Preface

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This manual covers the use and maintenance of MVE Cryogenic Freezers and the TEC 3000 control system. READ BEFORE USING THIS EQUIPMENT. It is intended for use by trained personnel only. All service and maintenance should be performed by an authorized MVE Distributor.

NOTE: All MVE models are Class I per IEC 61140, as the AC supply requires a protective earth ground. These devices are externally powered and intended for continuous operation. The general purpose cryogenic storage models are intended for professional use in research while the medical device versions are intended to be used in situations that directly support medical applications. They are not suitable for use with flammable anesthetics. These devices have been tested to, and are in compliance with, IEC 60601-1-2. The medical device versions of MVE models are Class IIa medical devices certified by a Notified Body and conform to Medical Device Directive 93/42/EEC.
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3. Safety

READ BEFORE OPERATING THIS EQUIPMENT

General

Liquid nitrogen (LN2) is used in MVE Cryogenic Freezers as a refrigerant. Understanding and following certain safety precautions is extremely important when handling LN2 and cryogenic containers (Dewars).

Liquid Nitrogen Properties

Nitrogen is a colorless, odorless, tasteless gas. Gaseous nitrogen makes up about 78% of the Earth’s atmosphere by volume. Once collected and isolated, nitrogen can be liquefied.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiling Point @ 1 atm</td>
<td>-195.8°C , -320.3°F , 77.4 K</td>
</tr>
<tr>
<td>Thermal Conductivity (Gas)</td>
<td>25.83 mW/(m∙K)</td>
</tr>
<tr>
<td>Heat of Vaporization (Liquid)</td>
<td>198.38 kJ/kg</td>
</tr>
<tr>
<td>Density @ 1 atm (Liquid)</td>
<td>1.782 lbs/L , 807.4 g/L , 808.6 kg/m³</td>
</tr>
</tbody>
</table>

Liquid Nitrogen Safety

Transferring LN2 and operating the TEC 3000 should be done in accordance with the manufacturer/supplier instructions. It is important that all safety precautions written on the storage Dewar and recommended by the manufacturer be followed.

![WARNING]

- Do not modify this equipment without authorization of the manufacturer.
- Nitrogen is a potential asphyxiant and can cause rapid suffocation without warning. Store and use in area with adequate ventilation. DO NOT vent container in confined spaces. DO NOT enter confined spaces where gas may be present unless area has been well ventilated. If inhaled, move to fresh air. If breathing is difficult, supplemental oxygen may be required. If not breathing, give artificial respiration. SEEK MEDICAL ATTENTION IMMEDIATELY!
- Liquid nitrogen can cause severe frostbite to the eyes or skin. DO NOT touch frosted pipes or valves. Cold nitrogen vapor can damage the eyes or skin. In case of frostbite, consult a physician at once. If a physician is not readily available, warm the affected area with water that is near body temperature.
- Never place LN2 in a sealed container without a pressure relief device. The expansion ratio of liquid nitrogen to gaseous nitrogen is approximately 1 to 700 (i.e. 1 cubic foot of LN2 becomes 700 cubic feet of gas when evaporated)

The two most important safety aspects to consider when handling LN2 are adequate ventilation and eye and skin protection. Although nitrogen gas is non-toxic, it is dangerous in that the gas will displace oxygen in a normal breathing atmosphere. Liquid products are of even greater threat since a small amount of liquid evaporates into a large amount of gas. Therefore, it is imperative that cryogenic supply and storage Dewars be stored and operated in well-ventilated areas. Persons transferring LN2 should make every effort to protect the eyes and skin from accidental contact with liquid or cold vapor. Chart MVE recommends the following protective clothing and accessories when transferring LN2 or handling hoses, valves, and plumbing components:
Recommended protective clothing

- Cryogenic gloves (loose fitting)
- Full-face shield or chemical splash goggles
- Cryogenic apron
- Long sleeve shirt and cuff less pants
- Closed toe shoes (no sandals)

Equipment Usage

Cryogenic containers must be operated in accordance with the manufacturer/supplier instructions. Safety instructions will also be posted on the side of each Dewar. Cryogenic Dewars must be kept in a well-ventilated area protected from weather and away from heat sources. In applications that use a modular liquid cylinder as a source of LN2, the supply will need to be replenished at regular intervals to ensure proper operation of the freezer. When exchanging liquid cylinders, follow the below procedure:

1. Allow all plumbing components to warm to room temperature before attempting to change supplies.
2. Close all valves associated with the liquid supply cylinder.
3. Relieve pressure in the plumbing assembly by initiating a brief fill by either pressing “Start Fill” or using the manual fill button.
4. Loosen the plumbing connection for the transfer hose at the liquid cylinder.
5. Remove empty liquid cylinder and replace with full liquid cylinder pressurized to 22 - 35 psig (1.52 - 2.41 bar).
6. Attach the transfer hose to the plumbing connection on the liquid cylinder. Ensure that the hose is connected to the connection labeled “LIQUID”.
7. Tighten the transfer hose plumbing connection at the liquid cylinder.
8. Open the liquid supply valve on the liquid cylinder.
9. Inspect plumbing for audible and visual leaks. Repair if necessary.
10. Manually initiate a fill to verify proper operation.

Recommended First Aid

Every site that stores and uses LN2 should have an appropriate Material Safety Data Sheet (MSDS) present. The MSDS may be obtained from the manufacturer/distributor. The MSDS will specify the symptoms of overexposure and first aid to be used. Here is a typical summary:

If symptoms of asphyxia such as headache, drowsiness, dizziness, excitation, excess salivation, vomiting, or unconsciousness are observed, remove to fresh air. If breathing has stopped, give artificial respiration. **CALL A PHYSICIAN IMMEDIATELY.** If breathing is difficult, supplemental oxygen maybe required. If exposure to cryogenic liquids or cold vapor occurs, restore tissue to normal, body temperature (37°C) as rapidly as possible, and then protect the injured tissue from further damage and infection.

Rapid warming of the affected areas is best achieved by bathing it in warm water. The temperature of the water used should not exceed 40°C. Under no circumstances should the frozen part be rubbed either before or after warming. If the eyes are involved, flush them thoroughly with warm water for at least 15 minutes. In case of massive exposure, remove clothing while showering with warm water. The patient should not drink alcohol or smoke. **CALL A PHYSICIAN IMMEDIATELY.**
4. Certifications and Listings

All fully automatic Chart MVE cryogenic freezer systems equipped with TEC 3000 controllers are UL / C-UL listed and CE marked to the Low Voltage Directive (LVD). Specially designated freezer models are also CE marked to the Medical Device Directive (MDD). The LVD is a European Union directive regulating the construction and operation of electrical equipment that is not considered a medical device. The MDD is a European Union directive regulating medical device construction and operation. These listings and certifications encompass the entire freezer system, and not just the electronic controller.

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Chart MVE brand manufactured liquid nitrogen freezers covered in this manual are non-hazardous, open mouth vacuum insulated dewars. They are constructed of stainless steel and aluminum and specifically designed to hold liquid nitrogen. They are not subject to any pressure vessel codes as they are open to atmospheric pressure.

MVE liquid nitrogen containers are shipped empty without liquid nitrogen or any hazardous material from our factory. An MSDS is not available for the final formed and welded assembly. An MSDS on the stainless steel or aluminum alloys used is available but is not specific for the complete manufactured vessel.
5. Product Information

This section will give an overview of Chart MVE cryogenic freezers and components.

Chart MVE offers a wide range of LN2 freezers with TEC 3000 controllers that can accommodate a variety of inventory systems designed to meet all of your cryogenic storage needs. Each freezer is a hand-made, double-walled, vacuum insulated stainless steel Dewar designed to maintain temperature with minimal LN2 evaporation.

5.1. MVE Freezer Models

There are several series, or groups, of freezers, each of which offer specialized features and functionality. Each freezer has a descriptive name from which the highlighted features and performance specifications can be determined.

MVE (Series)(Capacity)(Turn-tray?)(Temp?)(Cabinet?)(Full Auto?)(Gas Bypass?)(Battery Backup?)

<table>
<thead>
<tr>
<th>Series</th>
<th>MVE Freezer Series (i.e. 800, 1500, 1800)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>Approximate 1.2 or 2.0 mL vial capacity in thousands</td>
</tr>
<tr>
<td>Turn-tray</td>
<td>Shape of turn-tray dividers, HE and HEco series only; P = pie-shaped, R = rectangular</td>
</tr>
<tr>
<td>Temp</td>
<td>“Top box” temperature rating, if applicable; -150°C or -190°C</td>
</tr>
<tr>
<td>Cabinet</td>
<td>C = cabinet model, if applicable</td>
</tr>
<tr>
<td>Full Auto</td>
<td>AF = Automatic Fill</td>
</tr>
<tr>
<td>Gas Bypass</td>
<td>GB = Hot Gas Bypass, if applicable</td>
</tr>
<tr>
<td>Battery Backup</td>
<td>BB = Battery Backup*</td>
</tr>
<tr>
<td>Medical Device Directive</td>
<td>MDD = European Union directive regulating medical device construction and operation.</td>
</tr>
</tbody>
</table>

*Battery Backup is standard ONLY for Medical Device Directive freezers.

Example: MVE 1536P-190F-GB-BB-MDD

MVE 1500 Series freezer with capacity for approximately 36,000 vials, pie-shaped turn-tray dividers, -190°C temperature rating, equipped with a TEC 3000, Hot Gas Bypass, and Battery Backup.

The Battery Backup can be added as an optional accessory for all other models.

Example: MVE 1536P-190AF-GB

MVE 1500 Series freezer with capacity for approximately 36,000 vials, pie-shaped turn-tray dividers, -190°C temperature rating, equipped with a TEC 3000, Hot Gas Bypass.
5.1.1. MVE High Efficiency / Vapor Series

The MVE High Efficiency / Vapor Series freezers will maintain a vapor storage temperature of either -150°C or -190°C with minimal LN2 evaporation while accommodating a wide variety of inventory systems.

![Figure 1: Top-view of HE Freezer showing offset neck and P and R turn-trays](image)

Note: The values in the table for internal turn trays on the High Efficiency Freezers have a tolerance of +/- .25” (6mm).

<table>
<thead>
<tr>
<th>Freezer Model</th>
<th>Minimum Door Width in. (mm)</th>
<th>Minimum Ceiling Height in. (mm)</th>
<th>Liftover Height in. (mm)</th>
<th>Turn-tray Platform Height in (mm)</th>
<th>Weight Empty lbs. (kg)</th>
<th>Weight Liquid Full lbs. (kg)</th>
<th>Qty of Casters</th>
<th>Direct Load per Caster (Full) lbs. (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVE 815P-150</td>
<td>32 (813)</td>
<td>75.1 (1908)</td>
<td>47.3 (1202)</td>
<td>6 (152)</td>
<td>475 (215)</td>
<td>1134 (514)</td>
<td>4</td>
<td>284 (129)</td>
</tr>
<tr>
<td>MVE 815P-190</td>
<td>32 (813)</td>
<td>75.1 (1908)</td>
<td>47.3 (1202)</td>
<td>6 (152)</td>
<td>475 (215)</td>
<td>1134 (514)</td>
<td>4</td>
<td>284 (129)</td>
</tr>
<tr>
<td>MVE 818P-190</td>
<td>32 (813)</td>
<td>84.2 (2138)</td>
<td>51.6 (1310)</td>
<td>6 (152)</td>
<td>495 (225)</td>
<td>1168 (530)</td>
<td>4</td>
<td>292 (133)</td>
</tr>
<tr>
<td>MVE 819P-190</td>
<td>32 (813)</td>
<td>90.1 (2289)</td>
<td>55.3 (1405)</td>
<td>6 (152)</td>
<td>515 (234)</td>
<td>1340 (608)</td>
<td>4</td>
<td>335 (152)</td>
</tr>
<tr>
<td>MVE 1536P-190</td>
<td>42 (1066)</td>
<td>83.2 (2115)</td>
<td>37.1 (944)</td>
<td>9 (228)</td>
<td>690 (313)</td>
<td>2037 (924)</td>
<td>4</td>
<td>509 (231)</td>
</tr>
<tr>
<td>MVE 1539P-190</td>
<td>42 (1066)</td>
<td>87.8 (2230)</td>
<td>39.2 (995)</td>
<td>9 (228)</td>
<td>720 (327)</td>
<td>2140 (971)</td>
<td>4</td>
<td>535 (243)</td>
</tr>
<tr>
<td>MVE 1539P-190</td>
<td>60 (1524)</td>
<td>90.3 (2294)</td>
<td>40.2 (1021)</td>
<td>9.5 (242)</td>
<td>1721 (781)</td>
<td>4830 (2191)</td>
<td>4</td>
<td>1146 (520)</td>
</tr>
<tr>
<td>MVE 1542P-150</td>
<td>32 (813)</td>
<td>88.8 (2256)</td>
<td>38.7 (983)</td>
<td>9.5 (242)</td>
<td>1585 (719)</td>
<td>4458 (2022)</td>
<td>4</td>
<td>1115 (506)</td>
</tr>
<tr>
<td>MVE 1542R-190</td>
<td>32 (813)</td>
<td>88.8 (2256)</td>
<td>38.7 (983)</td>
<td>9.5 (242)</td>
<td>1721 (781)</td>
<td>4875 (2211)</td>
<td>4</td>
<td>1219 (553)</td>
</tr>
<tr>
<td>MVE 1542R-190</td>
<td>42 (1066)</td>
<td>87.8 (2230)</td>
<td>39.2 (995)</td>
<td>8 (203)</td>
<td>720 (327)</td>
<td>2140 (971)</td>
<td>4</td>
<td>535 (243)</td>
</tr>
<tr>
<td>MVE 1542R-190</td>
<td>60 (1524)</td>
<td>90.8 (2294)</td>
<td>40.2 (1021)</td>
<td>9.5 (242)</td>
<td>1721 (781)</td>
<td>4830 (2192)</td>
<td>4</td>
<td>1208 (548)</td>
</tr>
<tr>
<td>MVE 1542R-190</td>
<td>60 (1524)</td>
<td>98.6 (2504)</td>
<td>43.8 (1112)</td>
<td>9.5 (242)</td>
<td>1721 (781)</td>
<td>4875 (2211)</td>
<td>4</td>
<td>1208 (548)</td>
</tr>
<tr>
<td>MVE 1542R-190</td>
<td>60 (1524)</td>
<td>98.6 (2504)</td>
<td>43.8 (1112)</td>
<td>9.5 (242)</td>
<td>1721 (781)</td>
<td>4875 (2211)</td>
<td>4</td>
<td>1219 (553)</td>
</tr>
</tbody>
</table>
5.1.2. MVE Series

The MVE Series freezers are designed primarily for liquid phase storage, but can be used for vapor phase storage with the vapor storage accessory package. The wide neck opening allows easy access to stored samples. In vapor phase storage, these freezers will maintain a top box temperature of -90°C to -125°C.

<table>
<thead>
<tr>
<th>Freezer Model</th>
<th>Minimum Door Width in. (mm)</th>
<th>Minimum Ceiling Height in. (mm)</th>
<th>Liftover Height in. (mm)</th>
<th>Weight Empty lbs. (kg)</th>
<th>Weight Liquid Full lbs. (kg)</th>
<th>Qty of Casters</th>
<th>Direct Load per Caster (Full) lbs. (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVE 205</td>
<td>20.4 (518)</td>
<td>71.1 (1806)</td>
<td>41 (1041)</td>
<td>195 (88)</td>
<td>365 (166)</td>
<td>4</td>
<td>91 (42)</td>
</tr>
<tr>
<td>MVE 510</td>
<td>23.9 (606)</td>
<td>71.7 (1822)</td>
<td>41.6 (1057)</td>
<td>281 (127)</td>
<td>577 (262)</td>
<td>4</td>
<td>144 (66)</td>
</tr>
<tr>
<td>MVE 616</td>
<td>27.4 (696)</td>
<td>71.5 (1816)</td>
<td>41.4 (1051)</td>
<td>310 (145)</td>
<td>748 (339)</td>
<td>4</td>
<td>187 (85)</td>
</tr>
<tr>
<td>MVE 1426</td>
<td>33.8 (858)</td>
<td>70.1 (1781)</td>
<td>40 (1016)</td>
<td>490 (222)</td>
<td>1181 (536)</td>
<td>4</td>
<td>295 (134)</td>
</tr>
<tr>
<td>MVE 1839</td>
<td>46.1 (1171)</td>
<td>92.3 (2345)</td>
<td>47.3 (1202)</td>
<td>750 (341)</td>
<td>1950 (885)</td>
<td>6</td>
<td>325 (148)</td>
</tr>
</tbody>
</table>
5.1.3. MVE Stock Series

The MVE Stock Series freezers are designed primarily for storage of either vials or straws on canes in liquid nitrogen, but can also be used for vapor phase storage with the vapor storage accessory package. Dual lids on the MVE 1318 and two-tier turn-trays in the MVE 816P-2T-190 and the MVE 1877P-2T-150 are example features of these freezers built for durability and ergonomic sample retrieval.

<table>
<thead>
<tr>
<th>Freezer Model</th>
<th>Minimum Door Width in. (mm)</th>
<th>Minimum Ceiling Height in. (mm)</th>
<th>Liftover Height in. (mm)</th>
<th>Weight Empty lbs. (kg)</th>
<th>Weight Liquid Full lbs. (kg)</th>
<th>Qty of Casters</th>
<th>Direct Load per Caster (Full) lbs. (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVE 808</td>
<td>31 (787)</td>
<td>65.1 (1653)</td>
<td>39.1 (992)</td>
<td>250 (114)</td>
<td>660 (300)</td>
<td>3</td>
<td>220 (100)</td>
</tr>
<tr>
<td>MVE 816P-2T-190</td>
<td>32 (813)</td>
<td>59.5 (1512)</td>
<td>48.3 (1227)</td>
<td>475 (215)</td>
<td>1155 (524)</td>
<td>4</td>
<td>288.75 (131)</td>
</tr>
<tr>
<td>MVE 1318</td>
<td>42 (1067)</td>
<td>62.8 (1595)</td>
<td>43.6 (1107)</td>
<td>469 (213)</td>
<td>1328 (602)</td>
<td>3</td>
<td>332 (201)</td>
</tr>
<tr>
<td>MVE 1842P-150</td>
<td>60 (1524)</td>
<td>73 (1853)</td>
<td>42.5 (1078)</td>
<td>1167 (530)</td>
<td>2798 (1270)</td>
<td>4</td>
<td>699.5 (317.5)</td>
</tr>
<tr>
<td>MVE 1877P-2T-150</td>
<td>60 (1524)</td>
<td>67.5 (1716)</td>
<td>36.3 (923)</td>
<td>1600 (726)</td>
<td>4094 (1857)</td>
<td>4</td>
<td>1023.5 (464.25)</td>
</tr>
</tbody>
</table>

Figure 2: Diagram showing innovative two-tier turn-tray designed to maximize storage capacity while minimizing floor space.
5.1.4. **MVE Cabinet Series**

The MVE Series freezers are designed primarily for liquid phase storage, but can be used for vapor phase storage with the vapor storage accessory package. The wide neck opening allows for ergonomic sample retrieval and the aesthetic square cabinet design fits snugly into tight corners.

<table>
<thead>
<tr>
<th>Freezer Model</th>
<th>Minimum Door Width in. (mm)</th>
<th>Minimum Ceiling Height in. (mm)</th>
<th>Liftover Height in. (mm)</th>
<th>Weight Empty lbs. (kg)</th>
<th>Weight Liquid Full lbs. (kg)</th>
<th>Qty of Casters</th>
<th>Direct Load per Caster (Full) lbs. (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVE 616</td>
<td>28 (711)</td>
<td>71.5 (1816)</td>
<td>41.4 (1051)</td>
<td>352 (160)</td>
<td>785 (356)</td>
<td>4</td>
<td>196 (89)</td>
</tr>
<tr>
<td>MVE 1426</td>
<td>34.8 (883)</td>
<td>70.3 (1786)</td>
<td>40.2 (1021)</td>
<td>530 (240)</td>
<td>1198 (543)</td>
<td>4</td>
<td>300 (136)</td>
</tr>
</tbody>
</table>
5.1.5. **MVE HEco Series**

The MVE HEco Series freezers will maintain a vapor storage temperature of -190°C with minimal LN2 evaporation while accommodating a wide variety of inventory systems. This freezer is designed for easier access to the plumbing stack. This also allows for lower height clearance. The HEco is available only in the automatic fill version.

Model description example MVE HECO 1536P-190AF-GB

![MVE HEco Series freezer]

**CAUTION**: Pinch hazard, use caution when opening and closing the plumbing and electrical enclosures.
5.1.6. CryoSystem 6000 Full Auto

The MVE CryoSystem is designed primarily for liquid phase storage. The durable, tamper-proof lid design with its wide neck opening allows for ergonomic sample retrieval. The unique design is manufactured with the TEC3000 and plumbing system.

CryoSystem 6000 Full Auto with Gas bypass and TEC3000
5.2 Plumbing Assembly

The plumbing assembly carries and regulates the flow of LN2 from the liquid supply through the annular fill line, and into the freezer. There are three plumbing assembly configurations; one for the HE/Stock Series, one for the HEco Series, and one for the MVE/Cabinet Series. Each one of these configurations are comprised of three main circuits: fill circuit, purge circuit, and optional gas bypass circuit.

