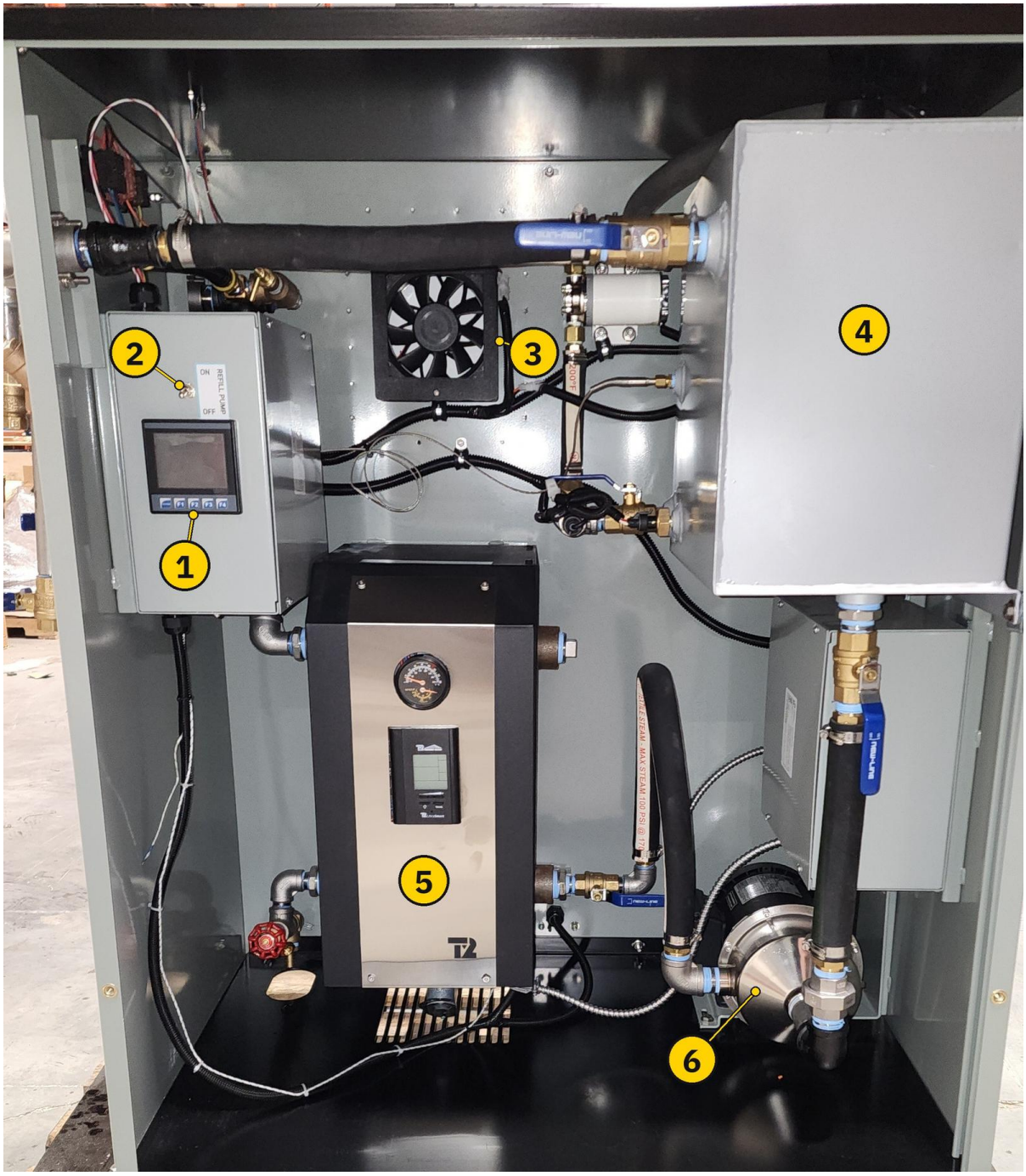


Figure 2. Cabinet interior with the door removed — numbered callouts match the table below

#	Component	Where it is covered
1	PLC touchscreen HMI	PLC Controller Overview
2	Refill Pump Switch (`ON` / `OFF`; a toggle above the HMI on the unit shown, a rotary selector below the HMI on current units)	Refill Pump Switch

#	Component	Where it is covered
3	Cabinet cooling fan	Cooling fan
4	Storage tank (10 gallons, vented to atmosphere)	Glycol storage and refill
5	Boiler, with its onboard digital controller	Temperature Control
6	Circulation pump	Circulation pump seal replacement

The distribution manifold and the **Start**, **Stop**, **Reset**, and **E-Stop** controls are on the outside of the cabinet — see Manifold layout. The Remote Output Box is on the rear of the unit — see Remote Output Box.

1.4. Controls and monitoring

The unit is supervised by an industrial **PLC controller** with an integrated touchscreen HMI on the inside-left wall of the cabinet. The PLC handles diagnostics, field calibration, and event logging, and drives a 0–10 V analog output of tank temperature for remote monitoring.

Day-to-day operation is via the **Start**, **Stop**, and **Reset** buttons on the manifold control panel — see PLC Controller Overview for PLC-specific functions.

1.5. Quick links

The sidebar groups this manual into the following sections:

- Safety — Hazards, lockout requirements, and how safety notices are used
- Specifications — Complete technical data
- Installation — Unpacking, power connections, initial system fill, and the Remote Output Box
- Operation — Startup, connecting tankers, temperature control, and the refill system
- PLC Controller — Status, calibration, controls, output tests
- Maintenance — Scheduled and as-required maintenance
- Troubleshooting — Common issues and resolution
- Warranty — Terms and claim procedure
- Release Notes — What changed in each revision of this manual



Before you begin

> Read the Safety page and the entire Installation section before unpacking or energizing the unit. Improper startup procedures — particularly skipping the air-purge step — can damage the boiler.

Chapter 2. Safety

This page collects the hazards that apply to installing, operating, and servicing the TankerTherm 123. Each hazard is also repeated as a safety notice at the step where it applies, so a technician who goes straight to one procedure still sees it.

2.1. Safety notices in this manual

Notice	Used for
WARNING	A hazard that can cause death or serious injury — electric shock, burns from hot glycol or hot surfaces.
CAUTION	A hazard that can damage the equipment or cause minor injury — for example, starting the boiler before the air purge, or dry-running the refill pump.
IMPORTANT	A required step or condition that is not itself a hazard — for example, obtaining a Warranty Request Number before shipping parts.
NOTE	Background information that helps you understand a procedure or reading.
TIP	Practical advice that makes a task easier.

2.2. Qualified personnel

- **Electrical installation and any work at the boiler face** must be performed by a licensed electrician in compliance with local electrical codes.
- **Calibration and setpoint changes** on the PLC are password-protected and change how the unit protects itself. Make them only if you understand the procedure — see PLC Calibration and PLC Controls and Setpoints.

2.3. Electrical hazards

The unit is supplied at 480 V or 600 V 3-phase, depending on SKU. The **Stop** and **E-Stop** buttons stop the unit's outputs; they do not remove power from the supply terminals in the boiler. Only the upstream main disconnect does that.



High voltage at the boiler face — lock out before touching any wire

Before touching any wire at the boiler face: open the upstream main disconnect, lock it out and tag it out, and verify zero voltage with a properly rated meter. This work must be performed by a qualified electrician.

> The boiler face exposes the 480 V or 600 V 3-phase supply next to the low-voltage control wiring. Contact with energized 3-phase conductors can be fatal.

2.3.1. Lockout/tagout

Before any work at the boiler face or on the supply wiring:

1. Open the upstream main disconnect.
2. Lock out and tag out the disconnect per site procedure.
3. Verify zero voltage at the boiler with a properly rated meter.

This applies to:

- Power Supply Connections — connecting the supply and ground conductors
- Any troubleshooting that involves electrical components, leaking glycol, or smoke — see Troubleshooting

2.4. Hot surfaces and hot glycol



Hot surfaces — personal protective equipment required

The distribution manifold and piping operate at up to **190°F (88°C)**. Always wear heat-resistant gloves when engaging ball valves or connecting/disconnecting tanker lines. Direct contact with the manifold can cause severe burns.

- Stop the system and let the glycol cool before opening any strainer, fitting, or drain — see Periodic Maintenance.
- The Tank Temp probe sits in a compression fitting on the storage tank. Withdrawing it with the tank above approximately 20 % lets coolant flow out of the sensor hole — see Temperature probe calibration.

2.5. Pressure

- A **30 PSI pressure relief valve** protects the boiler. Do not plug, cap, or adjust it.
- The PLC stops the refill pump if refill-line pressure exceeds the **Max Pressure** setting (default **20.0 PSI**). Do not raise this setting toward 30 PSI — see Refill pressure calibration.

2.6. Protective interlocks

Do not bypass or disable any of the following. Each is described in Specifications — Protection summary.

- **LWCO (Low-Water Cut-Off)** sensor — disables the boiler if the storage tank is critically low
- **ECO high-temperature limit switch** on the boiler
- **30 PSI pressure relief valve**
- **Fill Time Limit** and **Refill Pressure** cutoffs on the refill pump
- **E-Stop** button on the manifold control panel

2.7. Emergency stop

The red **E-Stop** button on the manifold control panel stops the circulation pump, the boiler, and the refill pump, and latches the alarm strobe. The PLC banner reads `Operator ESTOP`. The E-Stop does not de-energize the unit — use the main disconnect for that.

To recover, release the E-Stop, press **Reset**, and press **Start** — see Resolution — Operator ESTOP.

2.8. Equipment-damage hazards

These hazards damage the unit rather than injure people. Each is a **CAUTION** at the step where it applies.

Hazard	Consequence	Where it applies
Starting the boiler before the air purge is complete	Boiler damage, not covered by warranty	Startup & First Heat Cycle
Running the refill pump dry	The gear-type refill pump can be destroyed by approximately 20 minutes of cumulative dry running. Repeatedly pressing **Reset** after a `REFILL TIMER EXPIRED` fault adds to that total.	Refill fault protection
Rotating a bulkhead fitting while tightening	Damaged internal connections; may void the warranty	Installing loose-packed components
Pulling out crating blocking strips carelessly	Damaged distribution plumbing	Unpacking & Setup
Replacing a Remote Output Box fuse with a higher rating	Damaged PLC output drivers or 12 V DC converter	Remote Output Box

2.9. Glycol disposal

Drained glycol and wash water must be disposed of in accordance with local environmental regulations.

Chapter 3. Specifications

Complete technical specifications for the TankerTherm 123 circulating glycol heater.

3.1. At a glance

Specification	Value
Heater type	Circulating electric glycol heater with onboard day tank
Dimensions	38″ wide × 24″ deep × 50″ high on current units (earlier units are 46″ high)
Weight	380 lbs (173 kg)
Capacity	123,000 BTU/hr max input (13 °F temperature rise per pass through the boiler @ 19 GPM)
Power supply	480 V or 600 V 3-phase, 36 kW (see Voltage variants)
Control voltage	12 V DC, supplied by an internal 3-phase-to-12 V DC converter
Glycol temperature	Boiler digital controller holds up to 190 °F (88 °C) at the boiler outlet. PLC Tank Heat thermostat target adjustable from 80 °F to 195 °F (27 °C to 91 °C).
Venting	Through rear of chassis, temperature controlled, power vented
Construction	Powder-coated chassis, designed for outdoor installation
Controls	Onboard 2-stage boiler digital controller plus industrial PLC supervisor with integrated touchscreen HMI
Remote monitoring	Remote Output Box on rear of unit — Indicator + Strobe (digital 12 V DC, 0.5 A fused) and 0–10 V analog tank temperature (0–200 °F). See Remote Output Box.

3.2. Voltage variants

This manual covers two SKUs that differ only in voltage. The boiler heating elements and the circulation pump motor are voltage-matched to the supply; all other components are common.

SKU	Power supply	Notes
`20-TTDNH00-03`	480 VAC 3-phase, 36 kW	Standard variant.

SKU	Power supply	Notes
`20-TTDNH00-06`	600 VAC 3-phase, 36 kW	High-voltage variant. Heater and circulation pump motor are 600 V matched. Connection block is labelled `600V-3PH`.

See Power Supply Connections for wiring procedure (identical for both variants — the supply voltage is the only difference).

3.3. Performance details

3.3.1. Flow and pressure

Parameter	Rating
Pump flow rate	20 GPM
Operating pressure range	5–20 PSI
Bypass/deadhead pressure	20 PSI
Relief valve setting	30 PSI

3.3.2. Thermal performance

Parameter	Value
Design operating temperature	190°F (88°C)
Temperature rise	13°F per pass through the boiler @ 19 GPM
Time to reach 190°F from cold start	15–20 minutes (ambient-dependent)
User-adjustable offset (boiler controller)	±10°F (±5°C)
Tank Heat target (PLC)	80–195°F, factory setting 195°F
Tank Heat hysteresis (PLC)	1–50°F, factory setting 10°F

3.3.3. Storage and refill

Parameter	Value
Internal storage tank	10 gallons
Refill source	55-gallon supply drum (customer-supplied)
Refill pump	Gear-type, positive displacement
Refill rate	4 GPM
Drawdown per connected tanker	3–5 gallons
Refill trigger level	50% tank volume
Refill stop level	95% tank volume

3.4. Controls

- **Boiler controller** — ASME boiler with digital 2-stage temperature modulation, with a user-adjustable ±10 °F target offset (see Temperature Control)
- **Tank Heat thermostat** — the PLC holds the boiler off while the storage tank is above an adjustable target (80–195 °F) and lets it run again once the tank has cooled by the set hysteresis (see Temperature Control)
- **PLC supervisor** — industrial PLC with integrated touchscreen HMI (software v2.2) — see PLC Controller Overview
- **Glycol level control** — Automatic, with low-level refill activation; tank level visible on the PLC Status screen
- **Enclosure temperature** — Cooling fan and screen heater regulated by the PLC against ambient temperature setpoints
- **Connected tankers** — Up to **four** at once, filled in succession and heated together

3.5. Protection summary

Protection	Action
LWCO (Low-Water Cut-Off)	Hardware sensor disables boiler immediately if tank coolant is critically low; latches strobe; requires Reset

Protection	Action
ECO high-temperature limit	Hardware over-temperature switch on the boiler
30 PSI relief valve	Boiler over-pressure protection
Fill Time Limit	PLC stops refill pump, latches strobe, and locks out the system if a single refill cycle exceeds the configured time (default 300 s). This is how the unit protects the refill pump when the supply drum runs dry.
Refill Pressure cutoff	PLC stops refill pump and latches strobe if refill pressure exceeds the configured maximum (default 20.0 PSI)
Precaution Disable	PLC pauses circulation and heat at very low tank level (~3 %) to avoid dry running while refill catches up
Refill pressure sensor fault	PLC stops the refill pump, latches the strobe, and locks out the system if the refill pressure sensor signal is below 3.5 mA or above 21.0 mA for 0.5 s (broken wire, unplugged connector or failed sensor); requires Reset

3.6. Safety features



Critical safety systems

The TankerTherm includes multiple interlocks. Do not attempt to bypass or disable any of the following:

- **Automatic refill pump shutdown** if the supply drum is emptied (the Fill Time Limit)
- **ECO high-temperature limit switch** — hardware over-temperature protection
- **LWCO low-coolant cut-off sensor** — prevents dry-running
- **30 PSI pressure relief valve** — protects boiler from overpressure

3.7. Enclosure temperature regulation



Screen heater deprecated

The screen heater is deprecated. Current units are built without it; the cooling fan is unchanged.

The PLC regulates two independent enclosure functions: a cooling fan that ventilates the cabinet in hot

weather, and a screen heater that keeps the LCD HMI warm in cold weather. Each is controlled from its own temperature sensor.

Hot weather — cooling fan (watches cabinet ambient)

- Engages at **91 °F (33 °C)**
- Disengages below **86 °F (30 °C)**

Cold weather — screen heater (watches LCD temperature)

- Engages at **32 °F (0 °C)**
- Disengages above **37 °F (3 °C)**

Setpoints are field-adjustable — see PLC Controls and Setpoints.