**HE Series / CryoSystem 6000 Plumbing Assembly**

<table>
<thead>
<tr>
<th>Key</th>
<th>Part Number</th>
<th>Component</th>
<th>Spec Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14224611S</td>
<td>Fill Solenoid Valve</td>
<td>24 VDC, R = 70 Ω (single), 35 Ω (dual)</td>
</tr>
<tr>
<td>2</td>
<td>1810032</td>
<td>Pressure Relief Valve</td>
<td>50 PSI (3.45 bar)</td>
</tr>
<tr>
<td>3</td>
<td>11648945</td>
<td>Inline Filter</td>
<td>40-micron</td>
</tr>
<tr>
<td>4</td>
<td>1110052</td>
<td>Fill Transfer Hose Connections</td>
<td>½ in. ODT, 45° flare, ¼ in. MPT</td>
</tr>
<tr>
<td>5</td>
<td>13284954S</td>
<td>Purge (3-way) Solenoid Valve</td>
<td>24 VDC, R = 140 Ω</td>
</tr>
<tr>
<td>6</td>
<td>10713400</td>
<td>Gas Bypass Temp Sensor</td>
<td>Pt-1000 RTD</td>
</tr>
<tr>
<td>7</td>
<td>14224611S</td>
<td>Gas Bypass Solenoid Valve</td>
<td>24 VDC, R = 70 Ω</td>
</tr>
<tr>
<td>8</td>
<td>11499812</td>
<td>Gas Bypass Muffler</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>11885449</td>
<td>Gas Bypass Muffler Deflector</td>
<td>-</td>
</tr>
</tbody>
</table>
### MVE Series Plumbing Assembly

<table>
<thead>
<tr>
<th>Key</th>
<th>Part Number</th>
<th>Component</th>
<th>Spec Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14224611S</td>
<td>Fill Solenoid Valve</td>
<td>24 VDC, R ≈ 70 Ω (single), 35 Ω (dual)</td>
</tr>
<tr>
<td>2</td>
<td>1810032</td>
<td>Pressure Relief Valve</td>
<td>50 PSI (3.45 bar)</td>
</tr>
<tr>
<td>3</td>
<td>11648945</td>
<td>Inline Filter</td>
<td>40-micron</td>
</tr>
<tr>
<td>4</td>
<td>1110052</td>
<td>Fill Transfer Hose Connections</td>
<td>½ in. ODT, 45° flare, ¼ in. MPT</td>
</tr>
<tr>
<td>5</td>
<td>13284954S</td>
<td>Purge (3-way) Solenoid Valve</td>
<td>24 VDC, R ≈ 140 Ω</td>
</tr>
<tr>
<td>6</td>
<td>10713400</td>
<td>Gas Bypass Temp Sensor</td>
<td>Pt-1000 RTD</td>
</tr>
<tr>
<td>7</td>
<td>14224611S</td>
<td>Gas Bypass Solenoid Valve</td>
<td>24 VDC, R ≈ 70 Ω</td>
</tr>
<tr>
<td>8</td>
<td>11499812</td>
<td>Gas Bypass Muffler</td>
<td>-</td>
</tr>
</tbody>
</table>
HEco 800 Series Plumbing Assembly

<table>
<thead>
<tr>
<th>Key</th>
<th>Part Number</th>
<th>Component</th>
<th>Spec Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14224611S</td>
<td>Fill Solenoid Valve</td>
<td>24 VDC, R ≈ 70 Ω (single), 35 Ω (dual)</td>
</tr>
<tr>
<td>2</td>
<td>1810032</td>
<td>Pressure Relief Valve</td>
<td>50 PSI (3.45 bar)</td>
</tr>
<tr>
<td>3</td>
<td>20669243</td>
<td>Y Strainer (Filter)</td>
<td>40-micron</td>
</tr>
<tr>
<td>4</td>
<td>1110052</td>
<td>Fill Transfer Hose Connections</td>
<td>½ in. ODT, 45° flare, ¼ in. MPT</td>
</tr>
<tr>
<td>5</td>
<td>13284954S</td>
<td>Purge (3-way) Solenoid Valve</td>
<td>24 VDC, R ≈ 140 Ω</td>
</tr>
<tr>
<td>6</td>
<td>10713400</td>
<td>Gas Bypass Temp Sensor</td>
<td>Pt-1000 RTD</td>
</tr>
<tr>
<td>7</td>
<td>14224611S</td>
<td>Gas Bypass Solenoid Valve</td>
<td>24 VDC, R ≈ 70 Ω</td>
</tr>
<tr>
<td>8</td>
<td>11499812</td>
<td>Gas Bypass Muffler</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>11885449</td>
<td>Gas Bypass Muffler Deflector</td>
<td>-</td>
</tr>
</tbody>
</table>
## HEco 1500 Series Plumbing Assembly

<table>
<thead>
<tr>
<th>Key</th>
<th>Part Number</th>
<th>Component</th>
<th>Spec Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14224611S</td>
<td>Fill Solenoid Valve</td>
<td>24 VDC, R ≈ 70 Ω (single), 35 Ω (dual)</td>
</tr>
<tr>
<td>2</td>
<td>1810032</td>
<td>Pressure Relief Valve</td>
<td>50 PSI (3.45 bar)</td>
</tr>
<tr>
<td>3</td>
<td>20669243</td>
<td>Y Strainer (Filter)</td>
<td>40-micron</td>
</tr>
<tr>
<td>4</td>
<td>1110052</td>
<td>Fill Transfer Hose Connections</td>
<td>½ in. ODT, 45° flare, ¼ in. MPT</td>
</tr>
<tr>
<td>5</td>
<td>13284954S</td>
<td>Purge (3-way) Solenoid Valve</td>
<td>24 VDC, R ≈ 140 Ω</td>
</tr>
<tr>
<td>6</td>
<td>10713400</td>
<td>Gas Bypass Temp Sensor</td>
<td>Pt-1000 RTD</td>
</tr>
<tr>
<td>7</td>
<td>14224611S</td>
<td>Gas Bypass Solenoid Valve</td>
<td>24 VDC, R ≈ 70 Ω</td>
</tr>
<tr>
<td>8</td>
<td>11499812</td>
<td>Gas Bypass Muffler</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>11885449</td>
<td>Gas Bypass Muffler Deflector</td>
<td>-</td>
</tr>
</tbody>
</table>
### HEco 1800 Series Plumbing Assembly

<table>
<thead>
<tr>
<th>Key</th>
<th>Part Number</th>
<th>Component</th>
<th>Spec Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14224611S</td>
<td>Fill Solenoid Valve</td>
<td>24 VDC, R = 70 Ω (single), 35 Ω (dual)</td>
</tr>
<tr>
<td>2</td>
<td>1810032</td>
<td>Pressure Relief Valve</td>
<td>50 PSI (3.45 bar)</td>
</tr>
<tr>
<td>3</td>
<td>20669243</td>
<td>Y Strainer (Filter)</td>
<td>40-micron</td>
</tr>
<tr>
<td>4</td>
<td>1110052</td>
<td>Fill Transfer Hose Connections</td>
<td>½ in. ODT, 45° flare, ¼ in. MPT</td>
</tr>
<tr>
<td>5</td>
<td>13284954S</td>
<td>Purge (3-way) Solenoid Valve</td>
<td>24 VDC, R = 140 Ω</td>
</tr>
<tr>
<td>6</td>
<td>10713400</td>
<td>Gas Bypass Temp Sensor</td>
<td>Pt-1000 RTD</td>
</tr>
<tr>
<td>7</td>
<td>14224611S</td>
<td>Gas Bypass Solenoid Valve</td>
<td>24 VDC, R = 70 Ω</td>
</tr>
<tr>
<td>8</td>
<td>11499812</td>
<td>Gas Bypass Muffler</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>11885449</td>
<td>Gas Bypass Muffler Deflector</td>
<td>-</td>
</tr>
</tbody>
</table>
5.3 TEC 3000 Display

The TEC 3000 front panel display is the primary user interface for the TEC 3000. There are two display options: text or symbolic.

Text Display

Symbolic Display

<table>
<thead>
<tr>
<th>LDC Display</th>
<th>20 x 4 LCD with backlight</th>
</tr>
</thead>
<tbody>
<tr>
<td>START FILL Key</td>
<td>Used to manually initiate a fill</td>
</tr>
<tr>
<td>STOP FILL Key</td>
<td>Used to manually terminate a fill – Disables Auto Fill for 30 minutes</td>
</tr>
<tr>
<td>SETUP Key</td>
<td>Used to access Setup Menus and parameters</td>
</tr>
<tr>
<td>ALARM MUTE Key</td>
<td>Used to silence the audible alarm for 30 minutes. Will reset the latching alarm once it has been corrected</td>
</tr>
<tr>
<td>▲ Key</td>
<td>Used to increase parameter values or to toggle “YES/NO” or “ON/OFF” values</td>
</tr>
<tr>
<td>▼ Key</td>
<td>Used to decrease parameter values or to toggle “YES/NO” or “ON/OFF” values</td>
</tr>
<tr>
<td>ESC Key</td>
<td>Used to escape or exit a menu or menu level</td>
</tr>
<tr>
<td>ENTER Key</td>
<td>Used to select a menu or value or save a setting change</td>
</tr>
</tbody>
</table>
5.4 TEC 3000 Stand Alone Back Panel / Physical Connections

The TEC 3000 physical and electrical connections are located on the bottom of the stand-alone (non-cabinet) controller and on the back panel of the cabinet controller.

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Temp A Port</td>
<td>Connection for Temp A probe</td>
</tr>
<tr>
<td>2</td>
<td>Temp B Port</td>
<td>Connection for Temp B probe</td>
</tr>
<tr>
<td>3</td>
<td>Serial Number Barcode</td>
<td>TEC 3000 serial number written below barcode</td>
</tr>
<tr>
<td>4</td>
<td>30 VDC Power Input</td>
<td>Main power supply connection</td>
</tr>
<tr>
<td>5</td>
<td>Serial 1 Port</td>
<td>RJ-45 connection for Serial/COM 1</td>
</tr>
<tr>
<td>6</td>
<td>Serial 2 Port</td>
<td>RJ-45 connection for Serial/COM 2</td>
</tr>
<tr>
<td>7</td>
<td>Manual Fill Button</td>
<td>Used to manually fill freezer. When depressed and held, the fill valves open. When released, the fill valves close.</td>
</tr>
<tr>
<td>8</td>
<td>Discrete Contacts</td>
<td>Open collector alarm terminals</td>
</tr>
<tr>
<td>9</td>
<td>Global Remote</td>
<td>Dry contact alarm terminals</td>
</tr>
<tr>
<td>10</td>
<td>Wire Harness Connection</td>
<td>12-pin wire harness connection to plumbing assembly, lid switch, and battery backup</td>
</tr>
<tr>
<td>11</td>
<td>Level Connection</td>
<td>Level signal input. Clear, vinyl tube connects to hose barb</td>
</tr>
</tbody>
</table>

5.4.1 TEC3000 HEco/Cabinet Physical Connections

- 3 Serial Number Barcode: TEC 3000 serial number written below barcode
- 5 30 VDC Power Input: Main power supply connection
- 6 Serial 1 Port: RJ-45 connection for Serial/COM 1
- 7 Discrete Contacts: Open collector alarm terminals
- 8 Global Remote: Dry contact alarm terminals
- 9 Level Connection: Level signal input. Clear, vinyl tube connects to hose barb
1
2
4
10
11
5.4.2 TEC3000 12-Pin Wiring Harness Connections

<table>
<thead>
<tr>
<th>POSITION</th>
<th>DESCRIPTION</th>
<th>WIRE COLOR</th>
<th>WIRE GAUGE</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+24VDC BATTERY</td>
<td>DARK BLUE</td>
<td>18</td>
<td>50&quot;</td>
</tr>
<tr>
<td>2</td>
<td>-24VDC BATTERY</td>
<td>ORANGE</td>
<td>18</td>
<td>50&quot;</td>
</tr>
<tr>
<td>3</td>
<td>+ LID SWITCH</td>
<td>BLACK WHITE STRIPE</td>
<td>22</td>
<td>96&quot;</td>
</tr>
<tr>
<td>4</td>
<td>+ FILL VALVE</td>
<td>BROWN</td>
<td>18</td>
<td>82&quot;</td>
</tr>
<tr>
<td>5</td>
<td>- FILL VALVE</td>
<td>PURPLE</td>
<td>18</td>
<td>82&quot;</td>
</tr>
<tr>
<td>6</td>
<td>- LID SWITCH</td>
<td>RED GREEN STRIPES</td>
<td>22</td>
<td>96&quot;</td>
</tr>
<tr>
<td>7</td>
<td>+ PURGE VALVE</td>
<td>YELLOW</td>
<td>20</td>
<td>48&quot;</td>
</tr>
<tr>
<td>8</td>
<td>- PURGE VALVE</td>
<td>RED</td>
<td>20</td>
<td>48&quot;</td>
</tr>
<tr>
<td>9</td>
<td>+ BYPASS SENSOR</td>
<td>RED</td>
<td>22</td>
<td>67&quot;</td>
</tr>
<tr>
<td>10</td>
<td>+ BYPASS VALVE</td>
<td>BLACK</td>
<td>18</td>
<td>75&quot;</td>
</tr>
<tr>
<td>11</td>
<td>- BYPASS VALVE</td>
<td>GRAY</td>
<td>18</td>
<td>75&quot;</td>
</tr>
<tr>
<td>12</td>
<td>- BYPASS SENSOR</td>
<td>WHITE</td>
<td>22</td>
<td>67&quot;</td>
</tr>
</tbody>
</table>
### 5.5 Specifications

<table>
<thead>
<tr>
<th>TEC 3000 Dimensions (stand-alone)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>9.1 in. (232 mm)</td>
</tr>
<tr>
<td>Width</td>
<td>3.5 in. (89 mm)</td>
</tr>
<tr>
<td>Height</td>
<td>8.0 in. (203 mm)</td>
</tr>
<tr>
<td>Weight</td>
<td>6.5 lbs. (2.95 kg)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Display</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Liquid Crystal Display (LCD) with backlight</td>
</tr>
<tr>
<td>Size</td>
<td>20 x 4 Character</td>
</tr>
<tr>
<td>Resolution</td>
<td>8 x 5 Pixels per Character</td>
</tr>
<tr>
<td>Keypad</td>
<td>8 keys, Multi-function</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical – TEC 3000 Only</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>30 VDC</td>
</tr>
<tr>
<td>Input Current (max)</td>
<td>5 A</td>
</tr>
<tr>
<td>Input Current (continuous)</td>
<td>1 A</td>
</tr>
<tr>
<td>Power Consumption (max)</td>
<td>28 W</td>
</tr>
<tr>
<td>Power Consumption (continuous)</td>
<td>6 W</td>
</tr>
<tr>
<td>Fill Valve Output Voltage</td>
<td>24 VDC</td>
</tr>
<tr>
<td>Short Protection</td>
<td>Current limiting, automatic reset</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical – Jerome Power Supply (WSL730M V1)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>110 – 230 VAC</td>
</tr>
<tr>
<td>Input Frequency</td>
<td>50 – 60 Hz</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>30 VDC</td>
</tr>
<tr>
<td>Max Current Capability</td>
<td>3 A</td>
</tr>
<tr>
<td>Input Current</td>
<td>0.73 A @ 110 VAC</td>
</tr>
<tr>
<td>Input Current (continuous)</td>
<td>0.35 A @ 230 VAC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power Requirements – TEC 3000 + Power Supply</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>110-230VAC/50-60Hz</td>
</tr>
<tr>
<td>Input Current (max)</td>
<td>.73A@110VAC</td>
</tr>
<tr>
<td>Input Current (continuous)</td>
<td>.35A@230VAC</td>
</tr>
<tr>
<td>Input Power (max)</td>
<td>30 Watts</td>
</tr>
<tr>
<td>Input Power (continuous)</td>
<td>8 Watts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEC 3000 Physical Connections</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Probes</td>
<td>2-pin twist lock</td>
</tr>
<tr>
<td>Input Power</td>
<td>5-pin DIN</td>
</tr>
<tr>
<td>Output Power / Sensors / Battery Backup</td>
<td>15-pin AMP</td>
</tr>
<tr>
<td>Serial Ports</td>
<td>RJ-45, 4-pin RS-485</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature Sensor</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>2-wire Platinum RTD (Pt-1000)</td>
</tr>
<tr>
<td>Quantity</td>
<td>2</td>
</tr>
<tr>
<td>Resistance</td>
<td>1000 Ω @ 0°C</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>3.85 Ω / °C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature Measurement</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>0.1°C (0.2°F)</td>
</tr>
<tr>
<td>Accuracy – Single Point Calibration *</td>
<td>± 1.0°C (1.8°F)</td>
</tr>
<tr>
<td>– Two Point calibration **</td>
<td>± 2.0°C (3.6°F)</td>
</tr>
<tr>
<td>Range</td>
<td>-200°C to 70°C (-328°F to 158°F)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level Measurement</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Differential Pressure Sensor</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 0.5 in. (13 mm) LN2</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1 in. (2.5 mm)</td>
</tr>
<tr>
<td>Range</td>
<td>3.0 in. to 48 in. (76 mm to 1219 mm)</td>
</tr>
</tbody>
</table>

* Accuracy determined over range of -200°C to -135°C. Accuracy decreases slightly as range increases.
** Accuracy determined over a range of -200°C to 0°C. Accuracy decreases slightly as range increases.
5.6 Operating Environment

Ambient Temperature and Relative Humidity

MVE cryogenic freezers are designed to be operated in environments near room temperature (65°F – 80°F, 18°C – 27°C) and relative humidity below 50%. Due to the large gradient between LN2 and ambient temperatures, an additional change of a few degrees will not have a significant impact on the freezer performance. Although temperature changes will affect the open top MVE and MVE Stock series freezers to a greater degree, it again will not be a significant effect. The relative humidity should be maintained low enough so that condensation does not form on the TEC 3000. Elevated humidity levels can lead to excessive condensation and frost on and around the lid. In situations where the relative humidity is high and uncontrollable, the lid should be routinely wiped dry to prevent ice formation. Should significant ice formation develop, thaw as necessary. Refer to the Preventative Maintenance procedures for details.

Atmospheric Pressure

MVE cryogenic freezers are designed to be operated in environments with atmospheric pressure range of 8.2 psi (57.2 kPa) to 14.7 psi (101 kPa).

Thermal Load

Since MVE Freezers use LN2 as the refrigerant and do not employ any type of mechanical refrigeration, the thermal load will be negligible to negative.
6. Installation and Startup

This section will review the basic receiving, installation, and startup procedures for MVE Freezers. These instructions can also be applied to set up the CryoSystem 6000 Full Auto. Always inspect the bill of lading for accuracy and external crate/packaging for damage before accepting the shipment.

Included with each full auto freezer:
- Literature Packet
  - TEC 3000 Quick Start Reference Guide – PN 13289481
  - Manual Freezer Status Log – PN 10936355
- TEC 3000 – Packaged in box separately for HE/MVE Series models
- Transfer hose – 6 ft. – Inside freezer
- MVE Dipstick – Inside freezer
- Desiccant bag – To be removed and discarded – Inside freezer
- Liquid Nitrogen handling instructions
- MVE Certificate of Quality
Installation

NOTE: Do not apply power to the TEC 3000 controller or connect an LN2 supply until later in this procedure to avoid injury or damaging the equipment.

Following the careful uncrating and unpacking of the freezer, install using these basic instructions. Cabinet Series freezers will be shipped with some of the connections described below already installed.

NOTE: Only install the freezer on a level surface. Never fill freezer and move to another location. Always fill the freezer where it is to be installed/used.

- Locate the temperature sensor tube assembly that will house the two temperature probes. For HE, HEco, and some Stock Series freezers, a three-tube temperature sensor assembly will be installed in the center of the top of the freezer. The two smaller tubes are designed to house the included temperature probes. The third, larger tube is designed to accommodate a third-party temperature probe. A silicone plug will be installed in this third tube. If the third tube is going to be used, simply remove the silicone plug. For the MVE Series (all open top freezers), a dual sensor tube will be installed along the inside wall of the freezer storage space. *The CryoSystem 6000 temperature probes are inserted into the neck area.*

```
0.37 inches (9.4 mm)
0.21 inches (5.3 mm)
```

- Insert the two temperature probes into the sensor tubes and position the sensors at the preferred height in the freezer space. Selecting probe A and B as well as the sensor placement is adjustable and completely up to the user. MVE does recommend placing sensor (Temp A) at the “top box” level. This refers to the level in the freezer space where the highest sample is being stored. If storing vials in boxes, then this would be at the level with the top box. This is recommended as it will be the warmest temperature experience by samples being stored in the freezer space.

- Connect the temperature probes to the TEC 3000 temperature ports using the twist lock connectors.

- For HEco models, once the temperature probes are in the desired position the freezer is ready to be filled. Connect transfer hose to its fill source and proceed to step 2 of the first fill start up procedure.

- For HE models, once the temperature probes are in the desired position, apply a small amount of the silicone sealant, included with the freezer, surrounding the temperature probes where they enter the sensor tubes. This will help maintain their position and help keep moisture from entering the freezer storage space. Proceed to the next step.
- Connect the clear vinyl tubing to the TEC 3000 Level Input hose barb and connect the other end of the tubing to the 3-way purge valve.
- Ensure all of the plumbing assembly connections to the TEC 3000 wire harness are secure.

NOTE: Do not connect the battery backup (if equipped) to the wire harness until later in the installation procedure.

- Connect the 12-pin wire harness to the TEC 3000 wire harness connection.

- If the freezer is equipped with battery backup measure the voltage at the end connector for approximately 24VDC to 27VDC; if no voltage is present, the included battery fuse must be installed before connecting the battery to the main wire harness. Open the battery enclosure and unscrew the fuse harness. Install the fuse; close the fuse harness and the battery enclosure. (This is done at the factory but should be verified at installation)

NOTE: Do not connect the battery backup to the main wire harness until the power supply has been verified to power up the controller

- Plug in the power supply to an appropriate wall outlet with the proper AC voltage. Avoid wall outlets that are connected to emergency generator power if possible. Although an uninterruptible power supply (UPS) is ideal to ensure continuous power, a surge protector or power conditioner is recommended.
- Plug the power supply into the TEC 3000 30 VDC power input. The TEC 3000 display should illuminate and begin the startup sequence.

⚠️ WARNING ⚠️
To avoid risk of electrical shock, this equipment must only be connected to a properly grounded power source or outlet.

- Following the startup sequence, the TEC 3000 may start to alarm. This is normal.
- Press “Alarm Mute” to silence the audible buzzer for 30 minutes. For installation and startup purposes, the alarm buzzer can be disabled; however, be sure to enable it when installation is complete. For instructions, see the Alarm Buzzer page in Section 6 of this manual.
- Connect the battery backup to the main wiring harness. While running on outlet power, the TEC 3000 supplies a steady 27 VDC trickle charge to the battery backup. The battery backup may need to be charged for several hours before it is able to power the TEC 3000.
- Remove a caplug from the fill tee on the plumbing assembly in order to connect the LN2 supply. If using an LN2 cylinder as the liquid supply, securely connect and tighten the transfer hose to both the fill tee connection and the supply connection labeled “LIQUID”. If using a bulk LN2 supply system, securely connect and tighten the supply connection to the freezer fill tee connection.

NOTE: The recommended LN2 supply pressure is 22-35 psig (1.52 - 2.41 bar).

**First Fill Startup procedure**

1. Once the freezer has been properly installed, begin the first fill procedure. Fill freezer at the desired location where it is to be used. Do not fill to move freezer to another location.
2. Open or remove the lid for the first fill due to the accelerated LN2 evaporation rate when filling a warm freezer. If the freezer is equipped with a lid switch, engage the manual override (see the Lid Switch section of this manual for more info).
3. Verify supply pressure at 22-35 psig (1.52 – 2.41 bar) open valve and press “Start Fill” to begin filling the freezer.
4. The first fill will take significantly longer than subsequent fills due to a warm freezer.
5. It is recommended to place empty inventory system components such as racks, boxes, frames, or canisters in the freezer during the first fill. This will cool the inventory system as well as help the freezer reach its top box temperature rating faster.
6. It is normal for some condensation or frost to develop around the neck opening during the initial fill.
7. Once the TEC3000 reads a level; press stop fill; allow liquid to equalize and insert dipstick; verify level to the controller level display; change the offset value (+ or -) to match liquid level; press start fill to continue the fill process. When freezer has reached its high level set point wait 10 minutes for system to equalize then verify level with dipstick and calibrate if necessary.
8. Once the TEC3000 matches freezer LN2 level close or place the lid and allow the freezer to equilibrate and reach its temperature rating.
9. It is recommended that biological samples are not introduced into the freezer until several days after the top box temperature has stabilized at or below the freezer’s temperature rating. It is recommended to restart controller after 24 hours of initial install to reset the Liquid Usage.
10. Refer to the Operations section of this manual for further instructions.

**Note:** Pressing Stop Fill will disable TEC3000’s automatic fill function for 30 minutes.
7. Operation

This section of the manual will detail the functions and features of the TEC 3000 and demonstrate how to access and adjust the various user settings and options.

All MVE Freezers utilize LN2 as the means of refrigeration. Under atmospheric conditions, the temperature of LN2 is -196°C (-320°F, 77 K). Depending on the model, the LN2 resides either in or below the freezer storage space. Through normal usage and time, the LN2 will naturally boil off reducing the amount of refrigerant in the freezer. It is imperative that the LN2 level be properly maintained in order for the storage space temperature to be maintained. This, along with monitoring and recording temperature, is the main function of the TEC 3000.

![Figure 3: Illustration showing LN2 as the refrigerant. Left: LN2 below the storage space naturally boils off and cools the freezer. Right: LN2 resides in the freezer storage space.](image-url)
7.1. Functions and Features

The TEC 3000 utilizes a variety of functions and features that enable it to closely monitor and control the environment inside a cryogenic freezer. This section will give an overview of the following features and their functionality:

- Liquid Nitrogen Level Measurement
- Automatic Liquid Nitrogen Level Control
- Liquid Nitrogen Usage
- Temperature Measurement
- User Defined Alarms
- Passwords/Security
- Communication Capabilities
- Lid Switch
- Hot Gas Bypass (Optional)
- Battery Backup (Optional)
7.1.1. Liquid Nitrogen Level Measurement

The LN2 level in the Dewar is determined through the use of a differential pressure sensor. This sensor operates on the physical principle of hydrostatic head pressure. The pressure generated by a column of fluid is proportional to the height, or depth, of the fluid column. In this application, the pressure generated by the LN2 at the bottom of the freezer will increase as the LN2 level increases. This differential pressure system allows the controller to measure the exact LN2 level accurately.

![Figure 4: As the fluid level in the cylinder increases, the imposed head pressure at the bottom of the cylinder increases proportionally. The pressure gauges measure this increase in level.](image)

This pressure signal generated by the LN2 is transmitted from the bottom of the inner vessel through the freezer’s annular line to the differential pressure sensor inside the TEC 3000 controller. The TEC 3000 controller then compares this pressure signal to its atmospheric pressure readings and is then able to determine the exact LN2 level. The term “differential pressure” refers to the fact that the level is determined from the difference between the hydrostatic head pressure of the fluid column and atmospheric pressure. The measured LN2 level is displayed in inches, millimeters, or as percentage full.

Unlike alternative level sensing systems, such as thermistor based systems, differential pressure allows the exact level to be measured and displayed, not just a level range. This completely enclosed system requires minimal maintenance and is not affected by humidity, moisture, or other environmental variables. Also, the differential pressure system allows the automatic level settings and alarms to be set and adjusted electronically instead of having to physically move sensors.
7.1.2. Automatic Liquid Nitrogen Level Control

The TEC 3000 is equipped with a fully automated LN2 level control system. This level control system is based on user-defined parameters that can be adjusted to maintain a LN2 level in a freezer over a range of 3.0 inches (76 mm) up to 48.0 inches (1219 mm). Since this control system utilizes the differential pressure system described previously, these parameters can be adjusted electronically using the TEC 3000 keypad or remotely through a networked computer. This automatic fill control feature can be disabled. Below is a brief explanation of the four user-defined level control parameters. For instructions on accessing and adjusting the level control settings, see the Liquid Level Setpoints and Alarms section.

- **High Level Alarm** – If the LN2 level in a freezer reaches or exceeds this setting, a High Level Alarm will result. This audible/visual alarm will cause the High Level discrete contact and the global remote to switch to alarm state.
- **High Level Setpoint** – When the LN2 level in a freezer reaches this setting (with or without automatic fill enabled) the controller will close the fill valves and terminate the fill.
- **Low Level Setpoint** – When the LN2 level is at or below this setting (with automatic fill enabled) the controller will initiate a filling cycle.
- **Low Level Alarm** – If the LN2 level in a freezer is at or below this setting, a Low Level Alarm will result. This audible/visual alarm will cause the Low Level discrete contact and the global remote to switch to alarm state.

**NOTE:** Certain events can temporarily disable Auto Fill Control. Pressing “Stop Fill” will disable Auto Fill Control for 30 minutes. In the event of a Hot Gas Bypass Alarm or a Fill Time Alarm, Auto Fill Control will be disabled until the respective alarm is cleared by pressing “Alarm Mute” or restarting the controller.

**Overfill Protection**

The overfill protection (Software Version 2.03) will prevent an automatic fill if the LN2 level reading is 0 or if the level reading suddenly drops to 0. This prevents an overfill scenario in any situation where the TEC3000 loses its ability to measure the LN2 level.

![Figure 5: Example of automatic level control parameters](image)

**Note:** Pressing Stop Fill will temporarily terminate TEC3000’s automatic fill function for 30 minutes.
7.1.3. Liquid Nitrogen Usage

The TEC 3000 controller is able to calculate and display an estimated rate of LN2 evaporation inside a freezer. This liquid usage is displayed in inches or millimeters per day. It takes time for the real-time data to accumulate in order for the liquid usage rate to be calculated.

The liquid usage is calculated by measuring the time it takes the LN2 level in a freezer to decrease 0.5 inches (12.7 mm) and then extrapolating that value out to a 24 hour period in order to obtain a per day liquid usage.

\[
\text{Liquid Usage} = \left( \frac{L_1 - L_2}{\text{Elapsed Time (hrs)}} \right) \times 24 \text{ hrs}
\]

For example:
If the LN2 level to decrease from 6.0 to 5.5 inches in 12 hours, then the displayed liquid usage will be 1.0 inch/day. See below.

\[
\text{Liquid Usage} = \left( \frac{6.0'' - 5.5''}{12 \text{ hrs}} \right) \times 24 \text{ hrs} = 1.0''/\text{day}
\]

This calculation is suspended during fills and will resume 15 minutes after a fill to allow the LN2 level in the freezer to stabilize. The liquid usage calculation can be reset by restarting the controller or cycling the power. For liquid usage display options, refer to the Liquid Nitrogen Level Options section.

NOTE: Several scenarios can lead to a temporarily exaggerated liquid usage. If the level abruptly decreases 0.5 inches, then there will be a spike in the liquid usage. Having the freezer lid off for an extended period of time, adding or removing samples and racks, attempting to fill from an empty LN2 supply, or moving the freezer all can lead to an accelerated evaporation rate. Although the liquid usage is an accurate estimate of the daily evaporation rate, it can be temporarily skewed by certain events; however, because of method used to calculate the usage, it will recover as more data is acquired.
7.1.4. Temperature Measurement

The TEC 3000 is equipped with two independent temperature measurement channels. They are designed to be used with 1000 ohm platinum RTD temperature probes, also referred to as Pt-1000 RTDs. The electrical resistance of the very fine platinum wire in these probes changes linearly with temperature. Platinum’s very linear relationship between resistance and temperature makes Pt-1000 RTDs ideal for temperature measurement in cryogenic environments. The temperatures displayed on the TEC 3000 LCD are not real-time readings, but rather a running average of the previous few measurements. The TEC 3000 takes temperature measurements several times a second and then averages the previous few measurements while updating the displayed temperature every second. The optional hot gas bypass temperature sensor is also a Pt-1000 RTD.

![Pt-1000 RTD Temperature Measurement graph](image.png)

**Figure 6:** Platinum’s linear relationship between temperature and resistance
7.1.5. User Defined Alarms

The TEC 3000 employs 18 different audible/visual alarms. These alarms are designed to alert the user to possible problems with the freezer temperature, LN2 level, controller power, and LN2 supply. In the event that a condition triggers an alarm, an audible buzzer will sound, that particular alarm will appear on the TEC 3000 LCD display, and the global remote alarm contacts will switch to alarm state. If the triggered alarm is one of the four specified discrete contacts, then that contact will also switch to alarm state. For more information on the global remote and discrete contacts, refer to the Remote Alarm Monitoring section.

To clear an alarm, first correct the condition and then press the “Alarm Mute” key or restart the controller. If the alarm condition is still present, then pressing the “Alarm Mute” key will only mute the audible buzzer for 30 minutes. The condition must be corrected in order to clear the alarm.

NOTE: Most TEC 3000 alarms have a one minute delay to avoid false positive or nuisance alarms. * denotes alarms that do not have a one minute time delay.

<table>
<thead>
<tr>
<th>Table 1: TEC 3000 alarms and descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alarm Display</strong></td>
</tr>
<tr>
<td>High Temp A* Can be Enabled or Disabled</td>
</tr>
<tr>
<td>High Temp B* Can be Enabled or Disabled</td>
</tr>
<tr>
<td>Low Temp A Can be Enabled or Disabled</td>
</tr>
<tr>
<td>Low Temp B Can be Enabled or Disabled</td>
</tr>
<tr>
<td>High Level</td>
</tr>
<tr>
<td>Low Level</td>
</tr>
<tr>
<td>Liquid Usage Warning</td>
</tr>
<tr>
<td>Liquid Usage Alarm Can be Enabled or Disabled</td>
</tr>
<tr>
<td>Fill Time</td>
</tr>
<tr>
<td>Bypass Time Alarm*</td>
</tr>
<tr>
<td>Temp A Calibration*</td>
</tr>
<tr>
<td>Temp B Calibration*</td>
</tr>
<tr>
<td>Bypass Calibration*</td>
</tr>
<tr>
<td>Low Battery</td>
</tr>
<tr>
<td>Power Failure Can be Enabled or Disabled</td>
</tr>
</tbody>
</table>
### MVE Biological Systems

#### TEC 3000 Technical Freezer Manual

<table>
<thead>
<tr>
<th>Alarms</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lid Open</td>
<td>Freezer lid has been open longer than Lid Open Alarm Time setting</td>
</tr>
<tr>
<td>Communication Loss</td>
<td>TEC 3000 controller has lost communication with the LCD display</td>
</tr>
<tr>
<td><em>Stuck Valve Alarms</em></td>
<td>When the freezer is supposed to be filling, if the controller does not see an appropriate decrease in temperature, within the delay time entered in the menu, a stuck closed valve alarm will be initiated. After the freezer is supposed to have stopped filling, if the controller does not see an appropriate increase in temperature, within the delay time entered in the menu, a stuck open valve alarm will be initiated. <em>(Feature is only available on HEco Models)</em></td>
</tr>
</tbody>
</table>

If any alarms occur, contact your authorized MVE Distributor or Technical Service.
7.1.6. Remote Alarm Monitoring

The TEC 3000 is equipped with a global remote alarm relay and four specific discrete dry contacts that allow remote monitoring of alarm conditions. Once activated, these latching contacts will retain their alarm state until the alarm condition is corrected and cleared. Although Chart MVE does not provide remote monitoring or programmable logic controller (PLC) systems, these devices can be easily connected to the TEC 3000. For example, it is possible to setup a TEC 3000 so that if a Low Level Alarm is triggered, the remote monitoring system will automatically send an email or place a call to alert the necessary individuals of the freezer’s status. For proper discrete contact function, ensure the negative (low voltage) terminal of the remote monitoring system is connected to the COMMON discrete contact terminal and the positive (high voltage) terminal is connected to the respective discrete alarm terminal. Wires can be inserted and removed from the terminals by placing a small flathead screwdriver into the slot above the contact and prying down the latch until the clamp connector opens. Remove the flathead screwdriver to close the clamp connector. For alarm contact test procedures, refer to the Remote Alarm Tests section. Below are the remote alarm contact specifications and a typical remote monitoring setup schematic. If an alarm condition has been corrected, but it continues to register through the global or discrete contacts, remove the contacts and cycle the power on the controller. This will clear the alarm if it has latched in the system.

![Remote Alarm Monitoring Schematic](image)

**Figure 7:** TEC 3000 remote alarm contacts

<table>
<thead>
<tr>
<th>Discrete Contacts</th>
<th>Global Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normally Open</td>
<td>Normally Open or Normally Closed</td>
</tr>
<tr>
<td>Open Collector</td>
<td>Dry Contact Relay</td>
</tr>
<tr>
<td>Latching</td>
<td>Latching</td>
</tr>
<tr>
<td>Polarity Sensitive</td>
<td>Non-Polarity Sensitive</td>
</tr>
<tr>
<td>24 VDC at 100 mA max</td>
<td>230 VAC at 1 A max</td>
</tr>
</tbody>
</table>

**Table 2:** TEC 3000 remote alarm contact specifications

![Typical Remote Alarm Monitoring Schematic](image)

**Figure 8:** Typical remote alarm monitoring setup schematic. Temp A High monitoring shown
7.1.7. **Passwords / Security**

The TEC 3000 has a multilevel security system that can be customized to meet your security needs. Four different levels of security can be assigned up to 10 passwords allowing users to control who has the ability to change specific settings as well as to what extent these settings may be altered.

For example, in a tissue bank or repository that employs many technicians, the facility manager may want to restrict the technicians’ access to allow them to view alarm settings, but not have the ability to adjust the settings. In this situation, the technicians would be assigned a password with low level security privileges. Conversely, if the shift manager wants to have complete access to all menus and settings, then he/she would be assigned a password with high level security privileges.

Password entry mode can be disabled in the Password Menu. For more information on passwords and security, refer to the Passwords / Security Setup section.

**Table 3:** Password security levels and descriptions. X denotes access to adjust setting.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Not Password Protected</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Fill</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop Fill</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm Mute</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick Reference Settings</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp and Level Display Units</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Display Liquid Usage</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enable / Disable Temp Sensors</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp Alarm Settings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Temp Alarm Test</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lid Switch Settings</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot Gas Bypass Settings</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enable / Disable Alarm Buzzer</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level Control / Alarm Settings</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date/Time</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Language Settings</td>
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<td>Printer Settings</td>
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<td></td>
</tr>
<tr>
<td>Temp Calibration</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Level Calibration</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enable / Disable Auto Fill</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timed Fill Settings</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFAF Settings</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication Settings</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset to default settings</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Password Settings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Forgot your password? Contact your authorized MVE Distributor or Technical Service.
7.1.8. Communication / Networking Capabilities

The TEC 3000 RS-485 Serial interface offers several advanced communication capabilities. The TEC 3000 is equipped with two, independent RJ-45 serial ports. These ports are intended for connection to another MVE controller, PC, serial printer, or other RS-485 device. Up to 100 TEC 3000 controllers can be successfully networked.

NOTE: The TEC 3000 should never be connected directly to a LAN or public telecommunications network.

Below is a summary of the different communication / networking capabilities:

- **Host Computer** – The TEC 3000 can communicate with a computer via an RS-485 converter and ChartConnect 3000 or Windows HyperTerminal. Through the use of simple ASCII commands, all TEC 3000 settings and functions can be monitored and adjusted with these software programs. In addition to ASCII communication, ChartConnect 3000 also offers a user-friendly event log downloader. The event log is downloaded as a comma separated variable (.csv) file that can be opened in EXCEL. Either a single controller or a network of controllers may be connected to a host computer. For more information on computer communication capabilities, refer to the Communication / Networking section.

- **Serial Printer** – The TEC 3000 can be connected directly to a serial printer via an RS-485 converter. This allows controller events to be printed as they occur. This gives users the opportunity to keep hard-copy records of the freezer’s status in addition to the standard event log saved in the controller’s memory. This printed data bypasses the controller memory and is not given the opportunity to be altered electronically. For more information on the printer interface, refer to the Communication / Networking section.

- **MODBUS** – The TEC 3000 has RS-485 MODBUS communication capabilities. This will not be extensively covered in this manual. Please contact your MVE Distributor or Chart MVE Technical Service for more information.

- **One Fill All Fill (OFAF)** – A group of TEC 3000s can be networked in order to coordinate fill cycles and reduce LN2 transfer losses. For locations with multiple freezers, this function will increase the filling efficiency and drastically reduce LN2 consumption over time. A sequential or simultaneous OFAF network is possible. For more information on OFAF networking, refer to the Advanced Filling Options section.
7.1.9. **Event Log And Event Codes**

The TEC 3000 has a built-in data logging feature that automatically stores vital, time-stamped information including temperatures, LN2 level, liquid usage, and any alarms. Data is logged at a user-defined interval and anytime an event or alarm status changes. The default log interval is 4 hours. The TEC 3000 is able to store up to 30,000 events in its non-volatile memory. With a 4 hour log interval, the TEC 3000 is able to store approximately 10 years worth of data. This event log can be easily downloaded from the controller using ChartConnect 3000. This downloaded file is a .csv file that can be opened, analyzed, and plotted in EXCEL. Besides being a record of the freezer status, the event log is a vital tool for diagnosing problems or detecting potential problems with a freezer. For instructions on how to download the event log, refer to the Communication / Networking section of this manual or the ChartConnect 3000 User Manual (PN 13946348).

**NOTE:** Since the event log is stored in non-volatile memory, it will be retained and unaffected when the controller loses power, is restarted, if the firmware is updated, or when the event log is downloaded. However, resetting the controller to defaults will clear the event log. If the event log memory is exceeded, the oldest event will be deleted to make space for the most recent event.

Below is a sample event log and a list of event codes. The event log header displays the version of ChartConnect 3000 used to download the event log, the controller’s unit ID, and the controller’s firmware version. The events are logged so that Record #1 is the most recent event logged. The event parameters are logged in the units and format of that respective category. For example, if the TEC 3000 temperature units are set to be in degrees Celsius, then the temperature will be logged in degrees Celsius. If the time is set to a 24 hour clock, then the event log times will be in that format. Parameter changes will be logged as a string such as “Parameter number 126 changed from 60 to 180.” Contact your MVE Distributor or Chart MVE Technical Service for information regarding these parameter changes.