Chapter 4. Unpacking & Setup

The TankerTherm 123 ships partially crated to protect the distribution manifold plumbing. Follow these steps carefully to avoid damage during unpacking.

4.1. Before you unpack



Verify the shipment

Two items are loose-packed inside the cabinet. Confirm both are present before proceeding:

- Suction filter
- Suction tube/hose assembly

The **red expansion vent hose** is factory-installed at the storage tank end. The free (drum) end is fitted with the drum vent hose-barb described below — connect this to your supply drum during installation.

4.2. Removing the crating



Use care when removing crating

Blocking strips are wedged behind the manifold. Sliding them out carelessly can damage distribution plumbing.

1. Remove the crating using special care when sliding out blocking strips.
2. To remove the cabinet door:
    a. Remove the two bolts that secure the door near the bottom on either side.
    b. Pull the door out at the bottom.
    c. Gently slide the door down and away from the top lid.

4.3. Installing loose-packed components



Figure 3. Rear of the unit — the `OVERFLOW` and `REFILL IN` hose barbs for the supply-drum hoses are at the top of the rear panel



Figure 4. Supply drum hookup — the refill hose (blue here) runs from the drum to `REFILL IN` through the suction filter, and the red vent hose runs from `OVERFLOW` back to the drum. Illustration: the unit is a photograph, the surroundings are computer-generated to show a typical installation.

Install the two loose-packed items (suction filter, suction tube/hose assembly) into the bulkhead fittings.



Prevent bulkhead rotation

Before tightening any fitting, secure the bulkhead fitting from rotation with a crescent wrench. Rotating a bulkhead can damage internal connections and void your warranty.

4.3.1. Drum vent hose-barb fitting

The fitting at the drum end of the factory-installed red expansion vent hose connects the storage tank's atmospheric vent to your supply drum so that any expansion overflow drains back into the drum.

The drum vent `5/8"` hose-barb fitting is designed for re-use on each successive drum. When swapping drums:

- Screw the fitting into the `3/4" NPT` plug fitting **hand tight**
- **Do not** use thread sealant
- **Do not** use a hose clamp

4.4. Next steps

After completing mechanical setup, proceed to:

1. Power Supply Connections
2. Initial System Fill
3. Startup & First Heat Cycle

Chapter 5. Power Supply Connections

The TankerTherm 123 ships in two voltage variants. The connection procedure is identical; only the supply voltage differs. Confirm your unit’s SKU on the unit nameplate before energizing.

SKU	Supply	Connection block label
`20-TTDNH00-03`	480 VAC 3-phase, 36 kW	`480V-3PH`
`20-TTDNH00-06`	600 VAC 3-phase, 36 kW	`600V-3PH`



Qualified electrician required

All electrical connections must be performed by a licensed electrician in compliance with local electrical codes. Disconnect and lock out the power source before beginning any electrical work.

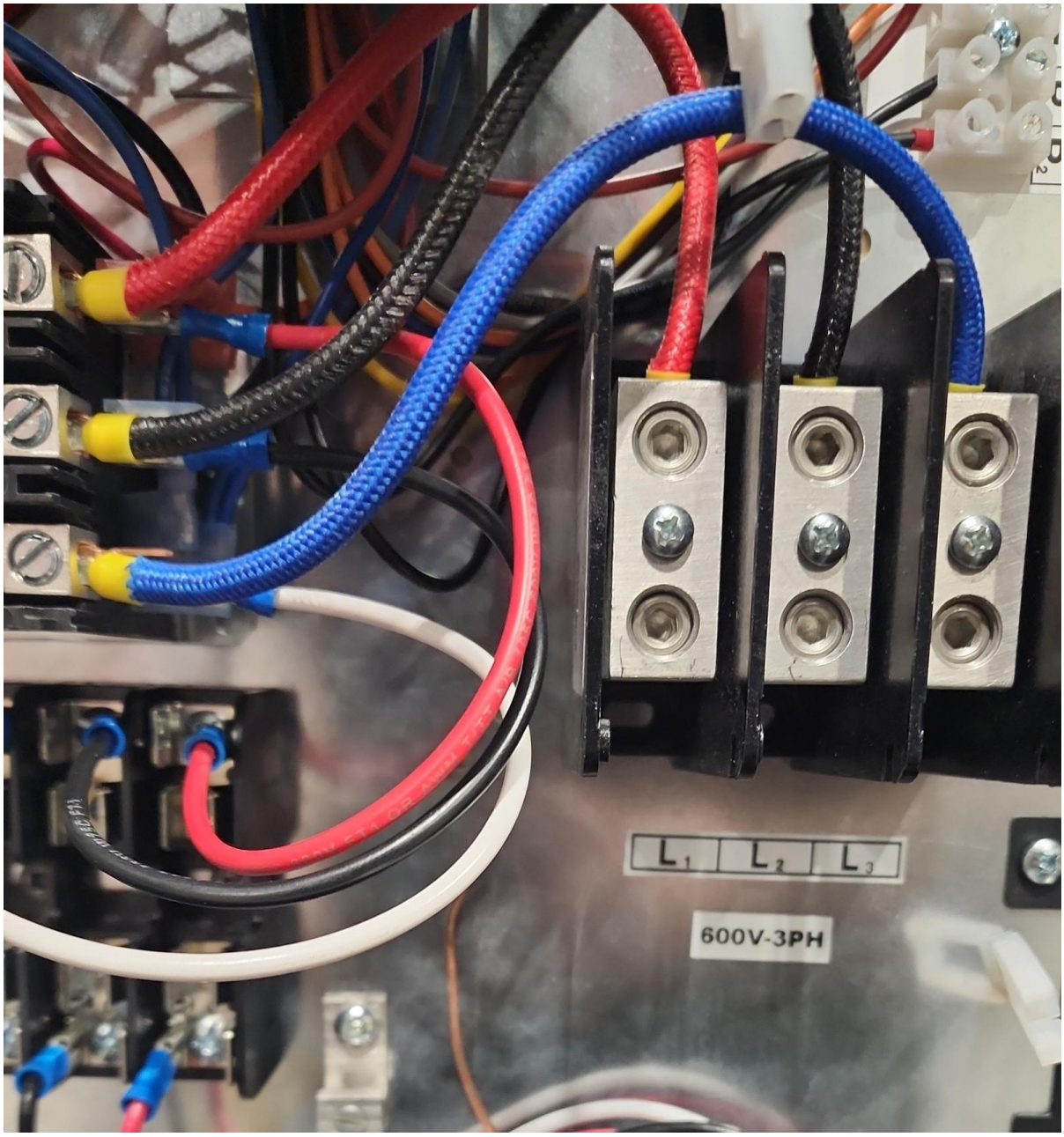


Figure 5. High-voltage hookup point on a 600 V variant — `L1`, `L2`, `L3` lugs labelled `600V-3PH`

5.1. Connection procedure

1. **De-energize and lock out the supply.**
    a. Open the upstream main disconnect that will feed the unit.
    b. Lock out and tag out the disconnect per site procedure.
    c. Verify zero voltage on the supply conductors with a properly rated meter.
2. **Remove the boiler cover** and set it aside while you make the connections. Reinstall it when the connections are complete and checked, before the unit is energized.

3. **Route electrical cabling** in through the 4×4 pull box on the rear of the cabinet.
4. **Run cables** through the attached conduit into the boiler.
5. **Connect the 3-phase wiring** — at the supply voltage matching your SKU (480 V or 600 V) — to the labelled connection block.
6. **Connect the grounding conductor** to the grounding lug.



The boiler face is live whenever the main disconnect is closed

Once the supply is connected, the boiler face is live whenever the main disconnect is closed. **Before touching any wire at the boiler face, open the main disconnect, lock it out and tag it out, and verify zero voltage** — see Safety.

Install the boiler cover when the connections are complete and checked. The air purge is run from the PLC and does not need the cover off — see Startup & First Heat Cycle.

5.2. Verify before energizing

Before applying power, verify:

- The unit's SKU and nameplate voltage match the supply voltage
- All three phases land on the labelled connection block (`480V-3PH` or `600V-3PH`)
- Grounding lug is secured with a properly sized conductor
- No loose conductors or debris inside the boiler
- Boiler cover is installed
- Conduit entries are sealed against weather

5.3. Next step

Proceed to Initial System Fill to fill the glycol storage tank before the first startup.

Chapter 6. Initial System Fill

Before the first heat cycle, fill the internal storage tank with glycol from a 55-gallon supply drum.



Figure 6. Refill Pump Switch on current units — a rotary selector labelled `REFILL PUMP`, below the PLC HMI. The micro SD port is above the HMI.



Figure 7. Refill Pump Switch on earlier units — a toggle above the PLC HMI

The **Refill Pump Switch** enables the automatic refill system; it is not a manual pump control. With the switch `ON`, the PLC runs the refill pump whenever the storage tank needs glycol. With the switch `OFF`, the refill pump is locked out and the unit will not heat — see Refill Pump Switch.

6.1. Procedure

1. Confirm a full **55-gallon glycol supply drum** is positioned adjacent to the unit and connected to the suction tube/hose assembly.
2. Turn the **Refill Pump Switch** to the `ON` position (on earlier units with a toggle, toggle up).
3. The refill pump will immediately engage and begin drawing glycol from the drum.

> *Expected fill duration*
>
> Initial fill takes **3–4 minutes**. The refill pump will automatically deactivate when glycol volume reaches the 95% level.

6.2. After initial fill

Leave the Refill Pump Switch in the `ON` position for normal operation — see Refill System Operation.

6.3. Next step

Proceed to Startup & First Heat Cycle to purge air from the system and commence heating.

Chapter 7. Remote Output Box

The **Remote Output Box** is a terminal enclosure on the rear of the unit. It gives a customer-supplied monitoring system — such as a remote PLC, scoreboard, or SCADA / data-acquisition system — fused access to three status signals from the TankerTherm 123.

Every unit ships with the Remote Output Box. Wiring it is optional; the unit operates fully without it. It is the supported connection point for any third-party monitoring or annunciation.

7.1. Location

The Remote Output Box is a **4 × 4 enclosure mounted on the rear of the unit**, adjacent to the high-voltage input. Cable entry is sized for typical low-voltage signal cable.



Figure 8. The Remote Output Box (left, with the terminal label on its cover) beside the high-voltage input (right, labelled with the supply voltage), low on the cabinet

7.2. Control voltage

Outputs are driven at **12 V DC**, supplied by an internal 3-phase-to-12 V DC converter that runs from the unit's main 480 V or 600 V supply. The `DC -` terminal is the 12 V DC return common for all three outputs.

7.3. Available signals

- **Indicator** — digital 12 V DC output that mirrors the manifold-panel indicator lamp, reproducing all blink patterns

- **Strobe** — digital 12 V DC output that mirrors the manifold-panel alarm strobe (high when illuminated)
- **Temperature** — **0–10 V analog** output of tank coolant temperature, scaled 0–200 °F

7.4. Terminal layout

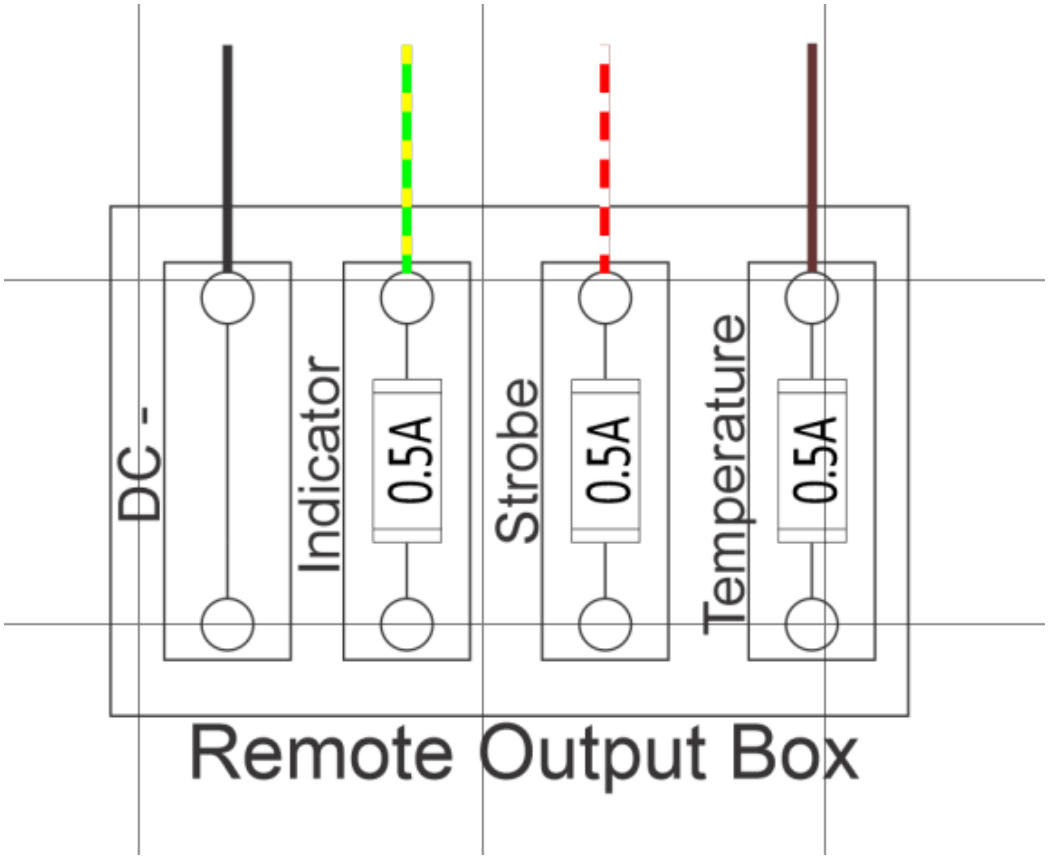


Figure 9. Remote Output Box label — terminal arrangement, fuse ratings, and factory wire colours



Figure 10. Inside the Remote Output Box — the green terminal is `DC -`*; the three black fused terminals are, from left to right,* `Indicator`*,* `Strobe` *and* `Temperature`*. The factory wiring enters at the top of each terminal; the openings at the bottom take the field wiring.*

Terminal	Fuse	Factory wire colour	Signal
`DC -`	—	Black	12 V DC return / common for all three outputs
`Indicator`	0.5 A	Green / yellow	Digital 12 V DC mirroring the indicator lamp (with blink patterns)
`Strobe`	0.5 A	White / red stripe	Digital 12 V DC mirroring the alarm strobe (high when illuminated)
`Temperature`	0.5 A	Brown	0–10 V analog, scaled 0–200 °F



Qualified electrician required

All electrical connections must be performed by a licensed electrician in compliance with

local electrical codes. Disconnect and lock out the power source before beginning any electrical work.



Replace fuses only with the same rating

Each output is protected at **0.5 A**. Do not substitute a higher-rated fuse — the fuses protect the PLC's output drivers and the 12 V DC converter as well as the downstream field wiring.

7.4.1. Connecting loads to the Indicator and Strobe outputs

Treat the Indicator and Strobe outputs as signal outputs. Each is fused at 0.5 A; the fuse protects the circuit and is not a load rating to design to. Connect them directly to a PLC digital input, a scoreboard input, or a small 12 V DC indicator lamp. To switch a heavier load — a horn, a beacon, or a contactor coil — drive an interposing relay from the output and switch the load through the relay's contacts.

7.5. Indicator output

The Indicator output reproduces the same blink patterns described in Indicator lamp:

- Solid — heating
- 1-second steady blink — warmup / cooldown
- Fast blink — resetting / initialization
- Double blink & pause — tank low (Precaution mode); auto-resumes when full
- Single blink & pause — refill system disabled

A remote **lamp** on the receiving side reproduces these patterns directly. A **PLC** on the receiving side can decode them using a pulse counter or duty-cycle measurement; reference the patterns above to map blink-codes back to system states.