<table>
<thead>
<tr>
<th>Record</th>
<th>Unit ID</th>
<th>Date</th>
<th>Time</th>
<th>TempA</th>
<th>TempB</th>
<th>LN2 Level</th>
<th>LN2 Usage</th>
<th>Event Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>200</td>
<td>12/15/10</td>
<td>9:00</td>
<td>-186.7</td>
<td>-194.8</td>
<td>6.1</td>
<td>0.5</td>
<td>AH</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
<td>12/15/10</td>
<td>5:00</td>
<td>-191.4</td>
<td>-195.8</td>
<td>6.3</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>200</td>
<td>12/15/10</td>
<td>1:00</td>
<td>-191.4</td>
<td>-195.8</td>
<td>6.5</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>200</td>
<td>12/15/10</td>
<td>00:00</td>
<td>-191.4</td>
<td>-195.8</td>
<td>6.6</td>
<td>0.5</td>
<td>ZO</td>
</tr>
<tr>
<td>5</td>
<td>200</td>
<td>12/14/10</td>
<td>21:00</td>
<td>-191.4</td>
<td>-195.8</td>
<td>6.6</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>200</td>
<td>12/14/10</td>
<td>17:00</td>
<td>-191.4</td>
<td>-195.8</td>
<td>6.8</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>200</td>
<td>12/14/10</td>
<td>9:00</td>
<td>-191.4</td>
<td>-195.8</td>
<td>6.8</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>200</td>
<td>12/14/10</td>
<td>7:15</td>
<td>-191.5</td>
<td>-195.8</td>
<td>7.0</td>
<td>0.0</td>
<td>F</td>
</tr>
<tr>
<td>9</td>
<td>200</td>
<td>12/14/10</td>
<td>6:32</td>
<td>-191.5</td>
<td>-195.8</td>
<td>5.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>200</td>
<td>12/14/10</td>
<td>5:00</td>
<td>-191.5</td>
<td>-195.8</td>
<td>5.3</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 9:** Sample event log download
Table 4: TEC 3000 Event Log Codes

<table>
<thead>
<tr>
<th>Event Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>Alarm Mute</td>
</tr>
<tr>
<td>AH</td>
<td>Temp A High Alarm</td>
</tr>
<tr>
<td>AL</td>
<td>Temp A Low Alarm</td>
</tr>
<tr>
<td>BB</td>
<td>Running on battery power</td>
</tr>
<tr>
<td>BH</td>
<td>Temp B High Alarm</td>
</tr>
<tr>
<td>BL</td>
<td>Temp B Low Alarm</td>
</tr>
<tr>
<td>BP</td>
<td>Bypass Sensor Open</td>
</tr>
<tr>
<td>BV</td>
<td>Low Battery Voltage Alarm</td>
</tr>
<tr>
<td>BY</td>
<td>Hot Gas Bypassing</td>
</tr>
<tr>
<td>CA</td>
<td>Temp A Calibration Alarm</td>
</tr>
<tr>
<td>CB</td>
<td>Temp B Calibration Alarm</td>
</tr>
<tr>
<td>CG</td>
<td>Bypass Sensor Calibration Alarm</td>
</tr>
<tr>
<td>F</td>
<td>Filling</td>
</tr>
<tr>
<td>FD</td>
<td>Fill Disabled</td>
</tr>
<tr>
<td>FT</td>
<td>Fill Time Alarm</td>
</tr>
<tr>
<td>HG</td>
<td>Hot Gas Bypass Time Alarm</td>
</tr>
<tr>
<td>LH</td>
<td>High Level Alarm</td>
</tr>
<tr>
<td>LL</td>
<td>Low Level Alarm</td>
</tr>
<tr>
<td>LO</td>
<td>Lid Open Alarm</td>
</tr>
<tr>
<td>PF</td>
<td>Power Failure</td>
</tr>
<tr>
<td>SC</td>
<td>Stuck Closed Alarm</td>
</tr>
<tr>
<td>SO</td>
<td>Stuck Open Alarm</td>
</tr>
<tr>
<td>US</td>
<td>Liquid Usage Alarm</td>
</tr>
<tr>
<td>UW</td>
<td>Usage Warning</td>
</tr>
<tr>
<td>ZO</td>
<td>Level Zeroing</td>
</tr>
</tbody>
</table>

Once the event log has been downloaded, it can be plotted to facilitate analysis.

Sample Event Log Plot

![Sample Event Log Plot](image)

Figure 10: Sample Plotted Event Log
7.1.10. Lid Switch

The TEC 3000 has the ability to support a lid switch. This additional feature allows the user to disable filling while the lid is open, utilize the Lid Open Alarm, or initiate an automatic fog clear. A lid switch comes standard on all MVE Series and MVE Cabinet Series freezers. There are two configurations of the lid switch: the standard UL lid switch configuration and the optional fog clear lid switch configuration. The difference in their functionality is based on how they are wired to the TEC 3000.

- **Standard UL Lid Switch configuration** – The UL lid switch configuration, which is standard on MVE Series and MVE Cabinet Series freezers, is wired directly in series with the fill valves. With this configuration, when the lid is open and the lid switch is disengaged, the fill valves cannot be energized. When the lid is down and the lid switch is engaged, the fill valve circuit is closed and the valves can be energized. The functionality of the UL lid switch is independent of the settings in the lid switch menu of the TEC 3000 since it is hardwired into the fill valve circuit. MVE’s UL listing stipulates that the models in these two series must have the lid switch hardwired in series with the fill valves when it leaves the factory to be compliant. The fog clear and lid open alarm features are not available with the UL lid switch configuration. It is available for users to easily adapt their UL lid switch configuration to a fog clear lid switch configuration and acquire these features. Contact your MVE Distributor or Chart MVE Technical Service for instructions.

  NOTE: The standard UL Lid Switch configuration is not controlled by the TEC 3000 Lid Switch Menus and the Lid Switch Installed option should be set to “NO”.

- **Optional Fog Clear Lid Switch configuration** – The optional fog clear lid switch configuration is connected directly to the TEC 3000 wire harness lid switch connector and is not wired in series with the fill valves. This lid switch configuration is controlled by the settings in the lid switch menu of the TEC 3000, which include the fog clear feature and the Lid Open Alarm. With the fog clear feature enabled, the freezer will fill for 30 seconds each time the lid is opened, which clears the fog and improves visibility. The Lid Open Alarm feature allows the user to set a maximum time that the lid can remain open before an alarm is triggered. For instructions on adjusting the lid switch settings, refer to the Optional Features section.

  NOTE: Converting from the standard UL Lid Switch configuration to the optional Fog Clear Lid Switch configuration voids the UL compliance and requires that the UL mark be removed from the freezer.

NOTE: Both lid switch configurations do have an override feature. Simply pull up on the lid switch until it clicks to engage the manual override.
7.1.11. Hot Gas Bypass

The Hot Gas Bypass is a feature on HE/MVE/HEco freezer series equipped with a TEC 3000. The Hot Gas Bypass is able to vent the warm nitrogen gas from the supply line before initiating a fill cycle. This prevents warm gas from entering the freezer space. The bypass system helps to maintain a stable temperature gradient inside the freezer and increases the efficiency by preventing excess LN2 evaporation while filling. This feature is advantageous for any freezer setup and is especially ideal for sites where longer transfer hoses cannot be avoided.

The Hot Gas Bypass system consists of these components:
- Solenoid Valve (24 VDC)
- Temperature sensor (Pt-1000 RTD)
- Muffler
- Plumbing and electrical connections

Freezers with the Hot Gas Bypass installed and enabled will complete a bypass cycle prior to filling. When a fill is initiated, the bypass solenoid valve will open first and begin venting nitrogen gas from the supply line through the muffler and into the atmosphere. The TEC 3000 monitors and displays the temperature in the plumbing system throughout the bypass cycle. As LN2 begins flowing, the temperature in the plumbing system will decrease. Once the bypass temperature sensor readings reach the user-defined Bypass Temperature Setpoint, the bypass solenoid valve will close terminating the bypass cycle. The fill solenoid valves will then open and the freezer will begin filling. The default Bypass Temperature Setpoint is -70°C and can be adjusted based on the freezer setup.

The Bypass Alarm Time Delay is the maximum allowable bypass time. If the temperature in the plumbing system does not reach the Bypass Temperature Setpoint within the Bypass Alarm Time Delay setting, the TEC 3000 will terminate the bypass cycle, initiate the fill cycle, and trigger a Hot Gas Bypass Time Alarm. Once the immediate fill cycle is complete, auto fill will be disabled until the Hot Gas Bypass Time Alarm is acknowledged. This feature prevents a freezer from continuing to attempt to fill from an empty supply. A Hot Gas Bypass Time Alarm could be a sign of an empty supply, a supply with too low of pressure, or it could mean that the Bypass Alarm Time Delay needs to be increased in order to effectively purge the supply line of nitrogen gas. The default Bypass Alarm Time Delay is 5 minutes, but should be adjusted based on the freezer setup. It should be arranged so that the Bypass Temperature Setpoint is easily reached within the Bypass Alarm Time Delay setting.

NOTE: If a Hot Gas Bypass Time Alarm is triggered, once the immediate fill cycle is complete, auto fill will be disabled until the alarm is acknowledged.
7.1.12. Battery Backup (Optional)

The Battery Backup is an optional feature on all domestic HE/MVE/HEco freezers equipped with a TEC 3000 and comes standard on all MDD freezers. The TEC 3000 is able to run seamlessly on power from this external battery system when the primary power source is interrupted. The TEC 3000 is able to run fully functional on the Battery Backup for approximately 72 hours in the event of a power failure. While the TEC 3000 is running on its primary power source, it continuously provides a 27 volt trickle charge to keep the Battery Backup fully charged. A Low Battery Alarm will trigger if the TEC 3000 is running on Battery Backup and the voltage falls below 21 volts. The TEC 3000 will begin losing select functionality when its power source falls below 18 volts. Non-essential circuits are disabled first to conserve power.

The battery status can be viewed in the Add-on Menus. With a Battery Backup connected while the controller is running on main power, the battery status screen will read On AC Power. While running on Battery Backup, the battery status screen will display on battery backup 26VDC 80%-100%. With no Battery Backup connected, the battery status screen will display On AC Power. This feature is available with Firmware Version 2.02 or higher.

The Battery Backup system consists of these components:

- Two, 12 VDC lead acid batteries wired in series
- Inline fuse (4A 250V F)
- Battery housing
- Electrical connections

For Preventative Maintenance and Battery Backup Installation instructions, reference section Battery Backup Replacement and Installation.

NOTE: The amount of time that a freezer will operate on power from the Battery Backup will vary depending on the fill status, the fill intervals, and the size of the freezer.
7.2. Adjusting Settings and Options

Password Entry
This section describes how to access the TEC 3000 menus and adjust the various settings and options. With password entry enabled, the controller will prompt for a password anytime a user attempts to access the setup menus. A flashing cursor on the password entry screen will make it clear which digit is being changed. Feature is available with Firmware Version 2.02.

These instructions will start from the main monitoring display screen, assume password entry mode is enabled, and the user has Security Level 4 clearance. Once in the setup menus, the user can press the “ESC” key to exit that menu level or press the “ESC” key repeatedly until the display returns to the main monitoring screen. After 30 seconds of inactivity, the display will automatically return to the main monitoring display screen.

TEC 3000 controllers with newer displays have the added functionality of a quick reference scroll menu. Pressing the up and down arrow keys simultaneously while on the main monitoring screen will display the controller’s serial number and firmware version. Pressing the up or down arrow keys will then scroll through the level, temperature, and gas bypass settings. The user can return to the main monitoring screen by pressing the “ESC” key or waiting 30 seconds.

Main Monitoring Display Screen

<table>
<thead>
<tr>
<th>Temp A</th>
<th>Temp B</th>
<th>Level</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>-196.2°C</td>
<td>-191.4°C</td>
<td>10.0 in</td>
<td>0.5 in/day</td>
</tr>
</tbody>
</table>
7.2.1. Temperature Settings

This section describes how to access and adjust the various temperature settings on the TEC 3000.

NOTE: Security Level 2 or higher is required to adjust the Temperature Settings.

7.2.1.1. Enable / Disable Sensors

The default setting for both Temp A and Temp B sensors is enabled.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “ENTER”
   The display will read “Temp A Menu”.
   NOTE: To access Temp B Menu, press “SETUP” instead of “ENTER”.

4. Press “ENTER”
   The display will read “Temp A Enabled”.
   Use the “▲/▼” keys to change Temp A to DISABLED and press “ENTER” to save the setting change.

   If a setting was changed, a confirmation display will read “New Setting Accepted”.

Higher User Level
Required use ▲▼ to
ENTER Password
0000

Press ENTER for Temperature Menus
or press SETUP for next menu

Press ENTER for Temp A Menu
or press SETUP for next menu

Temp A
ENABLED
Use ▲▼ to adjust
Press ENTER to save

New Setting Accepted
7.2.1.2. High Temperature Alarm Test

The high temperature alarm test allows a user to simulate a high temperature alarm without having to remove it from the freezer. Once initiated, the TEC 3000 will apply a small voltage to the sensor, which causes the sensor to heat up. The TEC 3000 will continue to heat the sensor until it exceeds the High Temp Alarm setting. Once surpassed, a High Temp Alarm will result and the sensor readings will begin to decrease. The alarm buzzer will sound and the remote alarm contacts will switch to alarm state until the simulated alarm is cleared. (Press Alarm Mute)

NOTE: The heat generated by the sensor during the High Temperature Alarm Test is NOT enough to affect the actual temperature in the freezer storage space. If the sensor is submerged in LN2, the heat generated by the sensor may not be sufficient to initiate a high temperature alarm.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “ENTER”
   The display will read “Temp A Menu”.
   NOTE: To access Temp B Menu, press “SETUP” instead of “ENTER”.

4. Press “ENTER”
   The display will read “Temp A Enabled”.

5. Press “SETUP”
   The display will read “Initiate High Temp A Alarm Test”. Use the “▲/▼” keys to change NO to YES and press “ENTER” to initiate the alarm test.

   If High Temp Alarm Test is initiated, the display will read “Testing” and show the temp change throughout the test.
   Note: If the temperature probe is open or no probe is connected the controller will not go into the high temperature alarm test mode.
7.2.1.3. Temperature Alarm Settings

This section describes how to navigate and adjust the temperature alarm settings. The high temperature alarm is used to alert the user when the temperature in the freezer space has risen above the set threshold. The low temperature alarm can be used as a calibration error or redundant overfill indicator.

To be used as a calibration error indicator, the low temperature alarm would be set to a temperature slightly colder than the LN2 saturation temperature. Since the temperature in the freezer storage space can never be colder than LN2, if this alarm is triggered, it is an indication that the sensor requires recalibration.

To be used as a redundant overfill, or high level alarm, the low temperature alarm would be set to a temperature slightly warmer than the LN2 saturation temperature and the sensor placed higher than the desired liquid level in the freezer. If the low temperature alarm is triggered, then it is an indication that sensor is submerged in LN2 and the liquid level is higher than desired.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “ENTER”
   The display will read “Temp A Menu”.  
   NOTE: To access Temp B Menu, press “SETUP” instead of “ENTER”.

4. Press “ENTER”
   The display will read “Temp A Enabled”.

5. Press “SETUP”
   Until the display reads “Temp A High Alarm”.
   Use the “▲/▼” keys to adjust setting and press “ENTER” to save the change.

6. Press “SETUP”
   The display will read “Temp A Low Alarm”.
   Use the “▲/▼” keys to adjust setting and press “ENTER” to save the change.

Alarm masks added for Low and High Temperature alarms for both sensors A and B. This allows these alarms to be enabled or disabled by the user. Note these are called alarm masks because the alarms are not actually disabled. They are simply no longer indicated via audio/visual means. The text in the menu screens uses enable and disable since that is the more conventionally understood terminology. Feature is available with Firmware 2.03.
7. Press “SETUP”
The display will read “Temp A High Alarm”. Use the “▲/▼” keys to adjust setting and press “ENTER” to save the change.

8. Press “SETUP”
The display will read “Temp A Low Alarm”. Use the “▲/▼” keys to adjust setting and press “ENTER” to save the change.
7.2.1.4. Liquid Nitrogen Saturation Temperature

This section shows how to adjust the LN2 saturation temperature. This temperature is altitude dependent. The default LN2 saturation temperature is -195.8°C (-320.4°F, 77.4 K). This value is accurate for altitudes ranging from sea level to 500 feet (152 m). For the appropriate saturation temperature, refer to Table 5: LN2 Saturation Temperatures.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “ENTER”
   The display will read “Temp A Menu”.

4. Press “SETUP”
   Until the display reads “LN2 Temperature”. Use the “▲/▼” keys to adjust setting per Table 5 and press “ENTER” to save the change.

Table 5: LN2 Saturation Temp vs. Altitude

<table>
<thead>
<tr>
<th>Altitude</th>
<th>LN2 Saturation Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feet − Meters</td>
<td>°C</td>
</tr>
<tr>
<td>Sea Level − 500</td>
<td>Sea Level − 152</td>
</tr>
<tr>
<td>501 − 1000</td>
<td>152 − 305</td>
</tr>
<tr>
<td>1000 − 1500</td>
<td>305 − 457</td>
</tr>
<tr>
<td>1501 − 2000</td>
<td>457 − 610</td>
</tr>
<tr>
<td>2001 − 3000</td>
<td>610 − 915</td>
</tr>
<tr>
<td>3001 − 4000</td>
<td>915 − 1220</td>
</tr>
<tr>
<td>4001 − 5000</td>
<td>1220 − 1524</td>
</tr>
<tr>
<td>5001 − 6000</td>
<td>1524 − 1829</td>
</tr>
<tr>
<td>6001 − 7000</td>
<td>1829 − 2134</td>
</tr>
<tr>
<td>7001 − 8000</td>
<td>2134 − 2439</td>
</tr>
<tr>
<td>8001 − 9000</td>
<td>2439 − 2744</td>
</tr>
<tr>
<td>9001 − 10000</td>
<td>2744 − 3049</td>
</tr>
</tbody>
</table>
7.2.2. Liquid Level Settings

This section demonstrates how to adjust the LN2 level settings.

7.2.2.1. Level Setpoints and Alarms

The auto fill settings can be adjusted in the Liquid Level Menus. With auto fill enabled, the TEC 3000 will initiate an auto fill when the level is at or below the Low Level Setpoint and terminate a fill when the level reaches the High Level Setpoint. If the level is at or below the Low Level Alarm or at or above the High Level Alarm, the TEC 3000 will initiate that respective alarm.

NOTE: There must be a minimum of 0.5 inches between each of setpoint and alarm. For example, if the Low Level Alarm is set to be 4.0 inches, then the Low Level Setpoint would have to be set at least 4.5 inches. The Low Level Alarm can be set to a minimum value of 3.0 inches and the High Level Alarm can be set to a maximum value of 48.0 inches.

NOTE: Security Level 2 or higher is required to adjust the Liquid Level Settings.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Liquid Level Menus”.

4. Press “ENTER”
   The display will read “High Level Alarm”. Use the “▲/▼” keys to adjust the High Level Alarm value and press “ENTER” to save the change.

5. Press “SETUP”
   The display will read “High Level Setpoint”. Use the “▲/▼” keys to adjust the High Level Setpoint value and press “ENTER” to save the change.

6. Press “SETUP”
   The display will read “Low Level Setpoint”. Use the “▲/▼” keys to adjust the Low Level Setpoint value and press “ENTER” to save the change.

7. Press “SETUP”
   The display will read “Low Level Alarm”. Use the “▲/▼” keys to adjust the Low Level Alarm value and press “ENTER” to save the change.

Higher User Level
Required use ▲▼ to ENTER Password
0000

Press ENTER for Temperature Menus
or press SETUP for next menu

Press ENTER for Liquid Level menus
or press SETUP for next menu

High Level Alarm
8.0 in
Use ▲▼ to adjust
Press ENTER to save

High Level Setpoint
7.0 in
Use ▲▼ to adjust
Press ENTER to save

Low Level Setpoint
5.0 in
Use ▲▼ to adjust
Press ENTER to save

Low Level Alarm
4.0 in
Use ▲▼ to adjust
Press ENTER to save
7.2.2.2. Enable / Disable Auto Fill Control

Auto Fill Control can be enabled or disabled in the Advanced Level Menus.

NOTE: Security Level 3 or higher is required to enable/disable Auto Fill.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Liquid Level Menus”.

4. Press “ENTER”
   The display will read “High Level Alarm”.

5. Press “SETUP”
   Until the display reads “Advanced Level Menus”.

6. Press “ENTER”
   The display will read “Auto Fill Control”. Use the “▲/▼” keys to adjust and press “ENTER” to save the change.
7.2.2.3. Level Offset

Since the annular line that carries the pressure level signal to the TEC 3000 is not located at the very bottom of the LN2 column, a Level Offset is needed. This value is determined and set at the factory and should not be adjusted to fix an inaccurate level reading unless setting up a freezer (see the First Fill Startup Procedure) or if instructed to do so by an authorized MVE Distributor or Technical Service. For liquid level calibration see section 7.3.2 page 84.

Note: Security Level 3 or higher is required to adjust the Level Offset.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Liquid Level Menus”.

4. Press “ENTER”
   The display will read “High Level Alarm”.

5. Press “SETUP”
   Until the display reads “Advanced Level Menus”.

6. Press “ENTER”
   The display will read Auto Fill Control

7. Press “SETUP”
   The display will read “Level Offset”. Use the “▲/▼” keys to adjust value and press “ENTER” to save the change.
7.2.3. Additional Feature Settings

This section details how to view and adjust the settings for the optional Battery Backup, Power Failure Alarm, Hot Gas Bypass, and Lid Switch.

NOTE: Security Level 2 or higher is required to adjust the Hot Gas Bypass and Lid Switch settings.

### 7.2.3.1. Battery Backup Status

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   The display will read “Add-on Menus”.

4. Press “ENTER”
   The current battery status will be displayed. The display will read On AC Power if battery is connected or not connected and controller running on AC.
   - OR -
   The display will read On Battery Backup 26VDC or 80% or 100% if controller is running on battery backup (AC disconnected)

5. Press “SETUP”
   The Power Failure Alarm status will display. Use the “▲/▼” keys to ENABLE or DISABLE and press “ENTER” to save the change.
7.2.3.2. Hot Gas Bypass Settings

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

   Higher User Level
   Required use ▲▼ to ENTER Password
   0000

2. Press “ENTER”
   The display will read “Temperature Menus”.

   Press ENTER for Temperature Menus
   or press SETUP for next menu

3. Press “SETUP”
   The display will read “Add-on Menus”.

   Press ENTER for Add-on menus
   or press SETUP for next menu

4. Press “ENTER”
   The current battery status will be displayed.

   Battery Status
   On AC Power

5. Press “SETUP”
   Until the display reads “Hot Gas Bypass Menus”.

   Press ENTER for Hot Gas Bypass menus
   or press SETUP for next menu

6. Press “ENTER”
   The display will read “Hot Gas Bypass”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

   Hot Gas Bypass
   DISABLED
   Use ▲▼ to adjust
   Press ENTER to save

7. Press “SETUP”
   The current Bypass Temperature Sensor reading will be displayed.

   Bypass Temperature
   20.0 °C

8. Press “SETUP”
   The display will read “Bypass Temp Setpoint”. Use the “▲/▼” keys to adjust the value and press “ENTER” to save.

   Bypass Temp Setpoint
   -70.0 °C
   Use ▲▼ to adjust
   Press ENTER to save

9. Press “SETUP”
   The display will read “Bypass Alarm Time Delay”. Use the “▲/▼” keys to adjust the value and press “ENTER” to save.

   Bypass Alarm Time Delay
   5 min
   Use ▲▼ to adjust
   Press ENTER to save

10. Press “SETUP”
    The display will read “Stuck Valve Alarms”. Use the “▲/▼” keys to adjust the value and press “ENTER” to save.

    Stuck Valve Alarms
    DISABLED
    Use ▲▼ to adjust
    Press ENTER to save

11. Press “SETUP”
    The display will read “Stuck Open Delay”. Use the “▲/▼” keys to adjust the value, 1min to 90min and press “ENTER” to save.

    Stuck Open Delay
    1 min
    Use ▲▼ to adjust
    Press ENTER to save
12. Press “SETUP”
The display will read “Stuck Closed Delay”. Use the “▲/▼” keys to adjust the value, 1min to 90min and press “ENTER” to save.

### 7.2.3.2.1 Stuck Valve Alarm

NOTE: This feature requires that the bypass sensor be relocated into the main plumbing assembly instead of in the bypass plumbing branch so that it can monitor the temperature of the incoming supply stream when the bypass is not active. The controller will monitor the gas bypass sensor during and after filling.

When the freezer is supposed to be filling, if the controller does not see an appropriate decrease in temperature, within the delay time entered in the menu, a stuck closed valve alarm will be initiated. After the freezer is supposed to have stopped filling, if the controller does not see an appropriate increase in temperature, within the delay time entered in the menu, a stuck open valve alarm will be initiated.

The menu pages are in the hot gas bypass menu within the Add On menu. This will allow enabling and disabling of these alarms and setting the time delays. These alarms are enabled together. They cannot be selectively enabled / disabled.

The event code for the stuck closed alarm is “SC”
The event code for the stuck open alarm is “SO”
Refer to the Hot Gas Bypass Settings 7.2.3.2 (page 58) to change Stuck Valve Alarm settings.
7.2.3.3. Lid Switch Settings

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   The display will read “Add-on Menus”.

4. Press “ENTER”
   The current battery status will be displayed.

5. Press “SETUP”
   Until the display reads “Lid Switch Menus”.

6. Press “ENTER”
   The display will read “Lid Switch Installed”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

7. Press “SETUP”
   The display will read “Lid Open Fog Clear”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

8. Press “SETUP”
   The display will read “Lid Open Alarm Time”. Use the “▲/▼” keys to adjust the value and press “ENTER” to save.
7.2.4. Display and Output Settings

This section demonstrates how to adjust the Display and Output Settings.

7.2.4.1. Temp and Level Display Units

NOTE: Security Level 1 or higher is required to change the display units.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Display and Output”.

4. Press “ENTER”
   The display will read “Temperature Units”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

5. Press “SETUP”
   The display will read “Level Display Menus”.

6. Press “ENTER”
   The display will read “Level Units”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

7. Press “SETUP”
   The display will read “Define 100%”. If using the percentage level units, then use the “▲/▼” keys to adjust and press “ENTER” to save.

8. Press “SETUP”
   The display will read “Define 0%”. If using the percentage level units, then use the “▲/▼” keys to adjust and press “ENTER” to save.

Percentage Level Units Explanation

The defined 0% and 100% values are independent of the automatic level control parameters. The percentage level units are just an alternative to displaying the measured level in inches or millimeters. The percentage parameters can be set to match the high and low fill setpoints or they can be set to any other value that makes interpreting the liquid level easier for the user.
7.2.4.2. Liquid Usage Display

NOTE: Security Level 1 or higher is required to enable/disable the liquid usage display.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Display and Output”.

4. Press “ENTER”
   The display will read “Temperature Units”.

5. Press “SETUP”
   Until the display reads “Display liquid usage”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

6. Press “SETUP”
   Until the display reads “Liquid Usage Alarm”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

DISPLAY AND OUTPUT:

Liquid Usage Alarm can now be “Enabled or Disabled” on software versions starting with 2.03. When this alarm is disabled, there will be no visual or audible indication at the controller, but the event code for the alarm will continue to be recorded in the internal data log. Since this alarm is the early warning to potential vacuum failure, it is recommended that it not be disabled.

With software version 2.03 the liquid usage warning will no longer be indicated on the unit either audibly or visually. It will only be recorded in the internal data log. This is to minimize self-correcting nuisance warnings. A New menu page was added in the Display and Output menu, after the Enable Liquid Usage Display page, to allow enabling / disabling the liquid usage alarm.
7.2.4.3. Alarm Buzzer

The audible alarm buzzer can be disabled. This will not disable the alarms, only the audible buzzer. Alarms will still be displayed visually on the screen if the alarm buzzer is inactive.

NOTE: Security Level 2 or higher is required to enable/disable the alarm buzzer.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Display and Output”.

4. Press “ENTER”
   The display will read “Temperature Units”.

5. Press “SETUP”
   Until the display reads “Advanced Display and Output”.

6. Press “ENTER”
   The display will read “Alarm Buzzer”. Use the “▲/▼” keys to adjust and press “ENTER” to save.
7.2.4.4. Languages

The TEC 3000 has five language options to choose from: English, Spanish, German, Italian, and French.

NOTE: Security Level 2 or higher is required to change the language setting.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Display and Output”.

4. Press “ENTER”
   The display will read “Temperature Units”.

5. Press “SETUP”
   Until the display reads “Advanced Display and Output”.

6. Press “ENTER”
   The display will read “Alarm Buzzer”.

7. Press “SETUP”
   The display will read “Language”. Use the “▲/▼” keys to adjust and press “ENTER” to save.
### 7.2.4.5. Printer

This section describes how to adjust the Printer settings. For instructions on how to connect a printer, see the Communication / Networking section.

**NOTE:** Security Level 2 or higher is required to adjust the Printer settings.

1. **Press “SETUP”**
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. **Press “ENTER”**
   The display will read “Temperature Menus”.

3. **Press “SETUP”**
   Until the display reads “Display and Output”.

4. **Press “ENTER”**
   The display will read “Temperature Units”.

5. **Press “SETUP”**
   Until the display reads “Advanced Display and Output”.

6. **Press “ENTER”**
   The display will read “Alarm Buzzer”.

7. **Press “SETUP”**
   Until the display reads “Printer Menu”.

8. **Press “ENTER”**
   The display will read “Print Interval”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

9. **Press “SETUP”**
   The display will read “Print Header”. Press “ENTER” to print a new header.

10. **Press “SETUP”**
    The display will read “Print Event”. Press “ENTER” to print a new event.
7.2.5. Advanced Settings

This section describes how to change the various Advanced Settings.

7.2.5.1. Timed Filling

The TEC 3000 has several advanced filling options including Timed Filling. Timed Filling allows the user to set a regular filling schedule based on a fill start time and a fill frequency. If a facility staff would like the peace of mind of knowing that all the freezers are full of LN2 before leaving for the weekend, then they could set up a timed fill for every Friday afternoon. Even if the LN2 level in a freezer is above Low Level Setpoint, the TEC 3000 will initiate a fill and top off the freezer to its High Level Setpoint. If the liquid level is at or above the High Level Setpoint, then the TEC 3000 will skip that timed fill event and not initiate a fill.

A TEC 3000 with a Timed Filling schedule will still maintain Auto Fill Control. If Timed Filling and Auto Fill Control are enabled, then the TEC 3000 will still initiate a fill anytime the liquid level reaches the Low Level Setpoint. Firmware Ver. 2.03 or higher will allow the Timed Fill Start to be set to any hour and minutes except midnight.

Timed Filling Setup

Enable Timed Filling and then select the number of days to elapse between timed fillings. Select a Timed Fill Start time that is later that same day. If Timed Filling is being enabled at 9:30 AM, then the Timed Fill Start should be set to 9:31 AM or later. This is recommended for simplicity. The TEC 3000 will initiate a fill when the Timed Fill Start is reached later that day. From then on, each time the Timed Fill Frequency elapses, the TEC 3000 will fill the freezer to its High Level Setpoint. The Timed Fill Frequency has a range of 1 to 28 days and the Timed Fill Start can be set to any hour and minutes except midnight. If midnight is selected controllers with Ver. 2.03 or higher will automatically change the hour and minutes to 01:00 hours.

NOTE: Security Level 3 or higher is required to setup or change Timed Filling.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Advanced Settings”.

4. Press “ENTER”
   The display will read “Advanced Fill Menus”.

Higher User Level
Required use ▲▼ to ENTER Password
0000

Press ENTER for Temperature Menus
or press SETUP for next menu

Press ENTER for Advanced Settings
or press SETUP for next menu

Press ENTER for Advanced Fill menus
or press SETUP for next menu
5. Press “ENTER”
The display will read “Timed Fill”. Use the ▲/▼ keys to adjust and press “ENTER” to save.

6. Press “SETUP”
The display will read “Timed Fill Frequency”. Use the ▲/▼ keys to adjust and press “ENTER” to save. It can be set from 1 to 28 days.

7. Press “SETUP”
The display will read “Timed Fill Start Hour”. Use the ▲/▼ keys to adjust and press “ENTER” to save.

8. Press “SETUP”
The display will read “Timed Fill Start Minute” Use the ▲/▼ keys to adjust and press “ENTER” to save.
7.2.5.2. Maximum Fill Time

The maximum fill time can be adjusted in the Advanced Fill Menus. If a freezer begins filling but does not reach its High Level Setpoint within the maximum fill time, then the TEC 3000 will terminate the fill and trigger a Fill Time Alarm. Auto Fill Control will then be disabled until the Fill Time Alarm is cleared. The maximum fill time has a range of 30 to 240 minutes.

NOTE: Security Level 3 or higher is required to adjust the maximum fill time.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Advanced Settings”.

4. Press “ENTER”
   The display will read “Advanced Fill Menus”.

5. Press “ENTER”
   The display will read “Timed Fill”.

6. Press “SETUP”
   Until the display reads “Maximum Fill Time”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

Higher User Level Required use ▲▼ to ENTER Password 0000

Press ENTER for Temperature Menus or press SETUP for next menu

Press ENTER for Advanced Settings or press SETUP for next menu

Press ENTER for Advanced Fill menus or press SETUP for next menu

Timed Fill DISABLED
Use ▲▼ to adjust
Press ENTER to save

Maximum Fill Time
60 min
Use ▲▼ to adjust
Press ENTER to save
7.2.5.3. Time and Date

The time and date can be set in the Advanced Settings Menus. The user has the option of a 12 or 24 hour clock and a MM/DD/YY or DD/MM/YY date format.

NOTE: Security Level 2 or higher is required to change the time and date.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Advanced Settings”.

4. Press “ENTER”
   The display will read “Advanced Fill Menus”.

5. Press “SETUP”
   The display will read “Set Time and Date”.

6. Press “ENTER”
   The display will read “Hour”. Use the “▲/▼” keys to adjust the hour and press “ENTER” to save.

7. Press “SETUP”
   The display will read “Minute”. Use the “▲/▼” keys to adjust the minute and press “ENTER” to save.

8. Press “SETUP”
   The display will read “Year”. Use the “▲/▼” keys to adjust the year and press “ENTER” to save.

9. Press “SETUP”
   The display will read “Month”. Use the “▲/▼” keys to adjust the month and press “ENTER” to save.

10. Press “SETUP”
    The display will read “Day”. Use the “▲/▼” keys to adjust the day and press “ENTER” to save.

11. Press “SETUP”
    The display will read “Time Format”. Use the “▲/▼” keys to adjust and press “ENTER” to save.
12. Press “SETUP”
The display will read “Date Format”. Use the “▲/▼” keys to adjust and press “ENTER” to save.
7.2.5.3.1. Communication Settings

7.2.5.3.2. COM Setup / Type

The settings for the two serial ports can be adjusted in the COM 1 and COM 2 Setup Menus. Since they are independent serial ports, only one serial port can be set to a given COM Type. If COM 1 is set to ASCII, then COM 2 cannot also be set to ASCII. Networked controllers must be daisy chained together with RJ-45 splitters in order to communicate using the same COM Type.

NOTE: Security Level 3 or higher is required to change the Communication Settings.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the "▲/▼" keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Advanced Settings”.

4. Press “ENTER”
   The display will read “Advanced Fill Menus”.

5. Press “SETUP”
   Until the display reads “COM 1 Menus”. For COM 2 Menus, press “SETUP”.

6. Press “ENTER”
   The display will read “COM 1 Setup”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

7. Press “SETUP”
   The display will read “COM 1 Type”. Use the “▲/▼” keys to adjust and press “ENTER” to save.
7.2.5.3.3. MODBUS ID

The TEC 3000 MODBUS ID also serves as the ASCII Unit ID. This address can be adjusted in the MODBUS Menu and has a range of 1 to 200.

NOTE: Security Level 2 or higher is required to change the MODBUS ID.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Advanced Settings”.

4. Press “ENTER”
   The display will read “Advanced Fill Menus”.

5. Press “SETUP”
   Until the display reads “MODBUS Menu”.

6. Press “ENTER”
   The display will read “MODBUS ID”. Use the “▲/▼” keys to adjust and press “ENTER” to save.
7.2.5.4. One Fill All Fill (OFAF)

This section describes how to adjust the various OFAF settings. For more information and instructions on how to setup an OFAF network, refer to the OFAF Network Setup section of this manual.

NOTE: Security Level 3 or higher is required to adjust the OFAF settings.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Advanced Settings”.

4. Press “ENTER”
   The display will read “Advanced Fill Menus”.

5. Press “SETUP”
   Until the display reads “OFAF Menus”.

6. Press “ENTER”
   The display will read “OFAF ID”. Use the “▲/▼” keys to adjust the OFAF ID and press “ENTER” to save.

7. Press “SETUP”
   The display will read “OFAF Units”. Use the “▲/▼” keys to adjust the number of units and press “ENTER” to save.

8. Press “SETUP”
   The display will read “One Fill All Fill”. Use the “▲/▼” keys to adjust the type and press “ENTER” to save.
7.2.5.5. Restore Default Settings (Global Password)

The TEC 3000 can be reset to the factory defaults in the Advanced Settings Menu. This will also reset post-factory calibrations and **global password to 3 4 5 6**. The accuracy of the level and temperature measurements should be confirmed after resetting.

**Note:** It is recommended to download complete data from the controller prior to performing a restore to defaults. Restoring to defaults will erase previous stored data and it cannot be retrieved once the restore function is performed.

**NOTE:** Security Level 3 or higher is required to reset to factory default settings.

1. Press “SETUP”
   
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   
   The display will read “Temperature Menus”.

3. Press “SETUP”
   
   Until the display reads “Advanced Settings”.

4. Press “ENTER”
   
   The display will read “Advanced Fill Menus”.

5. Press “SETUP”
   
   Until the display reads “Restore All Defaults”.

6. Press “ENTER”
   
   The display will read “Confirm Restore”. Use the “▲/▼” keys to change to “YES” and press “ENTER” to save.
# TEC3000 Default Settings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Temp Alarm</td>
<td>-110.0 °C / -166.0 °F / 163.2 K</td>
</tr>
<tr>
<td>Low Temp Alarm</td>
<td>-200.0 °C / -327.6 °F / 73.4 K</td>
</tr>
<tr>
<td>High Level Alarm</td>
<td>8.0 in / 205 mm</td>
</tr>
<tr>
<td>High Level Setpoint</td>
<td>7.0 in / 180 mm</td>
</tr>
<tr>
<td>Low Level Setpoint</td>
<td>5.0 in / 125 mm</td>
</tr>
<tr>
<td>Low Level Alarm</td>
<td>4.0 in / 100 mm</td>
</tr>
<tr>
<td>Defined 100%</td>
<td>8.0 in / 205 mm</td>
</tr>
<tr>
<td>Defined 0%</td>
<td>4.0 in / 100 mm</td>
</tr>
<tr>
<td>Level Offset</td>
<td>+1.3 in / +35 mm</td>
</tr>
<tr>
<td>Auto Fill</td>
<td>Enabled</td>
</tr>
<tr>
<td>Maximum Fill Time</td>
<td>60 minutes</td>
</tr>
<tr>
<td>Temperature Display Units</td>
<td>°C</td>
</tr>
<tr>
<td>Liquid Level Display Units</td>
<td>Inches</td>
</tr>
<tr>
<td>Hot Gas Bypass MENU</td>
<td>DISABLED</td>
</tr>
<tr>
<td>Hot Gas Bypass Temp Setpoint</td>
<td>-70 °C</td>
</tr>
<tr>
<td>Hot Gas Bypass Alarm Time Delay</td>
<td>5 minutes</td>
</tr>
<tr>
<td>COM 1 Type</td>
<td>ASCII</td>
</tr>
<tr>
<td>COM 2 Type</td>
<td>Disabled</td>
</tr>
<tr>
<td>Event Log Interval</td>
<td>240 minutes</td>
</tr>
<tr>
<td><strong>GLOBAL PASSWORD</strong></td>
<td>3 4 5 6</td>
</tr>
</tbody>
</table>
7.2.5.6. Restart Controller

The TEC 3000 can be restarted in the Advanced Settings Menu. Restarting the controller and cycling the power are both safe ways to reboot the controller.

NOTE: Security Level 3 or higher is required to restart the controller from the Advanced Settings Menu

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Advanced Settings”.

4. Press “ENTER”
   The display will read “Advanced Fill Menus”.

5. Press “SETUP”
   Until the display reads “Restart Controller”.

6. Press “ENTER”
   The display will read “Confirm Restart”. Use the “▲/▼” keys to change to “YES”.

7. Press “ENTER”
   The controller will restart and the display will read “Starting Please Wait”. Following the startup sequence, the display will return to the main monitoring screen.
7.2.5.7. Firmware Update

⚠️ WARNING ⚠️

TEC 3000 firmware should only be updated by authorized MVE Distributors or under the direction of Technical Service. Be sure not to disconnect the controller from power or disconnect the TEC COM kit from the controller or computer. Improper firmware updates can render the controller inoperable.

The firmware, or controller software, can be updated in the event that a new revision is released. A personal computer, Chart/MVE TEC COM USB communications kit (PN 13376947), and the current firmware updater program are required to perform an upgrade. Contact your authorized MVE Distributor or Technical Service for more information.

1. Connect the TEC COM USB kit to serial port 1 on the TEC 3000 and a USB port on a computer.
2. Start the current firmware updater program.
3. When prompted, select “Update Firmware” in the TEC 3000 Advanced Settings Menu and cycle power to the controller.
4. The updater program should begin loading the new firmware.
5. Once complete, the controller may take several minutes to reboot. It is normal for an occasional beep to sound during this rebooting period.
NOTE: Security Level 3 or higher is required to update the firmware.

1. Press “SETUP”  
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the ▲/▼ keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”  
   The display will read “Temperature Menus”.

3. Press “SETUP”  
   Until the display reads “Advanced Settings”.

4. Press “ENTER”  
   The display will read “Advanced Fill Menus”.

5. Press “SETUP”  
   Until the display reads “Update Firmware”.

6. Press “ENTER”  
   The display will read “Confirm Update”. Use the ▲/▼ keys to change to “YES”.

7. Press “ENTER”  
   The display will read “Connect COM 1 to a PC and cycle controller power”. After cycling controller power, the updater program should begin loading the new firmware.

8. During the firmware update, the display will read “Communications Loss Check Controller”. This is normal. Upon completion, the startup sequence should begin within several minutes.
7.2.6. **Password / Security Setup**

This section details how to enable / disable password entry mode as well as how to change and setup multilevel security passwords.

**NOTE:** Security Level 4 is required to setup or change passwords.

### 7.2.6.1. Password Entry Mode

This section details how to enable / disable password entry mode. Disabling the password entry mode will remove all TEC 3000 password protection.

1. **Press “SETUP”**
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. **Press “ENTER”**
   The display will read “Temperature Menus”.

3. **Press “SETUP”**
   Until the display reads “Password Menus”.

4. **Press “ENTER”**
   The display will read “Password Entry Mode”. Use the “▲/▼” keys to change and press “ENTER” to save.
7.2.6.2. Global Password Change

This section describes how to change the Global Password 3 4 5 6. The Global Password has Security Level 4 clearance.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Password Menus”.

4. Press “ENTER”
   The display will read “Password Entry Mode”.

5. Press “SETUP”
   The display will read “Change Global Password”. The Global Password has Security Level 4 clearance.

6. Press “ENTER”
   The display will read “Global Password”. Use the “▲/▼” keys to input new Global Password and press “ENTER” to advance the cursor.