7.6. Strobe output

The Strobe output is a digital signal — **high** when the local strobe is illuminated, **low** otherwise. It triggers on the same four conditions printed on the panel label (see Alarm strobe):

- Refill Timer Expired
- Refill Pressure Exceeded
- Tank Critically Low (LWCO)
- Operator E-STOP Pressed

A receiving system that reads this signal as an alarm input will see it fire on any of the four conditions; if the receiver needs to distinguish between them, it must also read the Indicator output (or query the PLC banner directly via a separate channel).

7.7. Temperature output

The Temperature output is the same 0–10 V analog signal tested by PLC Output Tests — Temperature Analog Output.

It is a **voltage** signal, not a 4–20 mA current loop. Connect it to a voltage-mode (0–10 V) analog input, which is high-impedance. Do not use it to power a device.

The mapping is linear:

Output voltage	Tank temperature
0 V	0 °F
10 V	200 °F

Each volt represents **20 °F**: tank temperature (°F) = output voltage × 20. A 5 V reading therefore indicates **100 °F**.

7.8. Verification after wiring

Confirm each output reaches the receiving end before relying on the connection.

1. Stop the system at the manifold panel.
2. From the PLC HMI, press **F2**, enter the password, and select **Output**.
3. Run each test in turn:
    a. **Alarm Strobe Output** — press **Test**; confirm the receiving alarm input asserts. Press **Cancel**.
    b. **Indicator Output** — press **Test**; confirm the receiving lamp or input asserts. Press **Cancel**.
    c. **Temperature Analog Output** — press **Press to simulate: 0**; confirm the receiving channel reads near 0 V / 0 °F. Press **Press to simulate: 200**; confirm the receiving channel reads near 10 V / 200 °F.
4. Return the unit to service.



Simulation drives the live output

The simulation buttons drive the actual analog output. Any monitoring system or alarm tied to that signal will see the simulated value during the test. Coordinate with whoever is

> watching the data feed before simulating.

7.9. See also

- PLC Controller Overview — full indicator and strobe legend
- PLC Output Tests — on-screen verification of each output
- Power Supply Connections — high-voltage hookup

Chapter 8. Operation Overview

Day-to-day operation uses the **Start**, **Stop**, and **Reset** buttons on the manifold control panel, the indicator lamp, and the pressure gauge. The PLC runs the circulation pump, enables the boiler, and keeps the storage tank filled from the supply drum without operator action. This page summarizes a normal operating session and points to the page that covers each task.



Figure 11. Manifold control panel — pressure gauge, **Reset**, **E-Stop** *and the combined* **Start** / **Stop** *button, with the indicator and alarm strobe legends to their right*

8.1. A normal operating session

Stage	What happens	PLC banner	Indicator lamp
Standby	The unit is powered and waiting for **Start**. The refill system still tops up the storage tank as needed.	`OFF- Ready`	—
Start and warmup	Press **Start**. The circulation pump runs and the boiler is enabled. Glycol reaches 190 °F in 15–20 minutes, depending on ambient temperature.	`Start Pressed`, then `Enabled - Warmup`	1-second steady blink
Heating	Glycol is at operating temperature. Connect tankers — see Connecting Tankers.	`Enabled-Heating`	Solid
Refill during heating	Each connected tanker draws the storage tank down by 3–5 gallons. Below 50 % the refill pump runs until the tank reaches 95 %. Heating continues.	`Heating - Refilling`	Solid
Stop and cooldown	After the last tanker is disconnected, press **Stop**. The boiler is disabled and the circulation pump runs through its off-delay, then the unit returns to standby.	`Stop Pressed`, `Cooldown`, then `OFF- Ready`	1-second steady blink during cooldown

8.2. Conditions that pause or stop heating

Condition	What the unit does	What you do
Storage tank above the **Tank Heat** target — banner `Enabled - Target Reached`, indicator 1-second steady blink	Holds the boiler off and keeps circulating. Heating resumes automatically when the tank has cooled.	Nothing — see Tank Heat thermostat.

Condition	What the unit does	What you do
Tank very low (below ~3 %) without LWCO tripping — banner `Precaution - Filling`, indicator double blink & pause	Pauses circulation and heat while the refill pump fills the tank, then resumes automatically at 95 %.	Nothing, unless it persists — see Precaution mode.
Refill Pump Switch `OFF` — banner `Refill Disabled`, indicator single blink & pause	Locks out the refill pump and does not heat.	Turn the switch `ON` — see Refill Pump Switch.
Latched fault — `REFILL TIMER EXPIRED`, `Refill Pressure Too High`, `REFILL SENSOR FAULT`, `Operator ESTOP`, or `ESTOP - LWCO`; alarm strobe on	Stops and locks out until reset.	Correct the cause, press **Reset**, then **Start** — see Troubleshooting — System lockout.

8.3. Where to find each task

- **First startup** — and after every drain and refill — Startup & First Heat Cycle. The air purge on this page is mandatory.
- **Connecting and disconnecting tankers** — Connecting Tankers
- **Adjusting the target temperature** — Temperature Control
- **Keeping glycol supplied, and refill faults** — Refill System Operation
- **Weekly drum check and monthly strainer cleaning** — Periodic Maintenance
- **Reading system state on the PLC** — PLC Status Screen

Chapter 9. Startup & First Heat Cycle

The first heat cycle requires a mandatory **air-purge step** to prevent boiler damage. Read this page completely before attempting first startup.



Air purge is mandatory for first startup

Skipping the air-purge step will cause the boiler to activate while air is still in the system, potentially damaging the boiler. This damage is **not covered under warranty**.

Do not press **Start** until the purge is complete.

The air purge is run from the PLC **PURGE** screen. The screen runs the circulation pump by itself and holds the boiler off, so no wiring is disconnected and the boiler cover stays on.

Repeat the air purge after every drain and refill.



PLC navigation at a glance

- **Home screen** — live status: Circ / Heat / Fill / Fault indicators, system state banner, tank temperature, Reset Delay countdown when applicable.
- **F1** — on the Home screen, opens the **Expanded Status** screen (live readouts, no password). On any other screen, returns to the Home screen and **clears the password**; you must re-enter it to reach the Menu again.
- **F2** — opens the password prompt. After successful entry, the **Menu** appears with four sections: Status, Calibration, Output, Controls.
- **Password entry** — press F2, tap the centre of the screen to bring up the on-screen number pad, enter `60525`, confirm.
- **Esc / back arrow** — returns to the previous screen.
- **Up / Down arrows** — scroll within a list.
- **Enter (⏎)** — confirm a selection.

9.1. Step 1 — Open the PURGE screen

Before you start, the storage tank must be filled — see Initial System Fill — and the unit must be stopped, with the PLC banner reading `OFF- Ready`.

1. On the PLC, press **F2** and enter the password. The **Menu** appears.
2. Select **Controls**. The **Cooling Fan** screen opens.

3. Press the **next** arrow three times: **LCD Screen Heat**, **Tank Heat**, then **PURGE**.

On the PURGE screen	Meaning
Start Circ Pump	Starts the circulation pump. The boiler stays off.
Stop Circ Pump	Stops the circulation pump.
Pump Running	Shows whether the circulation pump output is on.
Status line	The current system state. Reads `Purging` while the pump is running from this screen, or `Refilling` while the refill pump is topping up the storage tank at the same time. Use **Pump Running** to confirm the circulation pump is on.

9.2. Step 2 — Run the air purge

1. Press **Start Circ Pump**. The circulation pump primes and pushes entrapped air up into the vented storage tank. The banner reads `Purging`. As the loop fills, the storage tank level drops and the refill pump may start; the banner then reads `Refilling` while the purge continues. **Pump Running** shows that the circulation pump is on.
2. Listen at the storage tank. Wait until the churning / gurgling air noises have **completely ceased** — see the tip below.
3. Press **Stop Circ Pump**.



How to know purging is complete

Listen for churning/gurgling air noises in the storage tank. The system is fully purged when these noises have **completely ceased**. Do not proceed until the tank is silent. This typically takes 20 to 30 seconds.

While the PURGE screen is displayed:

- The **Start** button on the manifold panel is ignored, and the boiler cannot come on.
- The **E-Stop** button and the low-water cut-off (LWCO) still act. Either one stops the pump and locks out the unit.
- Pressing the **Stop** button on the manifold panel also stops the pump.
- The pump stops when you leave the screen.



The PLC returns to the Home screen 5 minutes after the password is entered

When the password times out, the PLC leaves the PURGE screen and the pump stops. If

> the tank is not yet silent, open the PURGE screen again (Step 1) and press **Start Circ Pump** to continue.

Start Circ Pump has no effect if the unit is already enabled (a heating session is running), while the **Stop** button is held, or while a fault or its reset delay is active. Stop the unit or clear the fault first — see Troubleshooting.

9.3. Step 3 — Commence heating

1. Press **F1** to return to the Home screen.
2. Press the external **Start button** (above the manifold). The boiler is now enabled and heating commences.

9.4. Step 4 — Monitor the first heat cycle

Heating will now commence. Expected behavior:

Reading	Expected
Time to reach 190 °F	15–20 minutes (ambient-dependent)
Boiler temperature display	On the boiler's onboard digital controller
PLC home-screen banner	`Start Pressed` → `Enabled - Warmup` → `Enabled-Heating`
PLC home-screen indicators	**Circ** solid; **Heat** solid; **Fault** clear
Manifold indicator lamp	1-second steady blink during warmup, then solid when heating

If the banner reads `Enabled - Target Reached` and **Heat** is off, the storage tank is already above the **Tank Heat** target. This is normal — see Temperature Control.

9.5. Adjusting target temperature

Temperature is set in two places:

- The **Tank Heat** screen on the PLC sets the tank temperature at which the PLC holds the boiler off.
- The **boiler's digital controller** (the display on the boiler face) holds the temperature at the boiler outlet, and accepts an offset of up to ±10 °F.

Both are described in Temperature Control.



Two displays, two roles

The **boiler digital controller** (mounted in the boiler unit) shows boiler outlet temperature.

The **PLC HMI** (mounted on the cabinet wall) shows system-level state (Heating, Refilling, Cooldown, faults) and the tank-temperature reading, and holds the Tank Heat settings. See PLC Controller Overview.

9.6. Next steps

- Connecting Tankers — Hook up tanker heating jackets
- Temperature Control — Day-to-day temperature management

Chapter 10. Connecting Tankers

The TankerTherm 123 supports up to **four tankers** connected at once. Connect and fill them one at a time, in succession; once filled, all connected tankers are heated together. Any tanker can be disconnected individually without interrupting heating of the others still connected.



Hot surfaces — personal protective equipment required

The distribution manifold and piping operate at up to **190°F (88°C)**. Always wear heat-resistant gloves when engaging ball valves or connecting/disconnecting tanker lines. Direct contact with the manifold can cause severe burns.

10.1. Manifold layout

The distribution manifold is divided into a supply side and a return side. Each side is labelled on the panel:

Panel label	Position and components	Purpose
`TANKER SUPPLY`	Left side — pressure gauge, ball valves	Hot glycol supply to tanker(s)
`TANKER RETURN`	Right side — wye strainers, ball valves	Return connection from tanker(s)

This manual calls them the **supply side** and the **return side**.

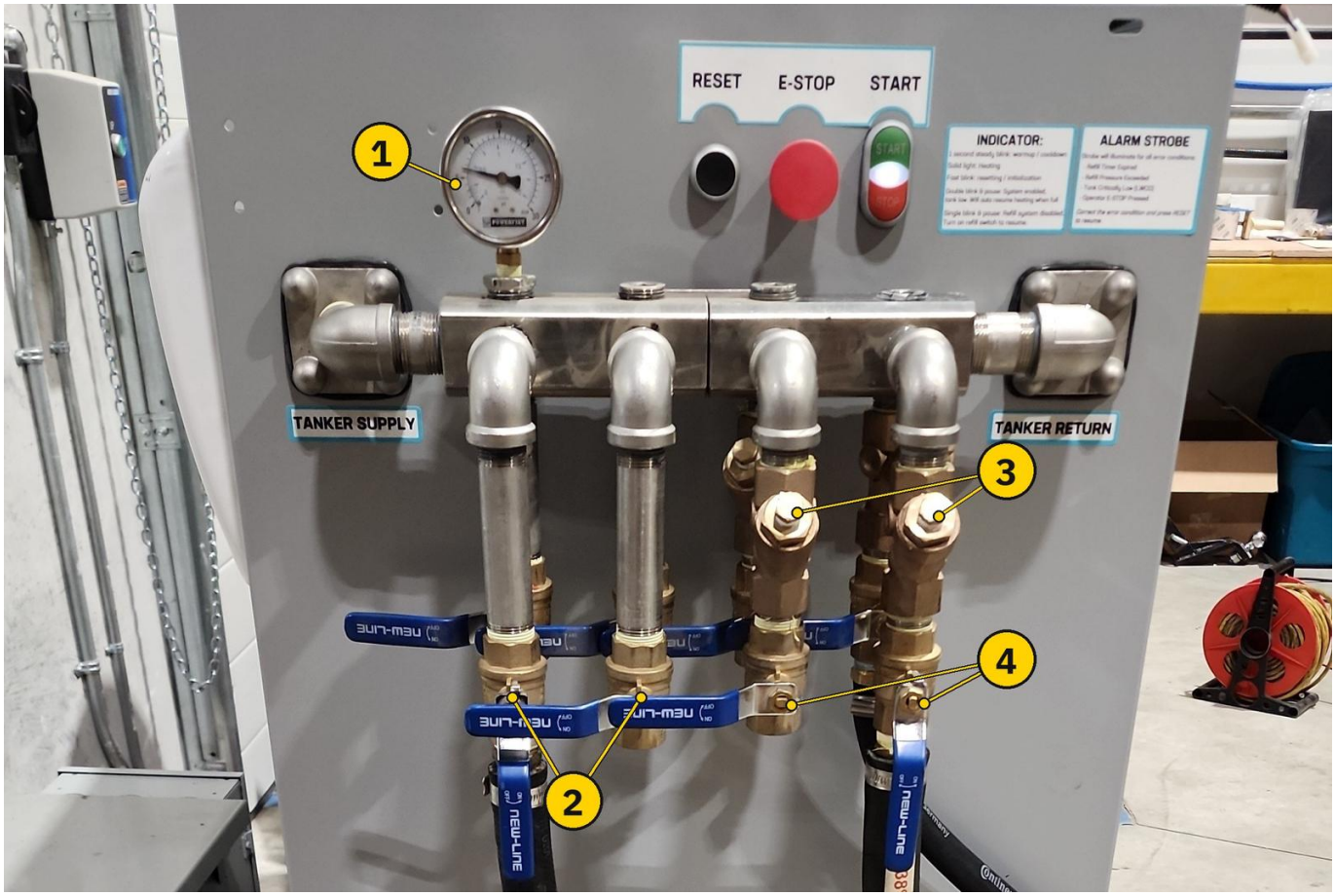


Figure 12. Manifold control panel — numbered callouts match the table below

#	Item	Notes
1	Pressure gauge	Supply pressure at the manifold. See Reading the pressure gauge.
2	Supply-side ball valves	One per tanker supply line, on the `TANKER SUPPLY` side.
3	Wye strainers	One per return line, on the `TANKER RETURN` side. Cleaned monthly — see Periodic Maintenance.
4	Return-side ball valves	One per tanker return line, directly below its wye strainer. Return glycol passes through the valve, then the strainer, into the manifold.

The panel also carries labelled **RESET**, **E-STOP**, and **START** / **STOP** buttons, and the printed **INDICATOR** and **ALARM STROBE** legends — see Manifold panel indicators and Emergency stop.

Reading a ball valve

> The manifold uses quarter-turn ball valves. The handle shows the valve position: **parallel to the pipe = open**, **perpendicular to the pipe = closed**.

10.2. Connection procedure



Figure 13. One tanker connected — a supply hose and a return hose run from the manifold to the tanker's heating-jacket connections. Illustration: the unit is a photograph, the surroundings are computer-generated to show a typical installation.