7. Press “ENTER”
   The display will read “Confirm new Password?” To confirm new password, use the “▲/▼” keys to change from “NO” to “YES” and press “ENTER” to save.
7.2.6.3. Multilevel Passwords

This section describes how to setup and change the 9 multilevel passwords.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Password Menus”.

4. Press “ENTER”
   The display will read “Password Entry Mode”.

5. Press “SETUP”
   Until the display reads “Change Password 1”. Continue to press “SETUP” to access passwords 2-9.

6. Press “ENTER”
   The display will read “Password 1”. Use the “▲/▼” keys to input Password 1 and press “ENTER” to advance the cursor.

7. Press “ENTER”
   The display will read “Password 1 Level” Use the “▲/▼” keys to select the appropriate Security Level.

8. Press “ENTER”
   The display will read “Confirm new Password?” Use the “▲/▼” keys to change “NO” to “YES” and press “ENTER” to save.
7.3. Calibration Procedures

7.3.1. Temperature Sensor Calibration

This section describes how to calibrate the TEC 3000 temperature sensors. There are two calibration procedures: single point and two point calibration. For single point calibration, the reference point is LN2. For two point calibration, the reference points are LN2 and ice water. Unless regulations require a two point calibration, the single point calibration procedure is recommended. The benefit of two point calibration is more accurate temperature measurement in near room temperature environments. The drawback is a longer, more complex calibration procedure. The benefit of a single point calibration is a simple calibration procedure. The drawback of single point calibration is less accurate temperature measurement in near room temperature environments.

All new freezers equipped with TEC 3000 controllers have been calibrated at the factory. The temperature sensors should only be calibrated if faulty readings are suspected, a sensor or the TEC 3000 itself has been replaced, following a firmware update, or as a part of a preventative maintenance schedule.

For an accurate calibration, the LN2 Saturation Temperature (Section 7.2.1.4) needs to be correctly set based on the altitude of the freezer location.

NOTE: Security Level 2 or higher is required to calibrate temperature sensors.

CAUTION: Always wear protective gloves and face shield when handling LN2. Refer to the Safety section of this manual.
7.3.1.1. Single Point Calibration

The single point calibration procedure requires a small volume of LN2; enough to completely submerge the end of the temperature sensor. It may be possible to use the LN2 in the freezer space if the probe length permits.

1. Press “SETUP”
   Controller will prompt for a password. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “ENTER”
   The display will read “Temp A Menu”. Press “SETUP” for Temp B.

4. Press “ENTER”
   The display will read “Temp A”.

5. Press “SETUP”
   Until the display reads “Temp A Calibration”.

6. Press “ENTER”
   The display will read “Calibration Type”. Use the “▲/▼” keys to adjust to “SINGLE POINT”.

7. Press “ENTER”
   The display will read “Temp A Calibration”. Completely submerge the sensing end of Temp probe A in LN2.

8. Press “ENTER”
   The display will read “Wait for Temp A to stabilize”. Wait for the displayed Temp A reading to stabilize while the probe is submerged in LN2 before pressing “ENTER”.

9. Press “ENTER”
   The display will read “Probe A single point calibration complete”.

   Higher User Level Required use ▲▼ to ENTER Password 0000

   Press ENTER for Temperature Menus or press SETUP for next menu

   Press ENTER for Temp A menu or press SETUP for next menu

   Temp A ENABLED Use ▲▼ to adjust Press ENTER to save

   Calibration Type SINGLE POINT Use ▲▼ to adjust Press ENTER for next

   Temp A Calibration Place Probe A in LN2 and press ENTER

   Wait for Temp A to stabilize then press ENTER Temp A -195.8 °C

   Probe A single point calibration complete
7.3.1.2. Two Point Calibration

The two point calibration procedure requires a small volume of LN2 and an ice water bath; enough to completely submerge the end of the sensor. Proper ice water bath preparation is imperative to ensure accuracy. It is best to add filtered water to a Styrofoam cup containing crushed ice. Allow the solution to stand at room temperature for five minutes prior to beginning procedure.

1. Press “SETUP”
   Controller will prompt for a password. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “ENTER”
   The display will read “Temp A Menu”.
   Press “SETUP” for Temp B.

4. Press “ENTER”
   The display will read “Temp A”.

5. Press “SETUP”
   Until the display reads “Temp A Calibration”.

6. Press “ENTER”
   The display will read “Calibration Type”. Use the “▲/▼” keys to adjust to “Two Point”.

7. Press “ENTER”
   The display will read “Temp A Calibration”. Completely submerge the sensing end of Temp probe A in LN2.

8. Press “ENTER”
   The display will read “Wait for Temp A to stabilize”. Wait for the displayed Temp A reading to stabilize while the probe is submerged in LN2.

9. Press “ENTER”
   The display will read “Remove Probe A from LN2”. Remove the temperature sensor from the LN2.

10. Press “ENTER”
    The display will read “Wait while probe warms to room temperature”. Wait while the temperature sensor warms to room temperature and the controller counts down.
11. **Wait 180 seconds**
   After the controller counts down, the display will read “Place Probe A in ice water”. Completely submerge the sensing end of the probe in the ice water bath.

| Place Probe A in ice water and press ENTER |

12. **Press “ENTER”**
   The display will read “Wait for Temp A to stabilize”. Wait for the displayed Temp A reading to stabilize while the probe is submerged in the ice bath.

| Wait for Temp A to stabilize then press ENTER |
| Temp A 0 °C |

13. **Press “ENTER”**
   The display will read “Probe A two point calibration complete”.

| Probe A two point calibration complete |
7.3.2. **Liquid Nitrogen Level Calibration**

This section describes the procedure to calibrate the LN2 level. This procedure requires the cryogenic meter dip stick supplied with each MVE freezer. This calibration method provides level measurements with a ±0.5" (±13 mm) accuracy.

All new freezers equipped with TEC 3000 controllers have been calibrated at the factory. The liquid level should only be calibrated if faulty readings are suspected, the TEC 3000 itself has been replaced, following a firmware update, or as a part of a preventative maintenance schedule.

**CAUTION:** Always wear protective gloves and face shield when handling LN2. Refer to the Safety section of this manual.

### Dip Stick Procedure

1. Open or remove the freezer lid to access the interior storage space.
2. Hold the meter dip stick vertically with the 0.0 inch end pointed down.
3. Lower the meter dip stick into the LN2 at the bottom of the freezer. Ensure the meter dip stick is vertical and touching the bottom of the inner Dewar. Some LN2 boiling will occur around the meter dip stick.
   a. **MVE High Efficiency / Vapor Series Freezers:**
      Insert meter dip stick into the rectangular channel on the turn tray in order to access the liquid below the tray.
   b. **MVE Series and MVE Cabinet Series Freezers:**
      Lower the meter dip stick to the bottom of the freezer as close to the center as possible to obtain an accurate measurement.
4. Leave the meter dip stick in the LN2 for approximately 5 seconds.
5. Remove the meter dip stick from the liquid and immediately wave it back and forth in the air. A distinct frost line will begin to develop as moisture in the air condenses on the meter dip stick predominately where it was submerged.
6. Subtract 0.5 inches (13 mm) from the observed frost line to account for the LN2 boiling up around the meter dip stick while it was submerged. This resultant level measurement represents the actual liquid level inside the freezer. Once you have obtained the measured level, proceed to the liquid level calibration.

![Figure 11: Meter dip stick showing example level frost line. The resultant measured level would be 5.5 inches after subtracting 0.5 inches from the frost line to account for the LN2 boiling.](image)

**Note:** LN2 liquid at or above turn tray height will rise higher in the dip stick channel.
Level dip stick inserted to measure the physical liquid nitrogen level
Liquid Level Calibration

NOTE: Liquid level calibration cannot be performed while the TEC 3000 is filling. If TEC 3000 is filling, press “Stop Fill” and perform the calibration. Allow freezer plumbing to thaw 10 to 15 minutes before calibrating.

NOTE: Liquid level calibration is most accurate when calibrated at 10.0 inches (254 mm). Calibration must be performed above 3.0 inches (75 mm).

NOTE: Security Level 3 or higher is required to calibrate the liquid level.

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Liquid Level Menus”.

4. Press “ENTER”
   The display will read “High Level Alarm”.

5. Press “SETUP”
   Until the display reads “Advanced Level Menus”.

6. Press “ENTER”
   The display will read “Auto Fill Control”.

7. Press “SETUP”
   Until the display reads “Level Calibration”.

8. Press “ENTER”
   The display will read “Please wait while the sensor zeros”. Wait for the controller to count down from 60 seconds.

9. Wait 60 seconds
   After the controller counts down, the display will read “Actual Level”. Use the “▲/▼” keys to input the meter dip stick measured level.
10. Press “ENTER”
   The display will read “Level Calibration Complete”.

11) Verify that the home screen reads the liquid level value that was just entered. In some cases the controller should be restarted. Contact Technical support with any questions.
7.3.3. Hot Gas Bypass Sensor Calibration

This section describes how to calibrate the TEC 3000 hot gas bypass sensor. There are two calibration procedures: single point and two point calibration. For single point calibration, the reference point is LN2. For two point calibration, the reference points are LN2 and ice water. Unless regulations require a two point calibration, the single point calibration procedure is recommended.

All new freezers equipped with TEC 3000 controllers and hot gas bypass have been calibrated at the factory. The hot gas bypass sensor should only be calibrated if faulty readings are suspected, bypass sensor has been replaced, or as a part of a preventative maintenance schedule.

For an accurate calibration, the LN2 Saturation Temperature (Section 6.2.1.4) needs to be correctly set based on the altitude of the freezer location.

Both the single and two point calibration procedures require a small volume of LN2; enough to completely submerge the bypass sensor. The two point calibration also requires an ice water bath. Proper ice water bath preparation is imperative to ensure accuracy. It is best to add filtered water to a Styrofoam cup containing crushed ice. Allow the solution to stand at room temperature for five minutes prior to beginning the calibration procedure.

NOTE: Security Level 2 or higher is required to calibrate the bypass sensor.
Hot Gas Bypass Sensor Removal

**CAUTION:** Removing the hot gas bypass sensor while a LN2 supply is connected to the freezer will cause the user to be exposed to LN2. Before beginning procedure, shut off and disconnect all LN2 supply sources. Always wear protective gloves and face shield when handling LN2. Refer to the Safety section of this manual.

1. Ensure all LN2 supply sources are shut off and disconnected.
2. Remove plumbing shroud or rear panel to access the plumbing assembly.
3. Locate the hot gas bypass sensor on the plumbing assembly.
4. Using a 9/16” or small adjustable wrench, remove the sensor from the plumbing assembly. It may be necessary to temporarily disconnect the sensor from the wire harness to avoid over twisting of the wires. Following removal of the sensor, reconnect the sensor wires.
5. Perform the hot gas bypass sensor calibration procedure.
6. Following calibration, reinstall the bypass sensor using new PTFE thread tape, ensure sensor wires are connected, reinstall plumbing shroud or rear panel, and reconnect the LN2 supply source.
7.3.3.1. Hot Gas Sensor Single Point Calibration

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “Temperature Menus”.

3. Press “SETUP”
   Until the display reads “Add-on Menus”.

4. Press “ENTER”
   The display will read “Battery Status”.

5. Press “SETUP”
   Until the display reads “Hot Gas Bypass Menus”.

6. Press “ENTER”
   The display will read “Hot Gas Bypass”.

7. Press “SETUP”
   Until the display reads “Bypass Probe Calibration”.

8. Press “ENTER”
   The display will read “Calibration Type”. Use the “▲/▼” keys to set as “SINGLE POINT”.

9. Press “ENTER”
   The display will read “Bypass Calibration”. Submerge the sensing end of the bypass probe in LN2.

10. Press “ENTER”
    The display will read “Wait for Bypass Temp to stabilize”. Wait for the displayed temp reading to stabilize while the probe is submerged in liquid.

11. Press “ENTER”
    The display will read “Bypass Probe single point calibration complete”.

Higher User Level
Required use ▲▼ to ENTER Password
0000

Press ENTER for Temperature Menus or press SETUP for next menu

Press ENTER for Add-on menus or press SETUP for next menu

Battery Status
On AC Power

Press ENTER to Hot Gas Bypass menus or press SETUP for next menu

Hot Gas Bypass
ENABLED
Use ▲▼ to adjust
Press ENTER to save

Press ENTER for Bypass Probe Calibration or press SETUP for next menu

Calibration Type
SINGLE POINT
Use ▲▼ to adjust
Press ENTER for next

Bypass Calibration
Place Bypass Probe in LN2 and press ENTER

Wait for Bypass
Temp to stabilize
then press ENTER
Bypass Temp -195.8 °C

Bypass Probe
Single point
Calibration complete
7.3.3.2. Hot Gas Sensor Two Point Calibration

1. Press “SETUP”
   Controller will prompt for a password. A flashing cursor will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”
   The display will read “TemperatureMenus”.

3. Press “SETUP”
   Until the display reads “Add-on Menus”.

4. Press “ENTER”
   The display will read “Battery Status”.

5. Press “SETUP”
   Until the display reads “Hot Gas Bypass Menus”.

6. Press “ENTER”
   The display will read “Hot Gas Bypass”.

7. Press “SETUP”
   Until the display reads “Bypass Probe Calibration”.

8. Press “ENTER”
   The display will read “Calibration Type”. Use the “▲/▼” keys to set as “TWO POINT”.

9. Press “ENTER”
   The display will read “Bypass Calibration”. Submerge the sensing end of the bypass probe in LN2.

10. Press “ENTER”
    The display will read “Wait for Bypass Temp to stabilize”. Wait for the temp reading to stabilize while the probe is submerged in LN2.

11. Press “ENTER”
    The display will read “Remove Probe A from LN2”. Remove the bypass sensor from the LN2.

12. Press “ENTER”
    The display will read “Wait while probe warms to room temperature”. Wait while the bypass sensor warms to room temperature and the controller counts down.

13. Press “ENTER”
    The display will read “Wait 180 seconds”.

After the controller counts down, the display will read “Place Probe A in ice water”. Completely submerge the sensing end of the probe in the ice water bath.

14. Press “ENTER”
    The display will read “Wait for Temp A to stabilize”. Wait for the displayed Temp A reading to stabilize while the probe is submerged in the ice bath.

15. Press “ENTER”
    The display will read “Bypass Probe two point calibration complete”.

Higher User Level Required use ▲▼ to ENTER Password 0000

Press ENTER for Temperature Menus or press SETUP for next menu

Press ENTER for Add-on menus or press SETUP for next menu

Battery Status
On AC Power

Press ENTER to Hot Gas Bypass menus or press SETUP for next menu

Hot Gas Bypass ENABLED
Use ▲▼ to adjust
Press ENTER to save

Press ENTER for Bypass Probe Calibration or press SETUP for next menu

Calibration Type
TWO POINT
Use ▲▼ to adjust
Press ENTER for next

Bypass Calibration
Place Bypass Probe in LN2 and press ENTER

Wait for Bypass Temp to stabilize then press ENTER
Bypass Temp -195.8 °C

Remove Bypass Probe from LN2 and press ENTER

Wait while probe warms to room temperature
180 seconds

Place Bypass Probe in ice water and press ENTER

Wait for Bypass Temp to stabilize then press ENTER
Bypass Temp 0.0 °C

Bypass Probe two Point calibration complete
7.4. Communication / Networking

The TEC 3000 is equipped with two independent RJ-45 serial ports. These ports are intended for connection to another MVE controller, PC, serial printer, or other RS-485 device. Up to 100 TEC 3000 controllers can be successfully networked.

NOTE: The TEC 3000 should never be connected directly to a LAN or public telecommunications network.

![Figure 12: TEC 3000 serial ports and RS-485 4-wire pin diagram](image1)

![Figure 13: Standard RJ-45 cable assembly wiring details (PN 10740053). Wire colors may vary.](image2)

<table>
<thead>
<tr>
<th>COM Setup</th>
<th>bits/sec</th>
<th>Parity</th>
<th>Data bits</th>
<th>Stop bits</th>
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<td>8</td>
<td>1</td>
</tr>
<tr>
<td>19200 N82</td>
<td>19200</td>
<td>None</td>
<td>8</td>
<td>2</td>
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<table>
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<th>OFAF</th>
<th>MODBUS</th>
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<tr>
<td>Transmission</td>
<td>Mode</td>
<td>Terminator</td>
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<td></td>
<td></td>
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<td>4-wire</td>
<td>Asynchronous</td>
<td>CR, LF</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7.4.1. TEC Connect (Computer Interface)

TEC Connect is a free, downloadable software program that enables a user to download the event log and query and adjust controller parameters. This easy-to-use computer interface is fully compatible with TEC 2000, TEC 3000, and Chart TS controllers. Features include a user-friendly ASCII command window, real-time temperature and level monitoring, event log download button, fill control buttons, and a quick parameter setup table.

![TEC Connect screenshot](image)

**Figure 14:** TEC Connect screen shot

**Required Items**
- Microsoft Windows (7, Vista, XP, 2000, 98)
- MVE TEC COM USB Kit (P/N 13376947)
- USB Port
Installing MVE TEC COM USB Kit
1. Insert the included USB to Serial Driver Disc into the PC CD-ROM
2. Plug the MVE TEC COM USB Kit into an open USB port
3. Follow the automatic installation prompts

Downloading TEC Connect
1. Uninstall in any previous TEC Connect versions
2. The latest version is available online at the Chart Industries website
3. Click the link and open the compressed folder
4. Extract all files from the compressed folder to a location on your hard drive
5. Open the extracted SETUP file
6. Follow the prompts to complete installation
7. A TEC Connect icon should appear on your programs list when complete

Connecting to Chart TS
Chart TS Settings
1. COM Setup: “9600 N81”
2. COM Type: “ASCII”
3. Select a unique MODBUS ID (Unit ID) for each controller involved

TEC Connect Settings
1. Connect Chart TS serial port to PC with MVE TEC COM USB Kit.
2. Open TEC Connect
3. The TEC Connect program Determine the Windows COM Port. This can be accomplished by navigating to the device manager and locating the COM port labeled “RS-485 Isolated Port”
4. Note the COM number listed beside “RS-485 Isolated Port” in the Device Manager window.
5. Close Device Manager and click “OK”
6. Select the appropriate Windows COM Port from the drop down menu
7. Connect to Chart TS
   • For a single controller: Check the “Auto Find” box or enter the MODBUS ID of the controller and click “Connect”.
   • For networked controllers: Uncheck the “Auto Find” box, enter the Unit ID of the desired controller, and click “Connect”. In order to connect to another controller on the network, click “Disconnect”, change the Unit ID, and then click “Connect”.
8. If the controller is successfully connected, the current temperature and level information from the controller will be displayed and “COMX connected” will be displayed under “Status”, where X is the COM port the TEC COM kit is connected to on the PC.

NOTE: Contact your MVE Distributor or Technical Service if you experience problems connecting to a controller.

Downloading the Event Log
1. Connect to controller using TEC Connect
2. Select Event Download Range with Event 1 being the most recent logged event. The default download range includes all events.
3. Select the “Download” button. Once the event log has finished downloading, select “Open Download” button.
Plotting the Event Log
1. Open downloaded event log with EXCEL
2. Before plotting be sure to delete any rows containing text; such as, “Parameter number…” refer to figure 15 for clean data
3. Insert new column between the Time and Temp A columns
4. Label this new column heading Date/Time
5. In cell E4, enter the formula “=C4+D4”
6. Fill down the rest of column E with this formula
7. Format the cells in column E so that the Number Category is Date and the Type is a date/time combination
8. Sort all the data by Descending Date, then by Descending Time, and then by Ascending Record #
9. Select the desired data to plot (Date/Time through LN2 Usage columns) and insert a scatter chart.
10. Once the chart has been created, select a secondary axis for the LN2 Level and LN2 Usage data sets
11. Format the chart and adjust the axis scales so that the data is easy to view and analyze.

Figure 15: Properly formatted event log for plotting
ASCII Command Interface
American Standard Code for Information Interchange (ASCII) commands can be used to query and adjust all TEC 3000 settings and parameters. Commands must be entered in all capital letters just as they appear in the below tables. For a complete list of proper syntax and responses, refer to Section 10.2 in the Appendix.