1. Put on heat-resistant gloves.
2. Confirm the system is running and at operating temperature. Quick check: the boiler digital controller reads near 190 °F, and the PLC home-screen banner reads `Enabled-Heating` with **Circ** and **Heat** indicators solid.
3. Verify that the supply-side and return-side ball valves you will use are `CLOSED`.
4. Connect the tanker supply line to a ball valve on the **supply side** (`TANKER SUPPLY`, left, with the pressure gauge).
5. Connect the tanker return line to a ball valve on the **return side** (`TANKER RETURN`, right, through the wye strainer).
6. Slowly open the return-side ball valve first.
7. Slowly open the supply-side ball valve.
8. Verify flow on the pressure gauge — pressure should settle within the **5–20 PSI** range depending on connected load.

Each manifold ball valve ends in a standard hose barb. Push the hose fully onto the barb and secure it with a worm-drive hose clamp. No special fittings are needed.

To connect more tankers, up to four in total, repeat steps 3–8 for each tanker, one tanker at a time.

10.2.1. Reading the pressure gauge

The gauge shows supply pressure at the manifold. With no tanker circuits open, the pump circulates through the internal bypass orifice at **20 PSI**. As tanker circuits are opened, glycol flows through the jackets and the reading falls. The normal range is **5–20 PSI**, depending on the number of connected jackets and their piping resistance.

If pressure fails to exceed **7 PSI** with no tankers connected, the circulation pump is worn — see Troubleshooting — Pressure fails to exceed 7 PSI during bypass.

10.3. Disconnecting a tanker

An individual tanker may be disconnected while the system continues to run for other connected tankers.



Hot surfaces — personal protective equipment required

The distribution manifold and piping operate at up to **190°F (88°C)**. Always wear heat-resistant gloves when engaging ball valves or connecting/disconnecting tanker lines. Direct contact with the manifold can cause severe burns.

1. Close the supply-side ball valve for the tanker being disconnected.
2. Close the return-side ball valve.
3. Allow the tanker lines to cool, or use heat-resistant gloves to disconnect immediately.
4. Disconnect the supply and return lines from the manifold.

To disconnect several tankers, repeat these steps for each one. When the last tanker is disconnected, shut the system down as described below.

10.4. Shutdown (all tankers disconnected)

If all tankers have been disconnected:

1. Press the **Stop button** to end the heating operation.
2. The control system remains in standby mode.
3. Standby mode continues to monitor:

- Glycol level
- Temperature controls
- Enclosure temperature

No further action is required until the next heating operation is initiated.

Chapter 11. Temperature Control

Glycol temperature is controlled in two places:

- The **PLC Tank Heat thermostat** watches the storage-tank temperature. When the tank rises above its **Target**, the PLC holds the boiler off; when the tank cools, the PLC lets the boiler run again.
- The **boiler's onboard digital controller** holds the glycol at a configured target temperature, measured at the boiler outlet, whenever the PLC allows the boiler to run.

Use the Tank Heat **Target** to choose how hot the storage tank is kept. Use the boiler controller's offset to trim the boiler outlet temperature by up to ±10 °F.

11.1. Tank Heat thermostat (PLC)

To open the **Tank Heat** screen: press **F2**, enter the password, select **Controls**, then press the **next** arrow twice (**Cooling Fan** → **LCD Screen Heat** → **Tank Heat**).

The screen shows the live tank temperature and three settings:

Setting	Range	Factory setting	Meaning
Target	80–195 °F	195 °F	Tank temperature above which the PLC holds the boiler off.
Hysteresis	1–50 °F	10 °F	How far the tank must cool below **Target** before the boiler is allowed to run again.
Delay	Up to 60 s	1 s	How long the tank must stay below **Target** minus **Hysteresis** before the boiler is allowed to run again. Keeps a momentary dip from restarting the boiler.

How it works during a heating session:

1. The boiler runs until the tank temperature rises above **Target**.
2. The PLC then holds the boiler off. The circulation pump keeps running, so the connected tankers still receive hot glycol. The banner reads `Enabled - Target Reached`, the **Heat** indicator on the Home screen is off, and the manifold indicator lamp shows a 1-second steady blink.
3. When the tank temperature has been below **Target** minus **Hysteresis** for the **Delay** time, the PLC allows the boiler to run again and the banner returns to `Enabled-Heating`.

For example, with a **Target** of 150 °F and a **Hysteresis** of 10 °F, the boiler is held off above 150 °F and runs again once the tank has cooled below 140 °F.



At the factory settings

The factory **Target** of 195 °F is above the 190 °F design operating temperature, so the thermostat does not normally interrupt heating and the boiler controller sets the working temperature. Lower the **Target** to hold the storage tank at a lower temperature.

11.1.1. Changing a Tank Heat setting

1. Open the **Tank Heat** screen.
2. Tap the value to change. The on-screen number pad opens.
3. Enter the new value and confirm. The PLC accepts only values inside the range shown above.
4. Press **F1** to return to the Home screen.

11.2. Adjusting the setpoint offset (boiler controller)

To run slightly hotter or cooler than the boiler controller's configured target, apply an offset of up to ±10 °F on the boiler controller's faceplate — no configuration menus are involved.

11.2.1. Adjustment range

- Maximum: **+10°F (+5°C)** above configured target
- Minimum: **−10°F (−5°C)** below configured target
- Adjustment resolution: **1°F / 1°C**

11.2.2. Adjustment procedure

1. Press `+` or `-` on the boiler controller.
2. The display shows `0` and blinks, indicating zero offset from configured target.
3. Continue pressing `+` or `-` to dial in the desired offset.
4. Stop pressing the buttons. The new value blinks for **5 seconds** and is then applied.
5. The display returns to standard view, showing the new effective target temperature.

11.2.3. Reviewing the current offset

Press `+` or `-` again to display the currently applied offset. You can re-adjust from this value.



Offset persistence

The offset is persistent across power cycles. To return to the configured target, adjust the

> offset back to `0`.

11.3. How the boiler holds the setpoint

The boiler controller is configured to hold a fixed target temperature using the boiler's two heating stages. The target does not vary with outdoor temperature.

1. On a **call for heat** — the unit is started and the tank is not above the Tank Heat **Target** — the circulating pump runs and the PLC enables the boiler.
2. The boiler activates the number of stages required to reach and maintain the configured target temperature at the boiler outlet.
3. Stage rotation occurs on an **equal time period** basis to distribute wear evenly across heating stages.

11.4. Tank temperature reading and remote monitoring

The PLC reads tank coolant temperature from a dedicated probe (independent of the boiler controller). The Tank Heat thermostat uses this reading. You can view or transmit it in two ways:

- On the PLC **Home**, **Status** and **Tank Heat** screens — see PLC Controller Overview.
- As a **0–10 V analog output** representing 0–200 °F, intended for connection to a remote monitoring or data-acquisition system. The scale is linear: each volt represents 20 °F, so tank temperature (°F) = output voltage × 20. See Remote Output Box — Temperature output and Temperature Analog Output.

The tank-temperature probe can be field-zero-calibrated against an ice-water reference — see Temperature probe calibration. Because the Tank Heat thermostat acts on this reading, keep the probe calibrated.

Chapter 12. Refill System Operation

The refill system keeps the internal 10-gallon **storage tank** filled from the external 55-gallon **supply drum**. After the Initial System Fill, it runs automatically as long as the Refill Pump Switch is `ON` and the supply drum has glycol in it.

This page covers three topics:

1. Automatic refill — how the PLC keeps the storage tank filled, including Precaution mode
2. Refill fault protection — the time and pressure limits that stop the refill pump
3. Restoring operation after a refill lockout — what to do after a refill fault locks out the system

12.1. Automatic refill

12.1.1. Refill Pump Switch

The switch labelled `REFILL PUMP` on the HMI panel enables the automatic refill system. On current units it is a rotary selector below the PLC HMI; on earlier units it is a toggle above the HMI. It does not run the pump directly — the PLC decides when the pump runs.

Position	Effect
`ON` (toggle up on earlier units)	Normal operating position. The PLC runs the refill pump automatically based on storage tank level.
`OFF` (toggle down on earlier units)	The refill system is disabled and heating is not enabled. The PLC banner reads `Refill Disabled`, and the indicator lamp shows a single blink & pause. Turn the switch back `ON` to resume.

12.1.2. Refill cycle

Trigger	System response
Storage tank level falls below 50 %	Refill pump starts. The PLC banner reads `Heating - Refilling` during a heating session, or `Refilling` in standby.
Storage tank level reaches 95 %	Refill pump stops.

The top 5 % of the storage tank is left empty on purpose. Glycol expands as it heats to 190 °F, and that space absorbs the expansion. Any overflow drains back to the supply drum through the red vent hose.

12.1.3. Precaution mode at very low tank level

The **LWCO (Low-Water Cut-Off)** is a hardware sensor in the storage tank. If it detects that the tank is critically low, it disables the boiler immediately and the PLC latches an `ESTOP - LWCO` fault, which needs an operator reset — see Resolution — ESTOP - LWCO.

Precaution mode is designed to act before that happens. If storage tank level drops below approximately **3 %** while the system is enabled, and the LWCO has not tripped, the PLC enters `Precaution - Filling`:

- Circulation and heat are paused.
- The refill pump runs.
- Operation resumes automatically once the storage tank reaches **95 %**.

No operator action is required unless the refill itself fails — in which case the PLC raises one of the refill faults below.

12.2. Refill fault protection

The PLC stops the refill pump and locks out the system on either of two refill faults. Both latch the alarm strobe and require an operator reset.



Do not run the refill pump dry

The refill pump is a **gear-type positive-displacement pump**. Approximately **20 minutes of cumulative dry running** can destroy it. Pressing **Reset** without correcting the cause adds to that total. Always replenish the supply drum or correct the cause before resetting.

12.2.1. Fill Time Limit — `REFILL TIMER EXPIRED`

The Fill Time Limit (default **300 s** / 5 minutes) caps how long a single refill cycle can run. If the supply drum becomes empty during a refill cycle:

1. The refill pump continues running until the Fill Time Limit expires.
2. The PLC shuts the refill pump off.
3. The alarm strobe energizes.
4. The PLC banner reads `REFILL TIMER EXPIRED`.
5. The entire system locks out.

The default of 300 s keeps a single fault well below the pump's dry-running tolerance. The Fill Time Limit is adjustable on the PLC — see PLC Controls — Fill Time Limit. Raising it is rarely the right answer; investigate the underlying cause first.

12.2.2. Refill pressure — `Refill Pressure Too High`

The PLC monitors refill-line pressure with a 4–20 mA / 0–30 PSI transducer. The limit is the **Max Pressure** setting (default **20.0 PSI**). It protects the storage tank and refill plumbing from over-pressurization caused by a kinked overflow, a closed downstream valve, or a fully-pressurized tank that the high-cal point has missed. If refill pressure exceeds the limit:

1. The PLC stops the refill pump immediately.
2. The alarm strobe energizes.
3. The PLC banner reads `Refill Pressure Too High`.
4. The entire system locks out.

See PLC Calibration — Refill Pressure for adjustment and zero calibration.

12.2.3. Refill pressure sensor — `REFILL SENSOR FAULT`

The PLC also checks that the refill pressure sensor itself is working. If the sensor signal is below 3.5 mA or above 21.0 mA for half a second — a broken wire, an unplugged connector or a failed sensor — the PLC can no longer see refill pressure:

1. The PLC stops the refill pump.
2. The alarm strobe energizes.
3. The PLC banner reads `REFILL SENSOR FAULT`.
4. The entire system locks out.

See Troubleshooting — Resolution — REFILL SENSOR FAULT.

12.3. Restoring operation after a refill lockout

A hard lockout (`REFILL TIMER EXPIRED`, `Refill Pressure Too High`, `REFILL SENSOR FAULT`, or either `ESTOP` state) drops the system out of the heating state. Unlike Precaution mode — which resumes automatically when the refill catches up — recovery from a hard lockout requires an operator-driven restart.

1. Replenish glycol in the supply drum (or correct the underlying cause for non-dry-run faults — see Troubleshooting).
2. Press the external **Reset** button on the manifold control panel.
3. Wait for the `Resetting- Wait` banner to clear. The strobe turns off and the banner settles at `OFF-Ready`.
4. Press the external **Start** button to resume heating.

12.4. Weekly inspection requirement

Prevent dry-run lockouts by inspecting the supply drum weekly:

- Visually check the glycol volume in the supply drum
- Confirm the drum holds enough glycol for the tanker connections you expect before the next check
- Replenish before the drum becomes empty



Estimating glycol use

Each connected tanker draws the storage tank down by **3–5 gallons**, which the refill pump replaces from the supply drum. Multiply by the number of tanker connections you expect per week to gauge how often the drum needs replacing.

Chapter 13. PLC Controller Overview

The TankerTherm 123 includes an industrial PLC with an integrated touchscreen HMI on the inside-left wall of the cabinet. The PLC continuously supervises pumps, refill, and fault handling, drives the indicator lamp and alarm strobe, logs events, and provides remote-monitoring outputs.

Operators only need the HMI for **calibration, maintenance, and troubleshooting** — day-to-day operation uses only the **Start**, **Stop**, and **Reset** buttons on the manifold control panel and the indicator lamp / pressure gauge for at-a-glance status. As long as the supply drum has glycol, the unit needs no other operator input.

This documentation describes PLC software **v2.2**.



What the PLC does — and does not do

The PLC supervises pumps, refill, and fault handling. It enables and disables the boiler. The boiler itself continues to be regulated by its own onboard digital controller (see Temperature Control).

13.1. Hardware location

The PLC HMI is mounted on the inside left wall of the cabinet, visible when the cabinet door is open.

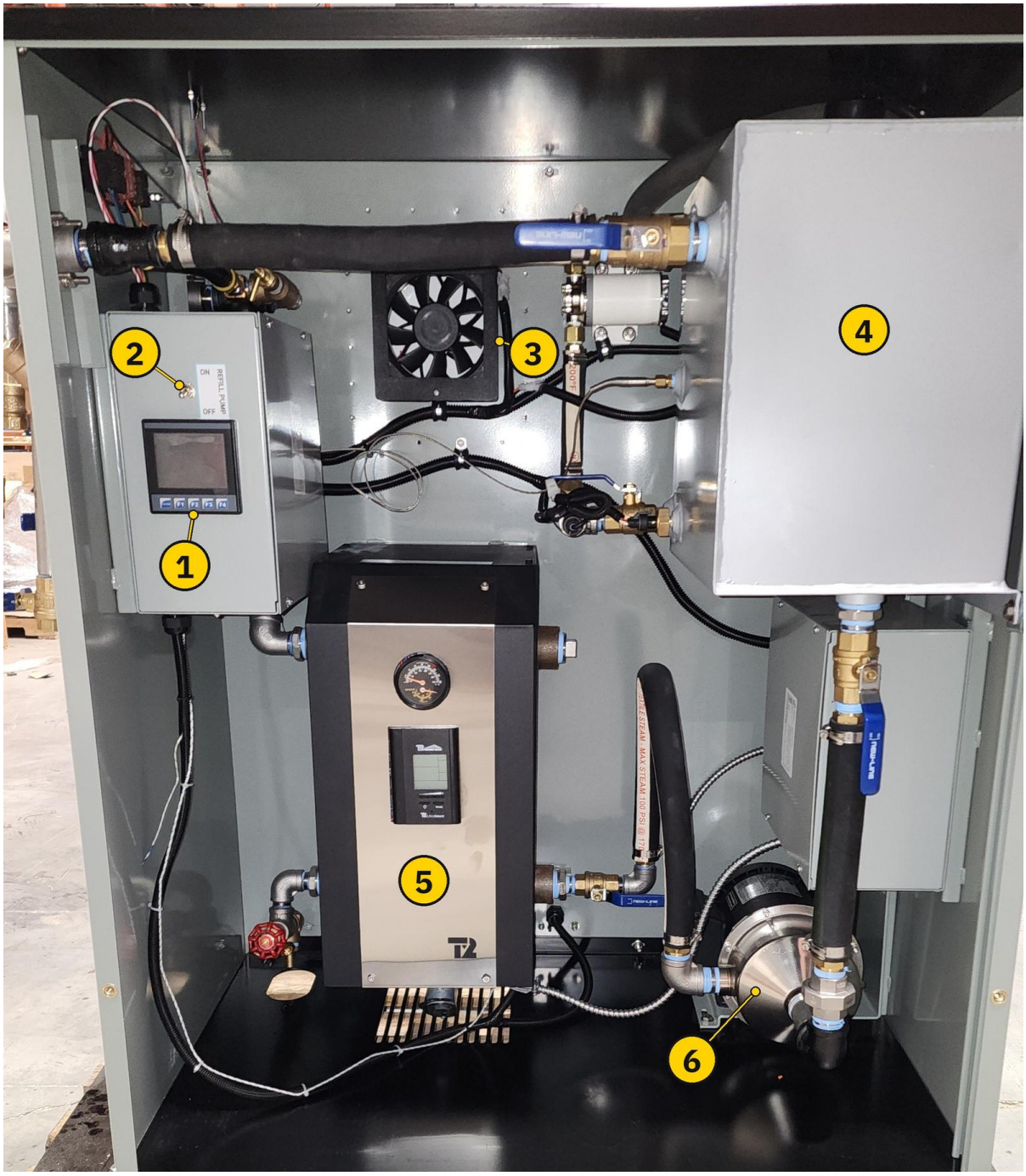


Figure 14. Cabinet interior — (1) PLC HMI and (2) Refill Pump Switch on the left wall. The other callouts are listed under Major components.

13.2. Home screen

The Home screen is the default view and shows live system state at a glance.

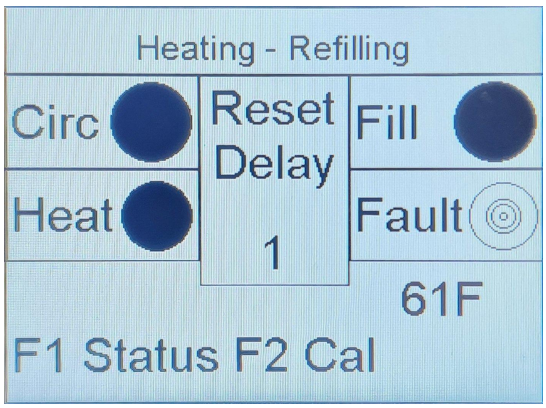


Figure 15. Home screen during a "Heating - Refilling" state with a one-second Reset Delay

Element	Meaning
Banner (top)	Current system state — verbatim text string. Common values include `OFF - Ready`, `Enabled - Warmup`, `Enabled-Heating`, `Heating - Refilling`, `Cooldown`, `Refilling`, `Resetting- Wait`, `Operator ESTOP`, `ESTOP - LWCO`, `REFILL TIMER EXPIRED`, `Refill Pressure Too High`, `Refill Disabled`, `Precaution - Filling`. Every state and its meaning is listed in Status — System states.
Circ	Circulation pump output. Filled circle = pump running. Hollow ring = pump off.
Heat	Boiler enable output. Filled circle = boiler enabled. Hollow ring = boiler not enabled.
Fill	Refill pump output. Filled circle = refill pump running. Hollow ring = refill pump off.
Fault	Filled circle = a fault is latched (mirrors the alarm strobe). Hollow ring = no fault.
Reset Delay (centre)	Countdown shown when the system is in the post-fault reset hold (typically 1 s).
Tank temperature	Current tank-temperature reading in °F (from the tank-temp probe).
Function-key legend	`F1 Status F2 Cal` — see Navigation.

13.3. Navigation

PLC navigation at a glance

- **Home screen** — live status: Circ / Heat / Fill / Fault indicators, system state banner,

tank temperature, Reset Delay countdown when applicable.

- **F1** — on the Home screen, opens the **Expanded Status** screen (live readouts, no password). On any other screen, returns to the Home screen and **clears the password**; you must re-enter it to reach the Menu again.
- **F2** — opens the password prompt. After successful entry, the **Menu** appears with four sections: Status, Calibration, Output, Controls.
- **Password entry** — press F2, tap the centre of the screen to bring up the on-screen number pad, enter `60525`, confirm.
- **Esc / back arrow** — returns to the previous screen.
- **Up / Down arrows** — scroll within a list.
- **Enter (⏎)** — confirm a selection.

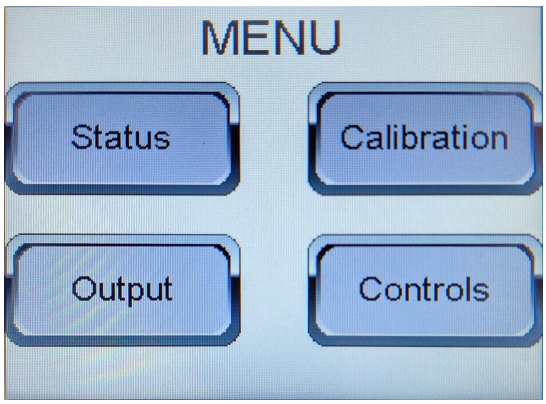


Figure 16. Menu — appears after entering the password via F2. Four sections.

The four Menu sections are:

- **Status** — Live readouts (circulation, heat, refill, LWCO, tank level, …). The same content is reachable directly from the home screen via **F1** without the password.
- **Calibration** — Tank level, temperature probes, and refill pressure calibration.
- **Output** — Manual tests of the alarm strobe, indicator lamp, and analog tank-temperature output.
- **Controls** — Adjustable parameters and the air purge: cooling fan setpoints, LCD-screen heater setpoints, the Tank Heat thermostat, and the PURGE screen. The fill time limit is reached through **Calibration**.

13.3.1. Password

The **Menu** and everything past it — Calibration, Output tests, Controls — is reached via **F2** from the home screen and is password-protected. The home screen and the F1 **Expanded Status** screen are not.

Most monitoring and routine troubleshooting can be done from the F1 Expanded Status (live readouts

including tank level, fault state, and current sensor values) without entering the password. The password is required only when you need to **change** something — calibrate, test outputs, adjust setpoints. Day-to-day operators do not use the PLC at all.

How to enter the password

1. Press **F2** from the home screen.
2. Tap the centre of the screen to bring up the on-screen number pad.
3. Enter `60525`.
4. Confirm. The Menu opens.

When you have finished, press **F1** from any Menu or sub-screen. The home screen returns and the password is cleared — the next person to access the Menu will have to re-enter it.

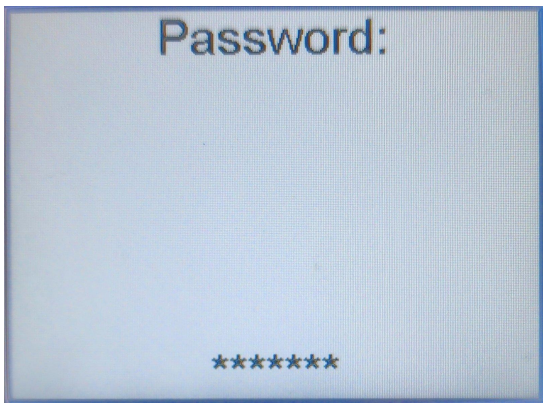


Figure 17. Password prompt

Password

The password is `60525`.

It is included in this manual because it gates against accidental change rather than against unauthorized access. If your installation requires stricter access control, contact Thermex Systems to configure a site-specific password.

13.4. Manifold panel indicators

The PLC drives two indicators on the manifold control panel: the indicator lamp, which reports system state, and the alarm strobe, which reports latched faults.

13.4.1. Indicator lamp

The indicator lamp on the manifold control panel reports system state at a glance. The same legend is printed on the panel beside the lamp.

Pattern	Meaning
1 second steady blink	Warmup / cooldown
Solid light	Heating
Fast blink	Resetting / initialization
Double blink & pause	System enabled, tank low. Will auto resume heating when full.
Single blink & pause	Refill system disabled. Turn on refill switch to resume.

The same indicator signal is available at the Remote Output Box for connection to an external scoreboard or remote PLC.

13.4.2. Alarm strobe

The strobe on the manifold control panel illuminates whenever the PLC has latched a fault condition. The same trigger conditions are listed on the panel label beside the strobe.

The strobe illuminates for any of the following error conditions:

- **Refill Timer Expired** — see Fill Time Limit
- **Refill Pressure Exceeded** — see Refill Pressure
- **Tank Critically Low (LWCO)**
- **Operator E-STOP Pressed**
- **Refill pressure sensor fault** — banner `REFILL SENSOR FAULT`. This cause is not listed on the panel label. See Troubleshooting.

To recover from a strobe-active state:

1. Identify the cause from the home-screen banner or the Status screen.
2. Correct the underlying condition (replenish glycol, clear an obstruction, release the E-Stop, etc.).
3. Press the external **Reset** button on the manifold control panel.
4. The system enters a brief `Resetting- Wait` hold, then settles at `OFF- Ready`.
5. Press **Start** to resume heating.

For cause-by-cause resolution steps, see Troubleshooting — System lockout and warning strobe active.

The same strobe signal is available at the Remote Output Box for connection to an external scoreboard or remote PLC.

13.5. Remote monitoring and event logging

The PLC drives an analog output that mirrors the tank temperature for connection to a remote monitoring or data-acquisition system. Output range is **0–10 V representing 0–200 °F** (20 °F per volt). See Temperature Analog Output for verification and simulation.

In addition, every system-state transition is recorded as an event in the unit's data log, and the current state is logged at periodic intervals as a heartbeat. The state strings recorded in the log are the same strings shown in the home-screen banner — see Status — System states for the full list. To retrieve the log, see PLC Data Log.

13.6. See also

- Status screen reference
- Calibration procedures
- Adjustable controls
- Output tests
- Troubleshooting — for fault-condition recovery

Chapter 14. PLC Status Screen

The Expanded Status screen is the single best place to check what the system is doing right now. Press **F1** from the home screen — no password required.

PLC navigation at a glance

- **Home screen** — live status: Circ / Heat / Fill / Fault indicators, system state banner, tank temperature, Reset Delay countdown when applicable.
- **F1** — on the Home screen, opens the **Expanded Status** screen (live readouts, no password). On any other screen, returns to the Home screen and **clears the password**; you must re-enter it to reach the Menu again.
- **F2** — opens the password prompt. After successful entry, the **Menu** appears with four sections: Status, Calibration, Output, Controls.
- **Password entry** — press F2, tap the centre of the screen to bring up the on-screen number pad, enter `60525`, confirm.
- **Esc / back arrow** — returns to the previous screen.
- **Up / Down arrows** — scroll within a list.
- **Enter (⏎)** — confirm a selection.

14.1. Reading the Status screen

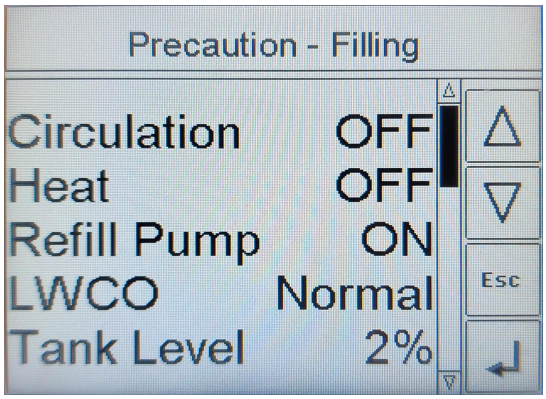


Figure 18. Status screen during a `Precaution - Filling` *condition — circulation and heat are paused while the refill pump tops up the tank. The screenshot shows the first five lines of the scrollable list.*

The Status screen is a scrollable list. Use the on-screen ▲ / ▼ arrows to scroll. The banner at the top of the screen is the **current system state** — the same banner shown on the Home screen.

The full list of fields, in scroll order, is:

Field	Format	Meaning
Circulation	Text	`ON` / `OFF` — circulation pump output
Heat	Text	`ON` / `OFF` — boiler enable output. `OFF` during a heating session means the PLC is holding the boiler off — for example while the banner reads `Enabled - Target Reached`.
Refill Pump	Text	`ON` / `OFF` — refill pump output
LWCO	Text	`Normal` / `Low` — Low-Water Cut-Off sensor. `Low` means the tank is empty enough to disable the boiler immediately.
Tank Level	Numeric, %	Tank coolant level as a calibrated percentage. Refill is automatic; with the supply drum kept full there is no need to monitor this value. Calibrated via Tank Level Calibration.
Tank Temp	Numeric, °F	Tank coolant temperature, read from the dedicated PLC tank-temp probe. The Tank Heat thermostat acts on this reading.
Refill Timer	Numeric, seconds	Elapsed seconds in the current refill cycle. Counts up against the Fill Time Limit.
Refill Pres.	Numeric, PSI	Live refill-line pressure.
Ambient	Numeric, °C	Cabinet ambient temperature. Drives the cooling-fan logic.
Fan	Text	`ON` / `OFF` — cabinet cooling-fan output.
LCD	Numeric, °C	Temperature at the HMI screen itself. Drives the LCD-heater logic.
LCD Heater	Text	`ON` / `OFF` — LCD-screen heater output (cold-weather use).

Field	Format	Meaning
Version	ASCII	PLC software version, for example `v2.2.1`. Useful when contacting support, and it tells you which manual matches the unit — see Release Notes.



Temperatures are shown in two units

The PLC displays **Tank Temp** in °F, and **Ambient** and **LCD** in °C. This is how the controller is programmed. The cooling-fan and LCD-heater setpoints on the Controls screens are also in °C; the Tank Heat settings are in °F. Where this manual quotes a factory default, it gives both units — see Specifications — Enclosure temperature regulation.

14.2. System states

The banner at the top of the Home and Status screens reports the current system state as a literal text string. The same string is recorded in the unit's event log on every state transition.

The full list of state strings the PLC reports — in order of progression through a normal session — is shown below. State strings are reproduced verbatim, including their (intentional) spacing.

State	Meaning
`Power Cycle`	Logged once at controller boot. Not a persistent state.
`OFF- Ready`	System is in standby, awaiting **Start**. No outputs energized.
`Start Pressed`	Momentary marker logged at the instant the operator presses **Start**. Immediately superseded by `Enabled - Warmup` or another state.
`Enabled - Warmup`	System enabled and ramping toward operating temperature. Indicator slow-blinks.
`Enabled-Heating`	Normal operating state — circulation running and boiler enabled. Indicator solid.
`Heating - Refilling`	Normal operation, plus the refill pump is topping up the storage tank.

State	Meaning
`Enabled - Target Reached`	The storage tank is above the **Tank Heat** target. Circulation keeps running and the PLC holds the boiler off until the tank cools — see Tank Heat thermostat. Indicator slow-blinks.
`Stop Pressed`	Momentary marker logged at the instant the operator presses **Stop**.
`Cooldown`	Boiler disabled, circulation pump still running through its off-delay.
`Purging`	The circulation pump is running from the **PURGE** screen with the boiler held off — see Startup & First Heat Cycle.
`Operator ESTOP`	The operator E-Stop button was pressed. System locked out; strobe latched. The banner stays until **Reset** is pressed, even after the button is released.
`ESTOP - LWCO`	The Low-Water Cut-Off has tripped. System locked out; strobe latched. Replenish coolant before resetting. The banner stays until **Reset** is pressed, even after the tank has refilled.
`Resetting- Wait`	Brief hold after pressing **Reset** while clear-conditions are evaluated. Returns to `OFF- Ready` on success; the operator must press **Start** to resume heating.
`Refilling`	System is refilling the storage tank (initial fill or post-drawdown).
`Refill Pressure Too High`	Refill pressure exceeded the configured maximum — refill stopped, fault latched.
`REFILL TIMER EXPIRED`	Refill ran longer than the configured fill time limit — fault latched.
`REFILL SENSOR FAULT`	The refill pressure sensor signal is outside its valid range (broken wire, unplugged connector or failed sensor) — refill stopped, fault latched.
`Reset Pressed`	Momentary marker logged at the instant the operator presses **Reset**.
`Refill Disabled`	The external refill switch is off — heating is not enabled and the refill pump is locked out.
`Precaution - Filling`	Tank fell to a near-empty level (below ~3 %) without LWCO tripping. Circulation and heat are paused while the refill pump catches up. Returns to `Enabled-Heating` automatically once the tank reaches ~95 %.