### CONTROL COMMANDS

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>*IDN?</td>
<td>ID Query</td>
</tr>
<tr>
<td>CODE?</td>
<td>Global Password Query</td>
</tr>
<tr>
<td>ALMS</td>
<td>Set Alarm Status</td>
</tr>
<tr>
<td>HITSTA</td>
<td>Initiate Temp A High Alarm Test</td>
</tr>
<tr>
<td>ALMS?</td>
<td>Alarm Status Query</td>
</tr>
<tr>
<td>HITSTB</td>
<td>Initiate Temp B High Alarm Test</td>
</tr>
<tr>
<td>CALTA</td>
<td>Calibrate Temp A in LN2</td>
</tr>
<tr>
<td>LNSATP</td>
<td>Set LN2 Saturation Temp</td>
</tr>
<tr>
<td>CALTB</td>
<td>Calibrate Temp B in LN2</td>
</tr>
<tr>
<td>LNSATP?</td>
<td>LN2 Saturation Temp Query</td>
</tr>
<tr>
<td>CALVL</td>
<td>Set Level Offset</td>
</tr>
<tr>
<td>LNSATP?</td>
<td>LN2 Saturation Temp Query</td>
</tr>
<tr>
<td>CALVL?</td>
<td>Level Offset Query</td>
</tr>
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</table>

### TEMPERATURE COMMANDS

<table>
<thead>
<tr>
<th>Command</th>
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<tbody>
<tr>
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<td>Bypass Temp Query</td>
</tr>
<tr>
<td>LOTA</td>
<td>Set Temp A Low Alarm</td>
</tr>
<tr>
<td>LOA?</td>
<td>Temp A Low Alarm Query</td>
</tr>
<tr>
<td>LOTAS?</td>
<td>Temp A Low Alarm Status Query</td>
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<td>HIT?</td>
<td>Temp A High Alarm</td>
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<td>LOTAM?</td>
<td>Temp A Low Alarm Mask</td>
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<td>LOTS?</td>
<td>Temp B Low Alarm Mask</td>
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<td>HITB?</td>
<td>Temp B High Alarm Query</td>
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</tr>
<tr>
<td>HITBS?</td>
<td>Temp B High Alarm Status Query</td>
</tr>
<tr>
<td>TEMPA?</td>
<td>Current Temp A Query</td>
</tr>
<tr>
<td>HITBM</td>
<td>Set Temp B High Alarm Mask</td>
</tr>
<tr>
<td>TEMPB?</td>
<td>Current Temp B Query</td>
</tr>
<tr>
<td>HITB?</td>
<td>Temp B High Alarm Mask Query</td>
</tr>
<tr>
<td>LOTES?</td>
<td>Temp B Low Alarm Mask</td>
</tr>
<tr>
<td>HITB?</td>
<td>Temp B High Alarm Mask Query</td>
</tr>
<tr>
<td>LOTB?</td>
<td>Temp B Low Alarm Mask</td>
</tr>
<tr>
<td>HITBM?</td>
<td>Temp B High Alarm Mask Query</td>
</tr>
<tr>
<td>LOTBS?</td>
<td>Temp B Low Alarm Status Query</td>
</tr>
<tr>
<td>HILA</td>
<td>Set Temp B High Alarm</td>
</tr>
<tr>
<td>LUNI?</td>
<td>Temp Units Query</td>
</tr>
<tr>
<td>HILA?</td>
<td>Temp B High Alarm</td>
</tr>
<tr>
<td>LUNI?</td>
<td>Temp Units Query</td>
</tr>
</tbody>
</table>

### LEVEL COMMANDS

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPFIL?</td>
<td>Bypass Status Query</td>
</tr>
<tr>
<td>HFIL</td>
<td>High Level Setpoint</td>
</tr>
<tr>
<td>HFIL?</td>
<td>High Level Setpoint Query</td>
</tr>
<tr>
<td>FILAS?</td>
<td>Fill Time Alarm Status Query</td>
</tr>
<tr>
<td>LFIL?</td>
<td>Level Setpoint Query</td>
</tr>
<tr>
<td>FILL?</td>
<td>Fill Status Query</td>
</tr>
<tr>
<td>LFIL?</td>
<td>Level Setpoint Query</td>
</tr>
<tr>
<td>FILL?</td>
<td>Fill Status Query</td>
</tr>
<tr>
<td>LFIL?</td>
<td>Level Setpoint Query</td>
</tr>
<tr>
<td>FILL?</td>
<td>Fill Status Query</td>
</tr>
<tr>
<td>LFIL?</td>
<td>Level Setpoint Query</td>
</tr>
<tr>
<td>FILFIL?</td>
<td>Fill Time Alarm Status Query</td>
</tr>
<tr>
<td>LFIL?</td>
<td>Level Setpoint Query</td>
</tr>
<tr>
<td>FILTIM?</td>
<td>Current Fill Duration Query</td>
</tr>
<tr>
<td>LOLA?</td>
<td>Low Level Alarm</td>
</tr>
<tr>
<td>HILA?</td>
<td>High Level Alarm</td>
</tr>
<tr>
<td>LUNI?</td>
<td>Level Units Query</td>
</tr>
<tr>
<td>HILA?</td>
<td>High Level Alarm</td>
</tr>
<tr>
<td>LUNI?</td>
<td>Level Units Query</td>
</tr>
<tr>
<td>HILA?</td>
<td>High Level Alarm</td>
</tr>
<tr>
<td>LUNI?</td>
<td>Level Units Query</td>
</tr>
<tr>
<td>HILA?</td>
<td>High Level Alarm</td>
</tr>
<tr>
<td>LUNI?</td>
<td>Level Units Query</td>
</tr>
<tr>
<td>HILS?</td>
<td>High Level Alarm Status Query</td>
</tr>
<tr>
<td>RATE?</td>
<td>Current Liquid Usage Query</td>
</tr>
</tbody>
</table>

### LEVEL PERCENT COMMANDS

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSPN?</td>
<td>Define 100% Point</td>
</tr>
<tr>
<td>DZER?</td>
<td>Define 0% Point</td>
</tr>
<tr>
<td>DSPN?</td>
<td>100% Point Query</td>
</tr>
<tr>
<td>DZER?</td>
<td>0% Point Query</td>
</tr>
<tr>
<td>PCNT?</td>
<td>Current Percent Query</td>
</tr>
</tbody>
</table>

### EVENT LOG COMMANDS

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEVLG</td>
<td>Clear Event Log</td>
</tr>
<tr>
<td>LOGPER</td>
<td>Set Event Log Interval</td>
</tr>
<tr>
<td>DATE?</td>
<td>Date Query</td>
</tr>
<tr>
<td>LOGPER?</td>
<td>Event Log Interval Query</td>
</tr>
<tr>
<td>DATE?</td>
<td>Date Query</td>
</tr>
<tr>
<td>TIME?</td>
<td>Set Time</td>
</tr>
<tr>
<td>EVENT?</td>
<td>Last Event Query</td>
</tr>
<tr>
<td>TIME?</td>
<td>Time Query</td>
</tr>
<tr>
<td>EVNCT?</td>
<td>Number of Events Query</td>
</tr>
<tr>
<td>UNID?</td>
<td>Set Unit ID</td>
</tr>
<tr>
<td>EVNLOG?</td>
<td>Event Log [n] Query</td>
</tr>
<tr>
<td>UNID?</td>
<td>Unit ID Query</td>
</tr>
</tbody>
</table>
7.4.2. **OFAF Network Setup**

OFAF networking allows multiple controllers to be linked together such that all of the freezers will fill whenever any networked controller calls for a fill. When multiple freezers are connected to a common supply source, it is advantageous to fill all freezers at the same time. LN2 transfer losses are significantly reduced by filling all networked freezers while the supply system is primed and cold. Using and OFAF network is more efficient than cooling the supply system every time an individual freezer fills. This approach is also more efficient than employing a keep full / keep cold system. Up to 100 TEC 3000 can be connected to an OFAF network.

An OFAF network can be configured in two modes: “Sequential” or “Simultaneous.” For both modes, when any controller in the network initiates a fill, the Master controller (OFAF ID 1) recognizes this and triggers all other controller to initiate fills as well.

In Sequential OFAF mode, once the controller that initiated the first fill has reached its High Level Setpoint, the Master will trigger the freezer with the next sequential OFAF ID to fill until it reaches its High Level Setpoint. The Master will then trigger the freezer with the next sequential OFAF ID to fill and this process will continue until all freezers in the network including the Master have reached their High Level Setpoints.

In Simultaneous OFAF mode, when any controller initiates a fill and fills for at least 60 seconds, the Master will then broadcast a signal for all freezers, including itself, to begin filling. Each freezer will continue to fill until its High Level Setpoint is reached.

A user would select sequential OFAF over simultaneous if their supply system is not able to maintain the proper filling pressure while multiple freezers filling at the same time. Sequential OFAF allows freezers to fill one at a time with a primed and cold supply system so that it is easier for the system to maintain the proper filling pressure.

![Diagram showing differences between Sequential and Simultaneous OFAF](image-url)

**Figure 16:** Diagram showing differences between Sequential and Simultaneous OFAF
Network Setup

![Diagram showing a typical OFAF network setup]

Figure 17: Diagram showing a typical OFAF network setup

Table 7: Required items for OFAF network

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
<th>Quantity needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>11358251</td>
<td>OFAF Master Cable</td>
<td>1</td>
</tr>
<tr>
<td>10740053</td>
<td>Standard CAT 5e Cable</td>
<td># of controllers - 2</td>
</tr>
<tr>
<td>10856312</td>
<td>RJ-45 Splitter</td>
<td># of controllers - 2</td>
</tr>
</tbody>
</table>

1. Designate the Master controller by setting its OFAF ID to “1”. Generally, this is the controller on the far end of the network from the LN2 supply.
2. Connect one end of the OFAF Master Cable to either Serial Port 1 or 2 of the Master controller.

NOTE: Either Serial Port 1 or 2 can be used for OFAF as long as the COM Types are in agreement.

3. Connect an RJ-45 splitter to the next controller in the network. Connect the free end of the OFAF Master Cable to this splitter.
4. Set the OFAF ID of this second controller to “2”.
5. Connect an RJ-45 splitter to the third controller in the network. Connect the splitters on the second and third controllers with a standard CAT 5e cable.
6. Set the OFAF ID of the third controller to “3”.
7. Continue this pattern until all controllers in the network are daisy chained and assigned sequential OFAF IDs.
8. Each controller in the network should also have the following settings:
   a. Auto Fill Control “Enabled”
   b. COM Setup “9600 N81”
   c. COM Type “OFAF”
   d. OFAF Type “Sequential” or “Simultaneous”. All controllers in a network must have the same OFAF Type.
   e. OFAF Units “# of controllers - 1”. The Master controller is not counted in the number of OFAF Units. All controllers in a network must have the same number of OFAF Units.
Cable Wiring

OFAF Master Cable

1
2
3
4
5
6
7
8

Figure 18: OFAF Master Cable wiring configuration. Numbering as viewed from side of RJ-45 connector opposite latch.

Standard Cable

1
2
3
4
5
6
7
8

Figure 19: Standard reverse RJ-45 network cable configuration. Numbering as viewed from side of connector opposite latch.

Note: Pressing Stop Fill will delay the automatic fill circuit for 30 minutes. To initiate the Auto Fill Circuit restart the controller.
7.4.3. Printer Setup

The TEC 3000 compatible printer kit allows users to print a hard copy of the freezer’s status at a set interval and as events occur. The TEC 3000 will print the current status of the freezer in the event log format. The default print interval is 30 minutes.

NOTE: Adjusting the print interval will not affect the event log interval. These two parameters are independent. The event log interval can be adjusted using ASCII commands. All printed events are not necessarily logged in the event log; however, all the events in the event log are printed.

TEC 3000 Printer Kit (P/N 11544943)
- Epson Printer
- RS-485 Converter and Adapters
- DB-25 Cable
- User’s Guide

Installation
1. Setup printer as described in the included user’s guide
2. Assemble and connect RS-485 converter and adapters as shown below
3. Connect the printer to TEC 3000 serial port 1 or 2 via the RS-485 converter assembly
4. Set the corresponding COM Setup to “9600 N81”
5. Set the corresponding COM Type to “Printer”
6. Adjust the Print Interval to the desired value
7. Test setup by forcing an event or printing a new header or event
7.5. Remote Alarm Tests

7.5.1. Global Remote

The Global Remote contacts can be checked for continuity using a digital multimeter or ohmmeter.

- Normal State (No Alarms)
  There should be continuity between the COM and NC terminals
  The COM – NO circuit should be open

- Alarm State
  There should be continuity between the COM and NO terminals
  The COM – NC circuit should be open

7.5.2. Discrete Contacts

The Discrete Contacts can be tested for continuity using a digital multimeter with diode check. Since the Discrete Contacts are open collectors, the diode check function ( ) should be used.

- Normal State (No Alarms)
  All Discrete Contact terminals should be open with respect to COMMON

- Alarm State
  There should be continuity between the specific active alarm terminal and COMMON. Inactive alarms should remain open with respect to COMMON
8. TEC 3000 Menu Maps

8.1. Main Setup Menus
8.2. Temperature Setting Menus

Press ENTER for Temperature menu or press SETUP for root menu.

(ENTER Level 2)

Press ENTER for Temp B menu or press SETUP for root menu.

Temp A High Alarm
-100.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp A Low Alarm
-200.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp A High Alarm
-100.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp B Low Alarm
-300.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp B High Alarm
-40.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp B Low Alarm
-300.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp B High Alarm
-40.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp A High Alarm
-100.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp A Low Alarm
-200.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp A High Alarm
-100.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp A Low Alarm
-200.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp A High Alarm
-100.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp A Low Alarm
-200.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp A High Alarm
-100.0°C
Use T.1 to adjust
Press ENTER to save

Setup

Temp A Low Alarm
-200.0°C
Use T.1 to adjust
Press ENTER to save

Setup
8.3. Temperature Calibration Menus

Press ENTER for Temp A Calibration or press ENTER for next menu

Calibration type (single or two)

Temp A Calibration
Place Probe A in LNG and press ENTER

Wait for Temp A to stabilize then press ENTER
Temp A -155.8°C

Probe A single point calibration complete

Remove Probe A from LNG and press ENTER

Wait while probe warms in room
Temperature 180 seconds

Place Probe A in ice water and press ENTER

Wait for Temp A to stabilize then press ENTER
Temp A 0°C

Probe A two-point calibration complete

Press ENTER for Temp B Calibration or press ENTER for next menu

Temp B Calibration
Place Probe B in LNG and press ENTER

Wait for Temp B to stabilize then press ENTER
Temp B -155.8°C

Probe B single point calibration complete

Remove Probe B from LNG and press ENTER

Wait while probe warms in room
Temperature 180 seconds

Place Probe B in ice water and press ENTER

Wait for Temp B to stabilize then press ENTER
Temp B 0°C

Probe B two-point calibration complete
8.4. Add On Menus
8.5. Hot Gas Bypass Sensor Calibration Menus

Press ENTER for Bypass Probe Calibration or press SETUP for next menu

Enter

Calibration Type SINGLE POINT (Use \( \uparrow \) to adjust
Press ENTER for next:

Enter

5 sec time out

Calibration aborted!

Enter

Bypass Calibration Place Bypass Probe in LN2 and press ENTER

Enter

Wait for Bypass Temp to stabilize then press ENTER
Bypass Temp -195.9°C

Enter

Remove Bypass Probe from LN2 and press ENTER

Enter

Wait while probe warms to norm temp approx 30 seconds

160 sec time out

Place Bypass Probe in ice water and press ENTER

Enter

Wait for Bypass Temp to stabilize then press ENTER
Bypass Temp 0.0°C

Enter

Bypass Probe two point calibration complete

Enter
8.6. Display and Output Menus

- **Level Units**
  - Use ++ to adjust
  - Press ENTER to save

- **Setup**
  - Define 100% 8.0% in
  - Use ++ to adjust
  - Press ENTER to save

- **Setup**
  - Define 0% 0.0% in
  - Use ++ to adjust
  - Press ENTER to save

- **Press ENTER for Display and Output or press SETUP for next menu**

- **Temperature Units**
  - Use ++ to adjust
  - Press ENTER to save

- **Set**

- **Press ENTER for Level Display Menus or press SETUP for next menu**

- **Display liquid usage ENABLED**
  - Use ++ to adjust
  - Press ENTER to save

- **Setup**

- **Press ENTER for Advanced Display and Output or press SETUP for next menu**

- **ENTER (Security Level 2)**

- **Alarm banner ENABLED**
  - Use ++ to adjust
  - Press ENTER to save

- **Print interval**
  - 30 Minutes
  - Use ++ to adjust
  - Press ENTER to save

- **Set**

- **Press ENTER to Print Header or press SETUP for next menu**

- **Set**

- **Language**
  - ENGLISH
  - Use ++ to adjust
  - Press ENTER to save

- **Set**

- **Press ENTER for Printer menus or press SETUP for next menu**

- **Set**
8.7. Liquid Level Menus

Press ENTER for Liquid Level menus or press SETUP for next menu.

ENTER (Security Level 2)

High Level Alarm
4.0 in
Use ↑↓ to adjust
Press ENTER to save

Setup

High Level Setpoint
7.0 in
Use ↑↓ to adjust
Press ENTER to save

Setup

Low Level Setpoint
6.0 in
Use ↑↓ to adjust
Press ENTER to save

Setup

Low Level Alarm
4.0 in
Use ↑↓ to adjust
Press ENTER to save

Setup

Press ENTER for Advanced Level menus or press SETUP for next menu.

ENTER (Security Level 3)

Auto Fill Control
ENABLED
Use ↑↓ to adjust
Press ENTER to save

Setup

Level Offset
1.3 inches
Use ↑↓ to adjust
Press ENTER to save

Setup

Level Calibration Press ENTER to start calibration or SETUP for next
8.8. Liquid Level Calibration Menus

- Calibration aborted!
- Please wait while the sensor zeroes 60 seconds
- Actual Level: 10.0 in
  Use ↑ or ↓ to adjust
  Press ENTER to save

ENTER

Leve Calibration Complete
8.9. Advanced Settings Menus
8.10. Password Menus

Password 1 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 2 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 3 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 4 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 5 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 6 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 7 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 8 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Press ENTER for Password menus or press SETUP for next menu

ENTER (Security Level 4)

Password Entry Mode
Select the use ↑ or ↓ to adjust
Press ENTER to save

Setup

Password 1 Input
Use ↑ or ↓ to adjust
Press ENTER for next
XXX

Password 2 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 3 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 4 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 5 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 6 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 7 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 8 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Press ENTER to Change Password 1 or press Setup for next

Setup

Password 1 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 2 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 3 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 4 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 5 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 6 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 7 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 8 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Press ENTER to Change Password 1 or press Setup for next

Setup

Password 1 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 2 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 3 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 4 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 5 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 6 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 7 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 8 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Press ENTER to Change Password 1 or press Setup for next

Setup

Password 1 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 2 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 3 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 4 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 5 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 6 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 7 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 8 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Press ENTER to Change Password 1 or press Setup for next

Setup

Password 1 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 2 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 3 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 4 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 5 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 6 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 7 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Password 8 Input
Use ↑ or ↓ to adjust
Press ENTER for next
Level 1

Press ENTER to Change Password 1 or press Setup for next

Setup
# TEC 3000 Display Screens

## Main Display
- **Temp A**: -200.0°C<br>**Level**: 0.0°C<br>**Status**: Downlow<br>- **Temp B**: -200.0°C<br>**Level**: 0.0°C<br>**Status**: Downlow<br>- **Temp C**: -200.0°C<br>**Level**: 0.0°C<br>**Status**: Downlow

## Filling Display
- **Temp A**
  - **Alarm**: High Temp A<br>  - **Event**: 11/25/05 15:30
- **Temp B**
  - **Alarm**: Low Temp A<br>  - **Event**: 11/25/05 15:30

## Bypass Display
- **Temp A**
  - **Alarm**: High Temp A<br>  - **Event**: 11/25/05 15:30

## Alternate Display Text
- **Alarm**: High Temp B<br>  - **Event**: 11/25/05 15:30

## Power Up Display
- **Alarm**: High Temp C<br>  - **Event**: 11/25/05 15:30

## Confirmation Display
- **Alarm**: Higher User Level<br>  - **Event**: 11/25/05 15:30

## Loss of communications from the control board to the display (English Only)
- **Alarm**: Communications Loss<br>  - **Event**: 11/25/05 15:30
9. Preventative Maintenance

9.1. Preventative Maintenance Schedule

This section describes the preventative maintenance that should be performed on MVE freezers to ensure optimum operation and performance, as well as maximum service life. As with any technical piece of laboratory equipment, preventative maintenance is key to equipment success.

NOTE: This is the MVE recommended preventative maintenance. MVE Distributors may have a more comprehensive maintenance/service plan. At the minimum, the below schedule should be followed.

Table 8: Periodic Preventative Maintenance Schedule

<table>
<thead>
<tr>
<th></th>
<th>Weekly</th>
<th>Monthly</th>
<th>6 Months</th>
<th>12 Months</th>
<th>24 Months</th>
<th>60 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Verification</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verify Adequate Supply</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Plumbing Leak Check</td>
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<td>X</td>
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</tr>
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<td>High Temp Alarm Test</td>
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<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level Alarm Test</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thaw Freezer Lid</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Folding Step Inspection</td>
<td></td>
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<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Lid Hinge Inspection</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>X</td>
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<tr>
<td>Inline Filter Replacement</td>
<td></td>
<td></td>
<td></td>
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<td>X</td>
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9.2. Preventative Maintenance Procedures

Level Verification

The differential pressure measurement system used on MVE freezers is nearly maintenance free. It provides a high level of accuracy and resolution to give the operator a precise indication of the exact amount of LN2 present in the freezer at all times. Despite its reliability, it is important that the accuracy of the level measurement system is verified on a weekly basis. This will prevent a control system malfunction from adversely affecting the temperature in the freezer storage space. Use the meter dipstick provided with every MVE freezer to manually measure the amount of LN2 in the freezer. Follow the “Dip Stick Procedure” listed in section 6.3.2 to properly measure the level. If the level is off by 1.0 inch (25mm) or more, follow the calibration procedure listed in the aforementioned section.

Verify Adequate Supply

Adequate LN2 supply pressure and flow is imperative to the proper operation of MVE freezers. Any LN2 supply whether from bulk tank or liquid cylinder must be able to maintain a pressure of 22-35 psi (1.52 – 2.41 bar) during a filling cycle, and must have enough liquid to ensure the completion of a fill cycle. The majority of nuisance alarms reported from MVE freezers are due to inadequate supply.

1. Observe the pressure of the supply source. Ideally, pressure should be 22 – 35 psi (1.52 – 2.41 bars).

   NOTE: It is very common for the pressure gauge on an industrial liquid cylinder to be inoperative. If you suspect this to be the case, install a pressure gauge inline between the liquid cylinder and the freezer for verification.