Why "Precaution" exists

> The `Precaution - Filling` state protects the boiler from running dry in the gap between tank level dropping below 3 % and LWCO physically tripping. Heat and circulation are paused, the refill pump runs, and operation resumes automatically once the tank refills to 95 %. No operator action is required **unless** the refill itself fails — in which case the PLC promotes the condition to `REFILL TIMER EXPIRED` or `Refill Pressure Too High` and latches the strobe.



Event logging

Every state transition is recorded as an event in the unit's data log, and the current state is also logged at periodic intervals as a heartbeat. The log is the authoritative record of what the unit was doing at any past moment — useful for diagnosing intermittent issues after the fact. To retrieve the log, see PLC Data Log.

14.3. See also

- PLC Controller Overview
- Tank Level Calibration
- Troubleshooting

Chapter 15. PLC Calibration

The Calibration menu provides three calibration routines: tank level, temperature probes, and refill pressure.

PLC navigation at a glance

- **Home screen** — live status: Circ / Heat / Fill / Fault indicators, system state banner, tank temperature, Reset Delay countdown when applicable.
- **F1** — on the Home screen, opens the **Expanded Status** screen (live readouts, no password). On any other screen, returns to the Home screen and **clears the password**; you must re-enter it to reach the Menu again.
- **F2** — opens the password prompt. After successful entry, the **Menu** appears with four sections: Status, Calibration, Output, Controls.
- **Password entry** — press F2, tap the centre of the screen to bring up the on-screen number pad, enter `60525`, confirm.
- **Esc / back arrow** — returns to the previous screen.
- **Up / Down arrows** — scroll within a list.
- **Enter (⏎)** — confirm a selection.

Calibration overwrites the stored sensor scaling

Calibration changes the constants the PLC uses to interpret raw sensor signals. An incorrect calibration makes the PLC misread tank level, temperature, or refill pressure, and its protection logic acts on those readings. Perform these procedures only when commissioning the unit, after replacing a sensor, or when verifying readings against a known reference.

The Calibration menu requires the standard password (`60525`) — see Password for details.

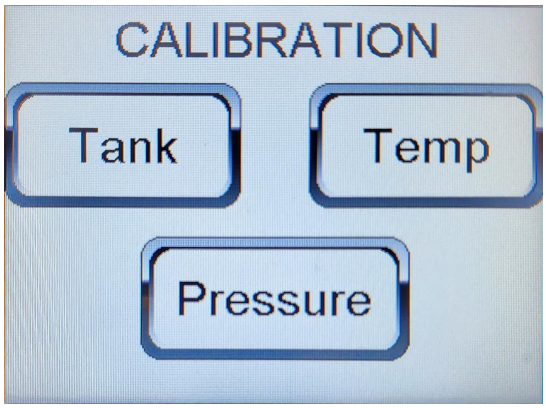


Figure 19. Calibration menu — three sub-menus: Tank, Temp, and Pressure

15.1. Tank level calibration

The storage tank level is measured by an analog sensor and reported as a percentage on the home and Status screens. Two calibration points define the percentage scale: the **empty** point and the **full** point.

15.1.1. Tank Low % (empty) calibration

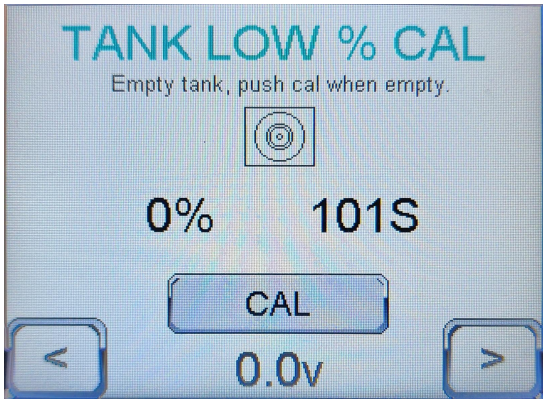


Figure 20. TANK LOW % CAL — calibrates the empty-tank reference. Enabled only when LWCO is active.

LWCO interlock

The empty-tank calibration requires the LWCO sensor to be in the **Low** state — i.e. the tank is actually empty. This prevents accidentally calibrating the empty point when there is still coolant in the tank.

1. Drain the storage tank completely so that LWCO trips. Confirm **LWCO: Low** on the Status screen.
2. Press **F2** from the home screen, enter the password, and select **Calibration → Tank → TANK LOW % CAL**.
3. Confirm the on-screen voltage reading is stable at the empty-tank reference (typically near **0.0 V**).
4. Press **CAL** to set the empty-tank zero point.

15.1.2. Tank High % (full) calibration

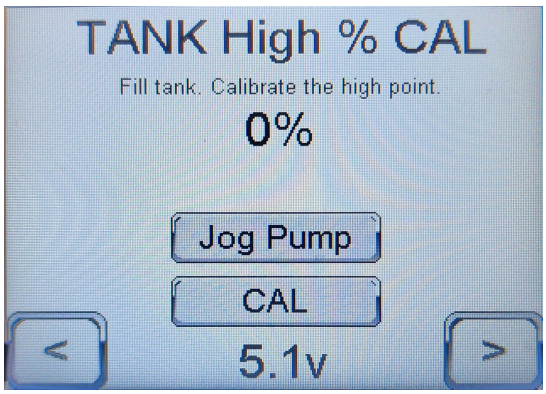


Figure 21. TANK High % CAL — calibrates the full-tank reference. Use **Jog Pump** *to advance the refill pump in short bursts.*

Confirming a full tank

The storage tank is enclosed in the cabinet and has no sight gauge. A full tank is confirmed when coolant begins to flow from the tank's overflow fitting. This procedure uses that point as the full-tank reference.

1. Confirm the supply drum is full and connected to the suction tube/hose.
2. Press **F2** from the home screen, enter the password, and select **Calibration → Tank → TANK High % CAL**.
3. Press **Jog Pump** to advance the refill pump in short bursts.
4. Continue jogging until coolant flows from the tank's **overflow** fitting — that is the physical "full" reference.
5. Stop jogging. Confirm the on-screen voltage reading is stable (typically around **5.1 V** on a properly-functioning sensor).
6. Press **CAL** to set the full-tank reference.
7. Verify the result: return to the Status screen and confirm **Tank Level** reads near 100 %.
8. During the next normal operating cycle, confirm the percentage drops as tankers draw down the tank, and recovers as the refill pump tops it up.

15.2. Temperature probe calibration

Generally not needed

Factory calibration of the temperature probes is normally adequate for the unit's service life. Calibrate only if a probe reading is clearly inconsistent with a known reference, or after replacing a probe.

The PLC reads three thermistor/probe inputs:

- **Tank Temp** — coolant temperature in the storage tank
- **Ambient Temp** — cabinet ambient temperature (drives cooling-fan and LCD-screen-heater logic)
- **LCD Temp** — temperature at the HMI itself (used to manage the screen heater in cold weather)

All three calibrate the same way. Each has a single **Zero Cal** offset, which corrects the displayed reading so that it matches a known reference temperature — an ice-water slurry at 0 °C / 32 °F.



Tank Temp probe — drain the tank to ≤20 % before removing the probe

The Tank Temp probe sits in a compression fitting on the storage tank. To place it in an ice-water slurry you must withdraw it from the fitting — if tank level is above approximately **20 %**, coolant will flow out the sensor hole.

Before calibrating the Tank Temp probe, stop the system and let the coolant cool. Draw the tank down (or drain it) to **≤20 %** and confirm the level on the Expanded Status screen before loosening the compression fitting.

15.2.1. Procedure (all three probes)

1. Place the probe being calibrated into a slurry of crushed ice and water and allow it to stabilize for at least 5 minutes.
2. Press **F2** from the home screen, enter the password, and select **Calibration → Temp** — then choose the probe.
3. Confirm the displayed temperature is stable.
4. Press **Zero Cal** to apply an offset that drives the displayed temperature to **0 °C / 32 °F**.



Tank Temp shows both °C and °F; ambient and LCD show °C only

The tank temperature display includes a Fahrenheit conversion since the rest of the manual specifies tank set-points in °F. Ambient and LCD readings remain in °C as they are used internally by the controller for fan and heater logic.

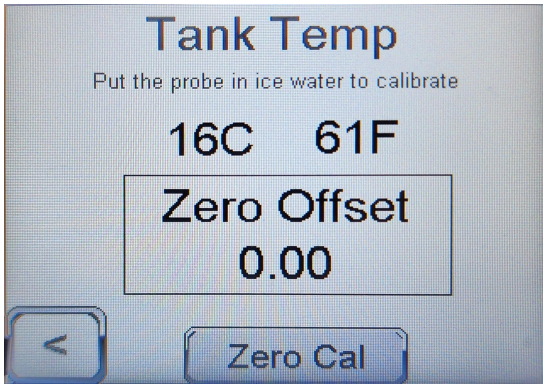


Figure 22. Tank Temp Zero Cal — currently 16 °C / 61 °F at zero offset

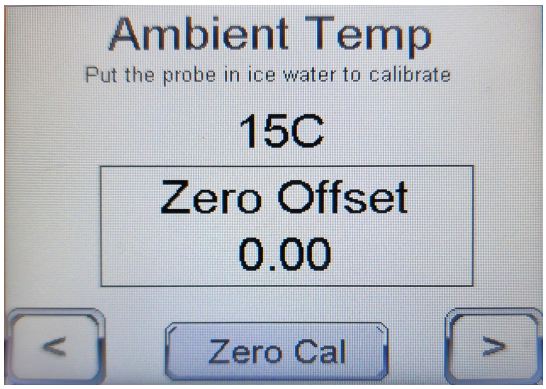


Figure 23. Ambient Temp Zero Cal

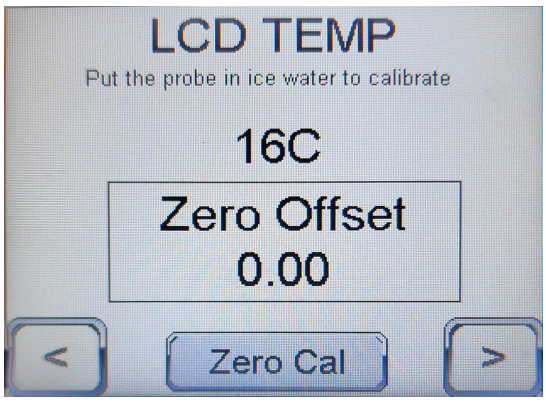


Figure 24. LCD Temp Zero Cal

15.3. Refill pressure calibration

The refill line is monitored by a 4–20 mA pressure transducer scaled 0–30 PSI. Two parameters are accessible from the **REFILL PRESSURE** screen: a zero calibration and a maximum-pressure cutoff.

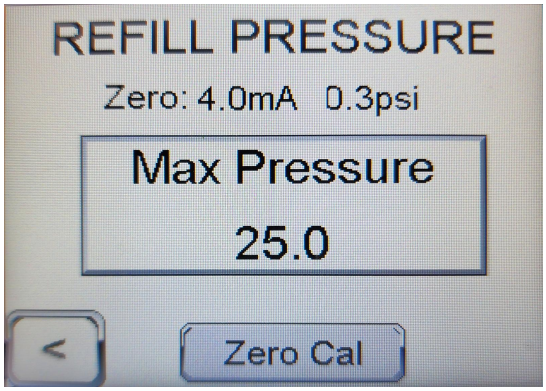


Figure 25. REFILL PRESSURE — Zero: 4.0 mA / 0.3 PSI; Max Pressure 25.0 PSI

15.3.1. Zero calibration

1. Vent the refill line so that the transducer sees atmospheric pressure (no head from the supply drum).
2. Press **F2** from the home screen, enter the password, and select **Calibration → Pressure**.
3. Confirm the displayed reading is near **4.0 mA / 0 PSI**.
4. Press **Zero Cal** to apply the offset.

15.3.2. Maximum pressure cutoff

The **Max Pressure** parameter (default **20.0 PSI**) is the threshold above which the PLC stops the refill pump and latches a **Refill Pressure Too High** fault. This protects the storage tank and refill plumbing from over-pressurization caused by, for example, a kinked overflow or a closed downstream valve during refill.



Do not raise the cutoff toward 30 PSI

The boiler is protected at 30 PSI by the relief valve. Raising the refill pressure cutoff close to or above 30 PSI defeats the protective intent of this parameter, and an over-pressurized storage tank or refill line can rupture and release hot glycol. The factory setting of **20.0 PSI** leaves a margin below the relief valve and should not be raised without engineering review.

To change the cutoff:

1. Press **F2** from the home screen, enter the password, and select **Calibration → Pressure**.
2. Tap the **Max Pressure** value to open the on-screen number pad.
3. Enter the new cutoff in PSI and confirm.
4. Check that the **Max Pressure** field shows the new value.

15.4. See also

- Status screen — confirm calibrated readings
- Fill Time Limit — companion protection to refill pressure
- Troubleshooting

Chapter 16. PLC Controls and Setpoints

The Controls menu holds the adjustable setpoints that are not part of a calibration routine — the cooling-fan and LCD-screen-heater setpoints and the Tank Heat thermostat — and the **PURGE** screen used for the air purge. This page also covers the fill time limit, which is part of the refill protection logic and is reached through the Calibration menu. Read its section before changing it.

16.1. Where each screen is

The Controls screens are a chain. Press **F2** from the home screen, enter the password, and select **Controls**: the first screen opens. Use the **next** and **previous** arrows on each screen to move along the chain.

Screen	How to reach it
Cooling Fan	**Menu** → **Controls**
LCD Screen Heat	**Menu** → **Controls** → **next**
Tank Heat	**Menu** → **Controls** → **next** twice
PURGE	**Menu** → **Controls** → **next** three times
Fill Time Limit	**Menu** → **Calibration** → **Tank** → **next** twice (after **TANK LOW % CAL** and **TANK High % CAL**)



PLC navigation at a glance

- **Home screen** — live status: Circ / Heat / Fill / Fault indicators, system state banner, tank temperature, Reset Delay countdown when applicable.
- **F1** — on the Home screen, opens the **Expanded Status** screen (live readouts, no password). On any other screen, returns to the Home screen and **clears the password**; you must re-enter it to reach the Menu again.
- **F2** — opens the password prompt. After successful entry, the **Menu** appears with four sections: Status, Calibration, Output, Controls.
- **Password entry** — press F2, tap the centre of the screen to bring up the on-screen number pad, enter `60525`, confirm.
- **Esc / back arrow** — returns to the previous screen.
- **Up / Down arrows** — scroll within a list.
- **Enter (⏎)** — confirm a selection.

16.2. Cooling fan

The PLC switches the cabinet cooling fan from the cabinet ambient temperature probe. The fan turns on when ambient temperature reaches the **High** setpoint and stays on until it falls to the **Low** setpoint. The gap between the two setpoints keeps the fan from switching on and off rapidly around a single temperature.

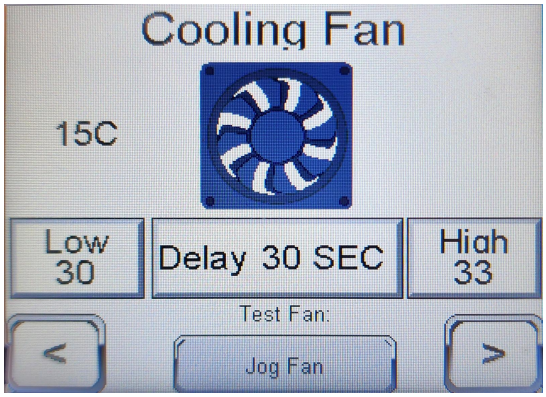


Figure 26. Cooling Fan — Low 30 °C, High 33 °C, 30 s delay, with a Jog Fan test

Field	Meaning
Low	Ambient temperature (°C) at or below which the fan turns **off**. Default **30 °C** (86 °F).
High	Ambient temperature (°C) at or above which the fan turns **on**. Default **33 °C** (91 °F).
Delay	Minimum delay between state changes (default **30 s**) — prevents short-cycling near the setpoint.
Jog Fan	Manual fan run for verification — energizes the fan output for a brief test. Use during commissioning or after maintenance.

16.2.1. Verifying the fan after maintenance

After cleaning or replacing the cooling fan, verify it before returning the unit to service:

1. Open the **Cooling Fan** screen.
2. Press **Jog Fan**.
3. Confirm the fan runs, which verifies its wiring, and that it turns in the same direction as before.

16.3. LCD screen heater

Deprecated

> The LCD screen heater is deprecated. Current units are built without it. On a unit without the heater, the **LCD Screen Heat** screen and the **LCD Heater** line on the Status screen are still shown but have no effect.

The HMI display is heated in cold weather to keep the LCD readable and within its operating temperature. The PLC switches the heater from the temperature sensor at the HMI screen: the heater turns on at the **Low** setpoint and off at the **High** setpoint, with a delay between state changes.

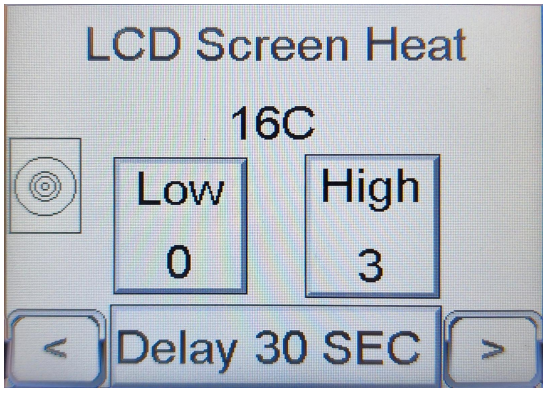


Figure 27. LCD Screen Heat — Low 0 °C, High 3 °C, 30 s delay

Field	Meaning
Low	LCD temperature (°C) at or below which the heater is **on**. Default **0 °C** (32 °F).
High	LCD temperature (°C) at or above which the heater is **off**. Default **3 °C** (37 °F).
Delay	Minimum delay between state changes (default **30 s**). The PLC accepts up to **60 s**.

16.4. Tank Heat

The **Tank Heat** screen sets the PLC thermostat that holds the boiler off once the storage tank is above its target temperature. The screen shows the live tank temperature.

Field	Range	Default	Meaning
Target	80–195 °F	**195 °F**	Tank temperature above which the PLC holds the boiler off.
Hysteresis	1–50 °F	**10 °F**	How far the tank must cool below **Target** before the boiler is allowed to run again.

Field	Range	Default	Meaning
Delay	Up to 60 s	**1 s**	How long the tank must stay below **Target** minus **Hysteresis** before the boiler is allowed to run again.

While the thermostat is holding the boiler off, the banner reads `Enabled - Target Reached`. How the thermostat works with the boiler's own controller, and how to change a setting, are described in Temperature Control — Tank Heat thermostat.

16.5. PURGE

The **PURGE** screen runs the circulation pump by itself, with the boiler held off, to push entrapped air out of the circulation loop and into the vented storage tank. Use it at first startup and after every drain and refill.

On the screen	Meaning
Start Circ Pump	Starts the circulation pump. Works only when the unit is stopped and no fault or reset delay is active.
Stop Circ Pump	Stops the circulation pump.
Pump Running	Shows whether the circulation pump output is on.
Status line	The current system state — `Purging` while the pump is running from this screen, or `Refilling` while the refill pump is also running.

While the screen is displayed, the **Start** button is ignored and the boiler cannot come on. The pump stops when you leave the screen, including when the password times out 5 minutes after it was entered. The full procedure is in Startup & First Heat Cycle.

16.6. Fill time limit

The fill time limit caps how long the refill pump may run continuously before the PLC declares a `REFILL TIMER EXPIRED` fault, latches the strobe, and locks out the system. This protects the unit from running the refill pump indefinitely on an empty supply drum, a kinked suction line, a stuck float, or a leak.

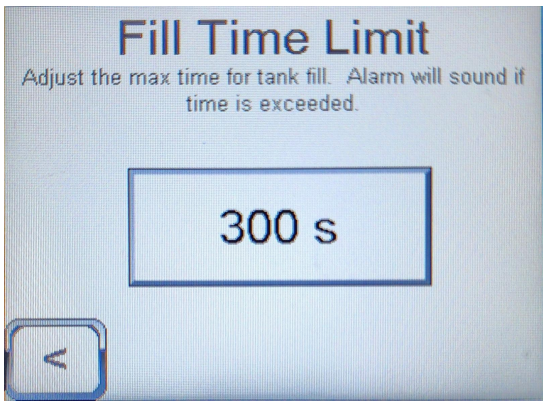


Figure 28. Fill Time Limit — default 300 seconds

Field	Range	Default	Meaning
Time limit	60–500 s	**300 s** (5 minutes)	Maximum continuous refill-pump run time. If exceeded, the PLC stops the refill pump, energizes the strobe, and locks out the system.



Do not raise the fill time limit to work around recurring timeouts

A longer limit lets the gear-type positive-displacement refill pump run dry for longer before the fault trips, and it hides whatever is slowing the refill. The pump's dry-running tolerance is **approximately 20 minutes cumulative before pump damage**.

If refill cycles are regularly approaching the 300 s limit, check for:

- A nearly-empty supply drum (replenish)
- A kinked or partially blocked suction line
- A clogged suction filter (the side-mounted refill-inlet strainer)
- A stuck or sluggish refill pump
- A pressure-side restriction triggering the pressure cutoff before fill completes

16.6.1. If the fill time limit trips

The PLC banner reads `REFILL TIMER EXPIRED`. Correct the cause, press **Reset**, wait for the banner to settle at `OFF- Ready`, and press **Start**. Step-by-step instructions are in Troubleshooting — Resolution — REFILL TIMER EXPIRED.

16.7. See also

- PLC Controller Overview — strobe and indicator legend

- Refill Pressure Calibration — companion protection
- Refill System Operation
- Temperature Control
- Troubleshooting

Chapter 17. PLC Output Tests

The Output menu lets a service technician test the PLC's discrete and analog outputs without putting the system into an operational state. Use these tests during commissioning, after wiring changes, or when verifying field-side equipment such as the strobe, the indicator lamp, or a connected SCADA / data-acquisition input.

PLC navigation at a glance

- **Home screen** — live status: Circ / Heat / Fill / Fault indicators, system state banner, tank temperature, Reset Delay countdown when applicable.
- **F1** — on the Home screen, opens the **Expanded Status** screen (live readouts, no password). On any other screen, returns to the Home screen and **clears the password**; you must re-enter it to reach the Menu again.
- **F2** — opens the password prompt. After successful entry, the **Menu** appears with four sections: Status, Calibration, Output, Controls.
- **Password entry** — press F2, tap the centre of the screen to bring up the on-screen number pad, enter `60525`, confirm.
- **Esc / back arrow** — returns to the previous screen.
- **Up / Down arrows** — scroll within a list.
- **Enter (⏎)** — confirm a selection.

System should be at standby for output tests

The output tests drive the physical outputs directly, bypassing normal control logic. Stop the system before testing, or be prepared for the unexpected behavior of energizing an output during operation.

17.1. Alarm Strobe Output

Drives the strobe output to verify wiring, the strobe itself, and the cable run from the PLC to the manifold control panel.

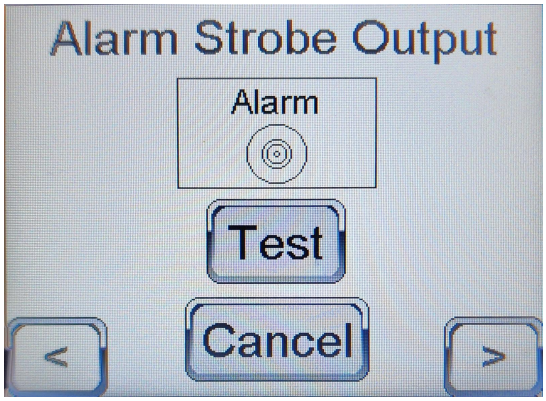


Figure 29. Alarm Strobe Output — Test / Cancel

1. Press **F2** from the home screen, enter the password, and select **Output → Alarm Strobe**.
2. Press **Test**. The strobe energizes for the duration the screen is held active.
3. Press **Cancel** to drop the output.

17.2. Indicator Output

Drives the indicator lamp output. Use to verify the lamp itself, the cable, or the placard alignment after panel work.

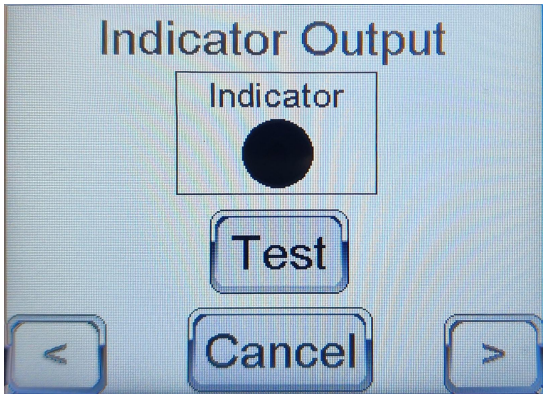


Figure 30. Indicator Output — Test / Cancel

1. Press **F2** from the home screen, enter the password, and select **Output → Indicator**.
2. Press **Test**. The indicator energizes for the duration the screen is held active.
3. Press **Cancel** to drop the output.

17.3. Temperature Analog Output

The PLC provides an analog output that mirrors tank temperature for connection to a remote monitoring or data-acquisition system. Output range is **0–10 V representing 0–200 °F**.

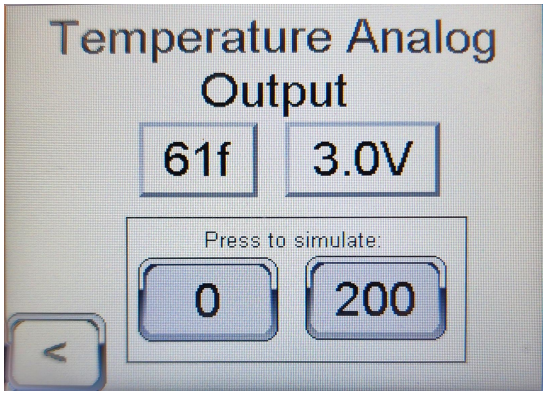


Figure 31. Temperature Analog Output — current value at top, simulate buttons below

Element	Meaning
Top reading (°F)	Current tank temperature in degrees Fahrenheit.
Top reading (V)	Current analog output voltage corresponding to that temperature.
`Press to simulate: 0`	Drives the analog output to **0 V** (= 0 °F) for verification on the receiving side.
`Press to simulate: 200`	Drives the analog output to **10 V** (= 200 °F) for verification on the receiving side.

Two-point loop verification

With a SCADA / DAQ system on the receiving end, press **0** and confirm the receiver reports near 0 °F (or 0 V), then press **200** and confirm the receiver reports near 200 °F (or 10 V). This proves the analog loop end-to-end without changing tank conditions.

Simulation drives the live output

Pressing **0** or **200** drives the actual analog output. Any monitoring system or alarm tied to that signal will see the simulated value. Coordinate with whoever is watching the data feed before simulating.

17.4. See also

- PLC Controller Overview
- Calibration procedures — for verifying probe inputs
- Remote Output Box — physical termination of the strobe, indicator, and temperature outputs

Chapter 18. PLC Data Log

The PLC keeps a data log on a micro SD card. The log is the record of what the unit was doing at any past moment, and it is the first thing Thermex Systems support asks for when diagnosing an intermittent problem.

18.1. What is recorded

The card holds two logs. Both are plain text files with comma-separated values (CSV), which open in any spreadsheet program.

Log	A row is written…
Main	Each time the system state changes, with the state text and the outputs and readings at that moment. Also every 30 minutes as a heartbeat (state text `Timed Log`), and at power-up (`Power Cycle`).
Param	With the current settings and calibration values: at power-up, when the password is entered, when the password times out (so that any change made in the menus is captured), and on the first day of each month.

18.2. Retrieving the log

The card sits in the `MICRO SD` port on the face of the HMI panel, above the PLC HMI:

1. Gently push the card in. It releases and springs out.
2. Remove the card and read it in a computer with a card reader.
3. Copy the log files to the computer. Do not edit or delete the files on the card.
4. Put the card back in the port and push it in gently until it latches.

The PLC cannot record while the card is out, so return it promptly.



Figure 32. The `MICRO SD` port is at the top of the HMI panel

When you send a log to Thermex Systems, send both the Main and the Param files, and give the unit serial number.

18.3. Reading the Main log

Column	Meaning
`Date`, `Time`	When the row was written, from the PLC clock.
`ascii_status`	The system state — the same text as the banner on the Home screen.
`CircPump_Out`	Circulation pump output: `1` on, `0` off.
`BOILER_OUT`	Boiler enable output: `1` on, `0` off.
`REFILL_OUT`	Refill pump output: `1` on, `0` off.
`STROBE_OUT`	Alarm strobe output: `1` on, `0` off.

Column	Meaning
`Fan_Out`	Cabinet cooling fan output: `1` on, `0` off.
`ptc_out`	LCD screen heater output: `1` on, `0` off.
`TankTempF`	Tank temperature, °F.
`AmbTemp`	Cabinet ambient temperature, °C.
`lcd_temp`	Temperature at the HMI screen, °C.
`LWCO_IN`	Low-water cut-off sensor: `1` normal, `0` low.
`tank_fill_pct`	Tank level, %.

State text longer than the column allows is cut short in the log — for example `REFILL TIMER EXPIRED`. The full list of states is in Status — System states.

18.4. Reading the Param log

Column names are cut to 16 characters in the file. The columns an operator can relate to a setting are listed below; the remaining columns are calibration values for use by Thermex Systems.

Column (as it appears)	Setting
`refill_timer_amo`	Fill time limit, seconds. See Fill Time Limit.
`refill_pressure_`	Refill **Max Pressure**, in tenths of a PSI: `200` means 20.0 PSI. See Refill pressure calibration.
`fan_low_temp`, `fan_high_temp`, `fan_high_delay`	Cooling fan setpoints (°C) and delay (s). See Cooling fan.
`lcd_low_temp`, `lcd_high_temp`, `ptc_on_delay`	LCD screen heater setpoints (°C) and delay (s). See LCD screen heater.
`TankTempTargetF`, `TankTempHysteres`, `TankTempCallForH`	Tank Heat target (°F), hysteresis (°F) and delay (s). See Tank Heat thermostat.
`unitSN`, `PLC_ID`	Unit serial number and controller identifier.

Column (as it appears)	Setting
`softwareVersion`	PLC software version — the same text as the **Version** line on the Status screen.

18.5. See also

- PLC Status Screen
- PLC Controls and Setpoints
- Troubleshooting

Chapter 19. Periodic Maintenance

A consistent maintenance schedule extends equipment life and ensures safe operation. Maintenance tasks are grouped by frequency below.

19.1. Maintenance schedule

Frequency	Task
Weekly	Check glycol level in supply drum; replenish before empty
Monthly	Clean manifold wye strainer screens and refill suction filter screen
Twice yearly	Drain system, flush with water, refill with glycol
As required	Replace circulation pump mechanical seal (typically years between replacements)

19.2. Weekly — drum level check

- Visually verify adequate glycol volume in the 55-gallon supply drum
- Replenish supply before drum becomes empty
- Record inspection in maintenance log

19.3. Monthly — strainer cleaning

Clean strainer screens on both the distribution manifold (wye strainers) and the refill suction filter.



Shut down before servicing strainers

Stop the system and allow piping to cool before removing strainer components. Manifold piping operates at up to **190°F (88°C)**.

1. Press the **Stop button**.
2. Allow the manifold to cool.
3. Close the upstream ball valve at each strainer.
4. Remove the strainer blow-down plug and screen.
5. Clean the screen with clean water and a soft brush.
6. Reinstall the screen and blow-down plug.

7. Reopen ball valves.
8. Repeat for the refill suction filter.

19.4. Twice yearly — water flush

A twice-annual water flush removes sediment and degraded glycol residues from the system.

19.4.1. Procedure

1. **Press Stop** and let the glycol cool before opening any drain.
2. **Drain the system** completely of glycol.
3. **Refill with water only.**
4. **Purge air** using the same procedure as initial startup — see Startup & First Heat Cycle.
5. **Operate in bypass mode** (no tankers connected) for a minimum of **8 hours**.
6. **Drain the system** again.
7. **Refill with fresh glycol.**
8. **Purge air** and return to normal operation.



Used glycol disposal

Drained glycol and wash water must be disposed of in accordance with local environmental regulations.

19.5. As required — circulation pump seal replacement

Replace the circulation pump mechanical seal if:

- Pump becomes noisy during operation, **or**
- System pressure fails to exceed **7 PSI** during bypass operation

The normal expected service life is **years rather than months**. Frequent seal failure indicates an underlying issue that should be investigated.



Parts information

Refer to the circulation pump parts list (available from Thermex Systems) for part numbers and replacement procedures. Contact 1-800-865-1532 for parts orders.

Chapter 20. Troubleshooting

Common issues, diagnostic steps, and resolutions for the TankerTherm 123.



Safety first

If any fault involves electrical components, leaking glycol, or smoke/unusual odors, **disconnect power at the main disconnect before investigating**. Contact Thermex Systems at 1-800-865-1532 if you are unsure.

20.1. System lockout and warning strobe active

The PLC banner identifies the specific lockout cause. Read the banner first, then apply the matching resolution below.

PLC banner	Most likely cause
`REFILL TIMER EXPIRED`	Refill ran longer than the **Fill Time Limit** — usually drum empty, suction blocked, or refill pump failure
`Refill Pressure Too High`	Refill pressure exceeded the configured maximum — usually a kinked overflow, closed downstream valve, or transducer issue
`REFILL SENSOR FAULT`	The refill pressure sensor signal is missing or out of range — usually a broken wire, an unplugged connector, or a failed sensor
`Operator ESTOP`	Operator E-Stop button was pressed. The banner stays until **Reset**, even after the button is released
`ESTOP - LWCO`	LWCO sensor has tripped — tank critically low. The banner stays until **Reset**, even after the tank has refilled

20.1.1. Resolution — `REFILL TIMER EXPIRED`

1. Verify glycol supply in the 55-gallon supply drum — replenish if empty.
2. Confirm the suction tube/hose is fully submerged and not kinked.
3. Inspect the **suction filter** (also referred to as the side-mounted refill-inlet strainer on the unit) for blockage — see Maintenance.
4. Press the external **Reset** button on the manifold control panel.

5. Wait for `Resetting- Wait` to clear; the strobe turns off and the banner settles at `OFF- Ready`.
6. Press **Start** to resume heating.

If the lockout recurs without the drum being empty, check:

- Refill pump for mechanical failure or loss of prime
- Fill Time Limit setting (default 300 s — investigate before raising)

20.1.2. Resolution — `Refill Pressure Too High`

1. Inspect the refill line, overflow, and storage-tank vent for kinks or blockages.
2. Verify any downstream valves on the refill line are open.
3. Check that the storage-tank overflow drains freely back to the supply drum.
4. Press **Reset**. Wait for `Resetting- Wait` to clear and the banner to settle at `OFF- Ready`.
5. Press **Start** to resume heating.

If the lockout recurs without an obvious mechanical cause, the pressure transducer may need re-zero or the **Max Pressure** setpoint may be too low — see PLC Calibration — Refill Pressure.

20.1.3. Resolution — `Operator ESTOP`

1. Twist or pull the operator E-Stop button on the manifold panel to release it.
2. Press **Reset**. Wait for `Resetting- Wait` to clear and the banner to settle at `OFF- Ready`.
3. Press **Start** to resume heating.

20.1.4. Resolution — `ESTOP - LWCO`

1. Replenish coolant in the storage tank (from the supply drum).
2. Confirm tank level rises on the Status screen; verify LWCO has cleared.
3. Press **Reset**. Wait for `Resetting- Wait` to clear and the banner to settle at `OFF- Ready`.
4. Press **Start** to resume heating.
5. Follow up with a tank-level calibration check — LWCO and the analog level sensor should agree, and a disagreement here often indicates the level sensor needs recalibration. See Tank Level Calibration.

20.1.5. Resolution — `REFILL SENSOR FAULT`

The PLC reads refill-line pressure from a 4–20 mA sensor. If the signal stays below 3.5 mA or above 21.0 mA for half a second, the PLC treats the sensor as faulty, stops the refill pump, locks out the unit and latches the

strobe. A reading that low or that high cannot come from real pressure; it means the PLC can no longer see the refill pressure.



Qualified electrician required

All electrical connections must be performed by a licensed electrician in compliance with local electrical codes. Disconnect and lock out the power source before beginning any electrical work.

1. Open the main disconnect, lock it out and tag it out, and verify zero voltage — see Safety.
2. Inspect the refill pressure sensor's connector and cable for a loose plug, a broken wire or damage.
3. Restore power. Press **Reset**. Wait for `Resetting- Wait` to clear and the banner to settle at `OFF-Ready`.
4. Press **Start** to resume heating.

If the banner returns as soon as the reset delay ends, the sensor or its wiring has failed. Contact Thermex Systems — see Contact Support.

20.2. System will not reach 190°F

20.2.1. Diagnostic steps

1. **Check glycol level** — low level may trigger LWCO cutoff.
2. **Check ambient temperature** — extreme cold extends warmup time.
3. **Verify no air in system** — repeat air-purge procedure if startup was recent.
4. **Check connected load** — four tankers at startup may extend warmup.
5. **Verify stage operation** on the boiler controller display.

If all stages are firing and the system still cannot reach target:

- Inspect for glycol leaks around manifold and piping
- Verify all three electrical phases are present and balanced
- Check that the **Tank Heat** target has not been set lower than the temperature you expect (see Tank Heat thermostat)
- Check that the boiler controller's target temperature offset is not set negative (see Temperature Control)

20.3. Pressure fails to exceed 7 PSI during bypass

This indicates circulation pump wear. See Maintenance — Circulation Pump Seal Replacement.

20.4. Unit will not start heating when Start is pressed

Check the PLC banner and the screen on display:

1. **The PURGE screen is displayed.** The **Start** button is ignored while this screen is open. Press **F1** to return to the Home screen, then press **Start**.
2. **The banner reads `Enabled - Target Reached`.** The unit has started; the storage tank is above the **Tank Heat** target, so the PLC is holding the boiler off. Heating resumes by itself when the tank cools — see Tank Heat thermostat.
3. **The banner reads `Refill Disabled`.** See the next section.
4. **The banner shows a fault and the strobe is on.** See System lockout and warning strobe active.

20.5. Unit will not start — banner reads `Refill Disabled`

The Refill Pump Switch is `OFF`. The indicator lamp shows a single blink & pause.

1. Turn the **Refill Pump Switch** (on the HMI panel) to `ON`.
2. Confirm the banner changes from `Refill Disabled`.
3. Press **Start**.

See Refill Pump Switch.

20.6. Pump churning/gurgling noises continue

Air has not been fully purged. Return to Startup & First Heat Cycle and repeat the air-purge procedure.

20.7. I cannot tell how full the storage tank is

The cabinet is enclosed and has no external sight gauge — tank level is reported on the PLC HMI.

1. From the **Home** screen, press **F1** (no password needed).
2. Scroll to **Tank Level** — the value is shown as a percentage.

If the percentage seems wrong (e.g. you just topped up the tank but it does not read near 100 %), the level sensor calibration has drifted. Recalibrate using Tank Level Calibration — the high-point procedure uses the tank's overflow fitting as the physical "full" reference.

20.8. PLC home screen says `Precaution - Filling`

This is not a fault. The PLC has detected that tank level is very low (~3 %) without LWCO tripping, has paused circulation and heat to avoid dry running, and is allowing the refill pump to catch up. Operation resumes automatically when the tank reaches ~95 %.

If the condition persists for more than several minutes, refill is failing — check the supply drum and refer to Resolution — `REFILL TIMER EXPIRED` above.

20.9. Cooling fan runs continuously or screen heater won't cycle off

The PLC controls the cooling fan and the LCD screen heater independently, each from its own sensor. Default setpoints:

Function	Engage	Disengage
Cooling fan	91 °F (33 °C) ambient	86 °F (30 °C) ambient
Screen heater	32 °F (0 °C) at LCD	37 °F (3 °C) at LCD

If behaviour deviates from these setpoints:

- Verify the affected sensor reads correctly on the Status screen (the **Ambient** and **LCD** fields). An obstructed sensor or a stale calibration is the most common cause.
- Verify the setpoints have not been changed on PLC Controls — **Cooling Fan** or **LCD Screen Heat**.
- If the sensor reading and setpoints look correct but the output behaviour is still wrong, contact Thermex Systems for controller diagnostics.

20.10. Contact support

If troubleshooting does not resolve the issue, contact Thermex Systems.

20.11. Contact Thermex Systems

Phone	1-800-865-1532
Website	https://www.thermex-systems.com
Address	2138 Carpenter Street, Unit 140, Abbotsford BC V2T 6B4

Have your unit serial number and purchase date available for warranty claims.

Chapter 21. Thermex Limited Warranty

TankerTherm heaters are warrantied against defects in materials and workmanship for **12 months from date of purchase**.

21.1. Scope of coverage

This warranty covers the repair or replacement of defective parts only. Thermex Systems will not be held liable for other costs including, but not limited to:

- Shipping and transport
- Removal or installation
- Analysis or contracting
- Consequential damages or equipment failure downtime

21.2. Exclusions

This warranty does **not** cover damage resulting from:

- Misuse
- Accident
- Tampering
- Neglect
- Alteration
- Force Majeure

21.3. Exclusive remedy

The obligation to repair or replace defective parts is the **exclusive remedy** for breach of this warranty. Thermex Systems will not be held liable for any other damages or claims, including failure of equipment or consequential damages.

This warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability, and of all other obligations or liabilities on our part.

21.4. Making a warranty claim



Warranty Request Number required

> A **Warranty Request Number** must be obtained from the factory before a claim can be submitted.

21.4.1. Claim procedure

1. Contact Thermex Systems at 1-800-865-1532 to request a Warranty Request Number.
2. Have the following information ready:
    - Unit serial number
    - Date of purchase
    - Description of the defect
    - Photos if applicable
3. Ship the affected component(s) **prepaid** to Thermex Systems.
4. Upon receipt and evaluation, the component will be repaired or replaced at Thermex Systems's discretion.



Shipping terms

All warranty parts must be shipped **prepaid**. Collect shipments will be refused.

21.5. Contact Thermex Systems

Phone	1-800-865-1532
Website	https://www.thermex-systems.com
Address	2138 Carpenter Street, Unit 140, Abbotsford BC V2T 6B4

Chapter 22. What Changed Since Software v2.1

This page is for anyone who knows a unit on PLC software v2.1 and is now working with v2.2 — for example after a software update. It lists what is different. The rest of this manual describes v2.2 as it is.

To check which software a unit runs, read the **Version** line on the Status screen — see Which manual matches my unit?.

22.1. Added

What	What it means for you
PURGE screen	The air purge is now run from the PLC. You no longer open the boiler cover or disconnect the boiler control wire. See Startup & First Heat Cycle.
Tank Heat thermostat	A new screen sets a tank-temperature **Target** (80–195 °F). Above the target the PLC holds the boiler off and the banner reads `Enabled - Target Reached`. See Temperature Control.
Refill pressure sensor fault	A broken wire, an unplugged connector or a failed refill pressure sensor now stops the unit with the banner `REFILL SENSOR FAULT` and the alarm strobe. Before, it went unnoticed. See Troubleshooting.
Three new system states	`Purging`, `Enabled - Target Reached` and `REFILL SENSOR FAULT`. See System states.

22.2. Changed

What	What it means for you
E-Stop cause stays on the banner	After an E-Stop or a low-water cut-off, the banner keeps showing `Operator ESTOP` or `ESTOP - LWCO` until you press **Reset**, even if the button has been released or the tank has refilled. Before, pressing **Start** or **Stop** replaced the text.
Very low tank level must persist for half a second	The `Precaution - Filling` pause now starts only when the tank level has been below about 3 % for 0.5 s. A brief slosh no longer triggers it.
Controls menu order	**Controls** now leads to **Cooling Fan**, **LCD Screen Heat**, **Tank Heat**, then **PURGE**. See Where each screen is.

What	What it means for you
Refill **Max Pressure** factory setting	20.0 PSI. See Refill pressure calibration.

22.3. Removed

What	What it means for you
Auxiliary circulation pump	The optional auxiliary circulation pump is no longer supported. Its screen, its three lines on the Status screen and its output are gone.

22.4. In the data log

The parameter log gains three columns for the Tank Heat settings (target, hysteresis and delay). The auxiliary pump columns are removed.

Chapter 23. TankerTherm 123 Release Notes

This manual carries two labels: **Software v2.2 · Manual Rev 1**.

- The **software version** is the PLC program this manual describes. It matches the **Version** line on the PLC Status screen. To check that you are reading the right manual, see Which manual matches my unit?.
- The **manual revision** counts every published change to this manual, including corrections and added photos that have nothing to do with the PLC program. It is a whole number and is separate from the software version.

23.1. Software builds

The program builds covered by this manual.

Build	Status screen shows	Date	What changed
v2.2.1	`v2.2.1`	3 November 2026	First release of Software v2.2. Adds the PURGE screen, the Tank Heat thermostat and the refill pressure sensor fault; removes the auxiliary circulation pump.

23.2. Revisions to this manual

Newest first. This manual is at **Rev 1**, published 19 November 2026.

23.2.1. Rev 1 — 19 November 2026

First issue of the manual for PLC software v2.2. It is the Software v2.1 manual with the pages that differ rewritten for v2.2.

- What Changed Since Software v2.1 — the differences in one place.
- Startup & First Heat Cycle — the air purge is run from the PURGE screen. No boiler cover removal and no wiring work.
- Temperature Control — the Tank Heat thermostat.
- PLC Controls and Setpoints — the path to every screen, and the range the PLC accepts for each setting.
- Troubleshooting — the `REFILL SENSOR FAULT` lockout.

23.3. Earlier versions

Versions **1.x** (pre-PLC button-and-switch units) are documented only as Microsoft Word manuals shipped with each unit at the time of purchase. They are not maintained on this site.

Appendix A: Contact and support

Chapter 24. Contact Support

24.1. Contact Thermex Systems

Phone	1-800-865-1532
Website	https://www.thermex-systems.com
Address	2138 Carpenter Street, Unit 140, Abbotsford BC V2T 6B4

24.2. Before calling

To help our support team resolve your issue quickly, have the following information ready:

- Unit model (e.g., TankerTherm 123)
- Unit serial number
- Date of purchase
- Description of the issue
- Any error conditions displayed on the boiler controller
- The PLC home-screen banner text, exactly as shown
- The PLC software version (last line of the PLC Status screen)
- Status of the warning strobe (if applicable)

Support hours: Monday–Friday, 7:00 AM – 5:00 PM Pacific

24.3. Service requests

For on-site service requests, please note:

- Service calls are scheduled based on technician availability
- Emergency service may be available — inquire when calling
- Out-of-warranty service is billable at current service rates

24.4. Warranty claims

For warranty-related inquiries, see the Warranty page for the claim procedure. A **Warranty Request Number** must be obtained from the factory before a claim can be submitted.