2. Verify the amount of liquid in the supply source. Most bulk tanks have some method of digital or analog volume measurement. Liquid cylinders typically use a sight gauge. As with the pressure gauge on liquid cylinders, it is common for the sight gauge to be inoperative.

3. The minimum amount of liquid necessary in the supply should be enough to completely fill the number of freezers it is supplying. This amount can be determined from the LN2 inch to volume table in the Appendix.

4. Initiate a fill start on at least one freezer on the network. The supply system should be able to maintain appropriate pressure throughout the duration of the fill cycle.

5. If the supply is determined to be inadequate, have your gas supplier replenish/replace the supply.
Plumbing Leak Check

Leaky plumbing connections can create a host of problems including but not limited to:

- Slow fill times
- Nuisance Alarms
- High LN2 Consumption
- Inaccurate level readings
- Inaccurate liquid usage readings

Leaky plumbing connections are especially common on liquid cylinder supply systems, since the fittings are regularly loosened and tightened during liquid cylinder swap out.

1. With the supply system at operating pressure, thoroughly spray all transfer hose connections and freezer plumbing connections with leak detect solution
2. Allow leak detect solution to penetrate fittings for at least 30 seconds
3. Large leaks will be immediately apparent with large bubble formations
4. Small leaks will take longer to detect, with small bubble formation in the appearance of “foam”
5. Most leaks can be repaired by tightening the suspect fitting with a crescent or appropriate sized wrench.
6. If tightening the fitting does not fix the leak, check the fitting for cracks and or galling. If the fitting is damaged, replace.
7. Recheck any replaced fittings for leaks.

High Temp Alarm Test

Please refer to Section 7.2.1.2 page 48 for details and instructions on the High Temp Alarm Test.
Level Alarm Test

The TEC 3000 control system can trigger a high level or low level alarm if the LN2 level in the freezer exceeds the user defined parameters.

High Level Alarm Test:

1. Observe and record the current LN2 level
2. Record the current level settings. They may be accessed by pressing the “▲” and “▼” simultaneously to access the quick reference menu, or through the Liquid Level Menus. The current LN2 level should be between the High Level Alarm setting and Low Level Alarm setting. If not, allow the freezer to fill until it reaches the High Level Fill set point.
3. Adjust the level offset so that the current level is a value that is greater than the High Level Alarm setting. For example, if the High Level Alarm setting is currently 10.0 inches, increase the offset value by at least 1.0 inch. This will "fool" the controller into thinking that the level inside the freezer is higher than actual. Reference section 7.2.2.3 page 54 for level offset adjustment.
4. Observe the audible/visual alarm. Be aware that the level alarms have a one minute delay. This delay is intentional and is to prevent nuisance alarms.
5. If the alarm does not occur after one minute, verify that the audible alarm is turned on
6. Decrease the offset value to the original observed setting.

Low Level Alarm Test (Stand Alone TEC 3000 configuration):

1. Observe and record the current LN2 level.
2. Remove the vinyl tube from the hose barb on the bottom of the TEC 3000. Be careful not to damage the tube.
3. The displayed level should drop to 0.0 inches.
4. After one minute, the audible alarm should sound.
5. If the alarm does not sound, verify that the audible alarm is turned on.
6. Reconnect the vinyl tube. If the tube is deformed at the end, it may be necessary to trim off ¼” of the tube to ensure a good connection.
7. Press “Fill Start” to purge the level sensing line. After 30 seconds, the level should gradually increase to actual.
8. After the fill cycle is complete, manually measure the level using the dipstick.

Low Level Alarm Test (Cabinet model freezers):

1. Observe and record the current LN2 Level
2. Adjust the High Level Alarm setting to a value that is at least 5.0 inches higher than the current LN2 level. For example, if the current LN2 level is 5.0 inches, adjust the High Level Alarm setting to at least 10.0 inches.
3. Adjust the High Level Fill setting to a value that is at least 4.0 inches higher than the current LN2 level.
4. Adjust the Low Level Fill setting to a value that is at least 3.0 inches higher than the current LN2 level. If auto fill is enabled, the freezer will begin filling automatically. Press “Fill Stop” to terminate the fill.
5. Adjust the Low Level Alarm setting to a value that is at least 2.0 inches higher than the current LN2 Level
6. After one minute, the Low Level Alarm should sound.
7. After alarm verification, return all level settings to their normal values.
Lid Thaw Procedure

1. Open or remove lid from freezer. Depending on the freezer model, it may be necessary to remove the lid from the hinges for it to completely warm to room temperature.
2. It is recommended that the freezer opening be covered with a spare lid or in another non-airtight manner to prevent moisture from entering the storage space and to minimize the top box temperature change while the lid is open.
3. Allow lid to sit at room temperature for approximately 30 minutes.
4. Once thawed, thoroughly dry lid, cork, and liner.
5. Inspect lid for damage and replace parts if necessary.

Folding Step Inspection

MVE 1500 and 1800 series freezers equipped with folding steps assemblies should be inspected for integrity at least every 6 months. Verify that hinges and free of cracks and all connections are secure. Check that the anti-slip strips on the steps are in good condition and replace if necessary (PN 4810179). Ensure the step locking strap is able to securely hold the steps in their folded position. If the pivot bolts continuously loosen, apply thread locker (PN 11087674) and retighten.

Lid Hinge Inspection

MVE freezers with hinged lids should be inspected for integrity at least every 6 months. Verify that the hinges are free of damage and securely attached to the freezer and lid. MVE hinged freezers are counterbalanced for easy opening and closing. Ensure the lid opens smoothly to a near 90° angle. The lid should remain completely open without assistance. Ensure lid closes smoothly and comes to rest centered on the freezer. Adjust hinges or replace as needed. For part numbers, contact Customer/Technical Service with the freezer serial number.

Inline Filter Replacement – For Stock, HE, Cabinet, and MVE series

**CAUTION:** Ensure that the LN2 supply valve is closed and the plumbing assembly is vented before removing the inline filter.

1. Close the LN2 supply valve and disconnect the LN2 transfer hose from the plumbing assembly fill tee.
2. Loosen and remove the fill tee and inline filter from the plumbing assembly.
3. Replace the inline filter (PN 11648945) and reassemble the fill tee and filter to the plumbing assembly using new Teflon tape if needed. Ensure the filter is oriented correctly so that the affixed arrow indicates the direction of LN2 flow.
4. Reconnect the LN2 transfer hose, open the LN2 supply valve and check fittings for any leaks.

Inline Filter Replacement – HEco Series

**CAUTION:** Ensure that the LN2 supply valve is closed and the plumbing assembly is vented before removing the inline filter.

1. Close the LN2 supply valve and disconnect the LN2 transfer hose from the plumbing assembly fill tee.
2. Using an adjustable wrench, loosen and remove the inline filter (Y Strainer – PN 20669243).
3. Clean/Replace the strainer as necessary. Reassemble the fill tee and filter to the plumbing assembly.
assembly using Teflon tape if needed. Ensure the filter is oriented correctly.

4. Reconnect the LN2 transfer hose, open the LN2 supply valve and check fittings for any leaks.

Complete Function Test

MVE recommends that freezers with TEC 3000 controllers undergo a complete function test every 12 months to ensure correct functionality and identify potential problems before symptoms develop. Function test documents can be written based on this manual or this manual itself can be used to verify the function of MVE freezers with TEC 3000 controllers.

Solenoid Valve Replacement

All MVE freezers are equipped with electromechanical solenoid valves that have been tested and approved by MVE for cryogenic use. These valves utilize a PTFE seal for optimal sealing in cryogenic environments. Over time, the normal thermal cycling that this seal is subject to will cause it to harden and lose its ability to seal completely. This will result in seepage past the sealing surface which can increase the LN2 consumption of the system, and in extreme cases result in an overfill situation. Thermal cycling through normal operation can also cause moisture ingress into the coil of the solenoid valve. Over time this may cause the connections and wiring in the coil to corrode and eventually fail. This will result in an inoperative solenoid valve.

NOTE: over the life of MVE freezer, several different interchangeable 24VDC solenoids have been used. The current model is pictured below. Always use replacement solenoid valves from MVE. Substituting non MVE components may result in inoperative valves and even damage to the TEC 3000 control system. Damage to the control system due to use of non MVE parts will not be covered by warranty.

SMC Solenoid Valve (Current production)

SMC (black) Solenoid Valve Replacement

⚠️ CAUTION: Ensure that the LN2 supply valve is closed and the plumbing assembly is vented before removing the solenoid valves.

1. Remove plumbing shroud (on HE and HEco series) or rear access panel (on MVE series) to gain access to plumbing system
2. Remove coil retaining clip by inserting a flathead screwdriver between the clip and the edge of the coil body. Twist the screwdriver, and the clip should slide off.

3. Remove and discard the coil assembly.

4. Using a crescent wrench loosen hex nut and remove the plunger housing. Remove plunger housing and plunger assembly. Discard these parts.

5. Remove any debris that may have collected in brass valve body.

6. Inspect the brass valve body of the solenoid valve for nicks or damage. If the sealing surface appears to be in good condition, the valve body may be reused. If the sealing surface is damaged, the plumbing will need to be disassembled and the entire body will need to be replaced (this is not common).

7. Disassemble a new SMC valve (PN 14224611S) using the above procedure.

8. Install the new plunger, plunger housing, and coil assembly onto the old valve body.

9. Assembly valve with new components in the reverse order.

10. Verify that no leaks are present using leak detect solution.

11. Open the LN2 supply valve and initiate a fill cycle by pressing "Fill Start". Allow the fill cycle to complete and verify that flow stops at the termination of the fill cycle.

NOTE: If the brass valve body requires replacing, the freezer plumbing will need to be disassembled and the entire valve replaced (PN 14224611S). It is typically easier to start disassembling the plumbing assembly beginning at the fill tee for fill valve replacement or the gas bypass muffler for gas bypass valve replacement.

NOTE: When installing a complete new valve, ensure it is oriented correctly. An "N" is engraved on the side of the SMC brass valve body. The valve should be installed so that this "N" is on the inlet side of the valve.

NOTE: If an older style solenoid requires replacing, the freezer plumbing will need to be disassembled and the entire valve replaced by the current production SMC solenoid valve (PN 14224611S). It is typically easier to start disassembling the plumbing assembly beginning at the fill tee for fill valve replacement or the gas bypass muffler for gas bypass valve replacement.
Purge Valve Replacement

**CAUTION:** Ensure that the LN2 supply valve is closed and the plumbing assembly is vented before removing the solenoid valves.

1. Remove plumbing shroud (on HE and HEco series) or rear access panel (on MVE series) to gain access to plumbing system.
2. Disconnect the Purge Valve wires from the TEC3000 wire harness.
3. Using an adjustable wrench, disconnect the copper tubing from the 2 fittings on the Purge Valve assembly.
4. Disconnect the clear vinyl tubing from the barbed fitting.
5. Remove the two bolts that mount the Purge Valve to the plumbing platform.
6. Repeat steps 1-5 in reverse order to install a new Purge Valve.

Relief Valve Replacement

**CAUTION:** Ensure that the LN2 supply valve is closed and the plumbing assembly is vented before removing the relief valve.

1. Remove plumbing shroud (on HE series) to gain access to plumbing system
2. If equipped with a relief valve deflector, loosen the deflector clamp and slide off the deflector.
3. Loosen the relief valve and remove it from the plumbing assembly. Be sure to support the attachment tube with wrench to prevent damage from twisting.
4. Install new relief valve (PN 1810032) applying new Teflon tape if needed. Ensure relief valve is rated to 50 PSI (3.4 bar).

**CAUTION:** Installing a relief valve with a different pressure rating could prevent proper operation and lead to a dangerous over pressurized condition. Additionally, this will void any warranty.
Lid Gasket Replacement
The lid gasket configuration and material will vary depending on the freezer model and vintage. For the correct part numbers, contact Customer/Technical Service with the freezer serial number. There are three main types of lid gaskets and the replacement instructions for each are given below.

MVE High Efficiency/HEco Series (Neoprene Tape)

1. Depending on the condition of the current gasket, the gasket material can be removed and replaced or more material can simply be added to the existing gasket.
2. The replacement gasket material will be a neoprene tape.
3. Simply clean the surfaces, remove the tape back to expose the adhesive and install gasket material.
4. Trim to size as needed.
5. Cut a 4 inch gap in the gasket material on either side of the lid as shown below to allow sufficient venting of the freezer space

MVE Series/HEco and HE 1800 Series (Gasket with Trim Seal)

1. Clean the surfaces and remove the existing gasket.
2. Trim new gasket to size as needed.
3. Cut a horizontal slit into the gasket for the locking tab.
4. Push new gasket firmly into position around the lid assembly.
   *Note: This gasket is also used on older XLC Freezers (230, 810, 1520).
MVE and MVE Stock Series – Riveted gasket

1. Note how the current gasket is attached to the lid. The replacement gasket will be installed the same manner.
2. If applicable, remove lid from hinges.
   a. Place the lid in the closed position.
   b. Remove spring pressure from the hinge by loosening the ½ inch nut on the rod inside the hinge body.
   c. Remove screws securing the hinges to the freezer lid.
3. Remove lid assembly, and place it upside down either on top of the freezer opening or on flat surface.
4. Using a 1/8 inch drill bit, carefully drill off the heads of the existing rivets holding the gasket to the lid.
5. Remove gasket.
6. Inspect plastic lid liner and Styrofoam cork for damage and replace if necessary.
7. Install new gasket so that it lays flat and the flange is between the lid and the lid liner.
8. Properly align lid liner so that the existing rivet holes can be reused.
9. Insert 1/8 inch pop rivets into the existing liner holes, through the gasket, and then through the lid holes so that the fat part of the rivet is exposed. Sometimes it is easier to carefully drill through the gasket then inserting the rivets instead of attempting to puncture the gasket with the rivet.
10. Using a pop rivet gun, securely rivet the liner and gasket to the freezer lid.
11. Cut a 6 inch (150 mm) gap in the gasket at the rear of the freezer lid to allow the freezer space to vent.
12. Reinstall lid.
13. If applicable, reinstall lid hinges.
   a. With the lid closed, install and tighten screws securing hinges to the lid
   b. Using the ½ inch deep well socket, increase spring pressure until the hinges will hold the lid at approximately a 45° angle.
MVE Cabinet Series

1. Remove lid from freezer hinges.
   a. Place the lid in the closed position.
   b. Remove spring pressure from the hinge by loosening the ½ inch nut on the rod inside the hinge body.
   c. Remove screws securing the hinges to the freezer lid.
2. Remove liner retainer plate from the back of the lid.
3. Slide the plastic liner and plate assembly out through the back of the lid.
4. Note how the current gasket is installed. The replacement gasket will be installed in the same manner.
5. Separate the plastic liner from the plate.
6. Remove gasket.
7. Inspect plastic liner and Styrofoam cork for damage and replace if necessary.
8. Install new gasket in the same manner between the liner and plate.
9. Slide plastic liner and plate assembly back into the lid.
10. Cut a 6 inch (150 mm) gap in the gasket at the back of the lid to allow sufficient venting.
11. Reinstall lid hinges.
   a. With the lid closed, install and tighten screws securing hinges to the lid
   b. Using the ½ inch deep well socket, increase spring pressure until the hinges will hold the lid at approximately a 45° angle.
Complete Freezer Thaw and Moisture Removal

1. Remove freezer LN2 supply.
2. Unplug TEC 3000 main power and battery backup if equipped.
3. Open or remove lid from freezer.
4. Allow LN2 to completely evaporate and the freezer space to warm to room temperature. Placing a fan blowing into the freezer will accelerate this process.
5. After it has reached ambient temperature, thoroughly remove any moisture from the freezer space. This can be done with a wet/dry vacuum and towels. For High Efficiency models, open the hinged hatch on the bottom of the turn-tray to access the bottom of the freezer.
6. Once moisture has been removed from the freezer space, purge the plumbing assembly and annular lines with nitrogen gas. Compressed nitrogen or the gas use valve on a LN2 cylinder work best. The LN2 cylinder vent valve can also work, but will deplete the cylinder head pressure quickly. Ensure the nitrogen gas pressure does not exceed 50 PSI (3.4 bar).
7. Plug in the TEC 3000 main power and connect the freezer plumbing via transfer hose to a compressed nitrogen supply or the gas use valve on a LN2 cylinder. Ensure gas bypass is disabled if equipped.
8. Press “Start Fill” and allow the freezer to fill for 30 seconds.
9. Press “Stop Fill”
10. Press “Start Fill” and allow the freezer to fill for 30 seconds.
11. Continue cycling fills for 30 seconds until the plumbing assembly and annular lines are clear and completely dry.

In some cases, it may be necessary to purge the level sensing annular line separately. This can be done by connecting pressurized nitrogen gas directly to the freezer annular line fitting.

**CAUTION:** Ensure that the LN2 supply valve is closed and the plumbing assembly is vented before loosening the compression fittings and removing the annular line tube.

1. Loosen and remove the 1/4 inch compression fittings from the purge valve and the freezer annular line fitting.
2. Remove 1/4 inch copper tube and purge to clear any moisture.
3. Connect nitrogen gas source directly to the freezer’s 3/8 inch FPT annular line connection.
4. Purge annular line with nitrogen gas, maintaining a pressure below 50 PSI (3.4 bar), until the line in clear and completely free of any moisture.

**NOTE:** If moisture is not completely removed for the freezer space and annular lines, ice will form when LN2 is reintroduced into the freezer. Ice blockage in the freezer space or annular lines will interfere with proper function of the freezer and level sensing system.

**ENSURE ALL MOISTURE IS COMPLETELY REMOVED PRIOR TO INTRODUCING LN2**
Battery Backup Replacement and Installation

General
The freezer backup batteries (BB) can be replaced every five years or if the BB voltage has dropped below 21 VDC. The TEC3000 will start to lose functionality when the BB is below 18 VDC. To test any suspect BB, disconnect the AC power and allow freezer to run for 30 minutes; the power failure (PF) alarm should trigger. While it is still in PF alarm allow the freezer to perform a fill still using the BB, and once it has reached its high level set point measure the BB voltage. If the voltage measures 24 to 27 VDC the batteries are good. In any case, the best approach is to always replace a suspect battery or if the battery age is more than five years old.

**Note:** New batteries may need to be charged for several hours before it is able to power the TEC3000. The TEC3000 will constantly monitor, charge, and sense the current in its battery circuit. With its main power connected, the TEC3000 will constantly produce a 27 VDC trickle charge to keep the batteries fully charged.

This installation procedure applies to the following models:
HEco Series, Cabinet Series, and MVE (Open Tops) Series -- Use Battery Backup PN: 11864171
Variō Series, Stock Series, and High Efficiency Series -- Use Battery Backup PN: 12885791

Each BB utilizes two internal batteries (PN: 10718155). If performing preventative maintenance, then it is recommended to purchase 2x 10718155 and replace the internal batteries. See the Battery Replacement section below for replacement instructions.

**TOOLS REQUIRED**
- Phillips Screwdriver
- Small Flat Head and Phillips Screw Driver
- Volt/Ohm Meter
- Wire Ties

**UNPACKING**
Unpack the assembly and inspect for damage. If any damage is found, a freight claim should be filed with the carrier as soon as possible. Inspect to insure that all parts of the assembly are included.

**BATTERY BACKUP PREVENTATIVE MAINTENANCE AND NEW INSTALLATION**
Reference the Battery Replacement section below if just replacing the internal batteries (2x PN 10718155) on the BB. This is the recommended preventative maintenance procedure.

Reference Table 1 and 2, and Figure 1 and 2 along with the Installation Instructions below if purchasing a new Battery Backup Assembly (PN 11864171 or 12885791).

**Note:** Due to running design changes, the actual assembly may differ slightly from Figure 1 and Figure 2.

**Battery Replacement**
1. Make sure the power supply and the battery backup are disconnected.

2. Remove the battery backup assembly from the HE plumbing stack assembly by removing the four Phillips head screws; Note: if an MVE Series, the battery backup is mounted inside the rear cabinet.
3. Remove the four Phillips screws holding the backing plate.

4. Cut the plastic zip ties and remove the batteries noting the wire connection. Batteries are connected in series, - to + as shown in the below diagram.

5. Ensure the cables are routed as shown:

6. Reverse the removal procedure
Part Number: 11864171 includes the following in Table 1. Please reference Figure 1.

Reference Table 1 and 2, and Figure 1 and 2 for installation instructions if purchasing a new Backup Battery Assembly.

**Table 1**

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*Fuses item 9 should be taped to battery when battery enclosure cover is removed. One fuse is a spare to remain taped inside the enclosure after installation.

**Mounting hardware items 16, 17 and 18 should be in a plastic bag tied to the cable.
Figure 1 - Internal View of Battery Backup

Part Number: 12885791 (Pictured Below) includes everything in Table 1 plus the following in Table 2.

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</table>
INSTALATION INSTRUCTIONS - Variō Series, Stock Series, and High Efficiency Series

1. Installing the Bracket for the Battery Backup – Follow these instructions for the Variō Series, Stock Series, and High Efficiency Series. These are instructions for mounting the bracket included with PN:
12885791. If PN: 11864171 was ordered, it will not come with a bracket. Please skip to Section 2 for Battery Backup Installation Instructions.

1.1. Disconnect main power cord.
1.2. Disconnect LN2 supply.
1.3. Use the 10-32 screws to install the bracket to the freezer on the plumbing stack cover. Please reference Figure 4 and 5 for an example of the Vario Freezer Plumbing Stack Cover.

**Figure 4 - Vario Screw Location on the Plumbing Stack Cover**

**Figure 5 - Vario Battery Backup Bracket Installed**

**INSTALLATION INSTRUCTIONS** - HEco Series, Cabinet Series, and MVE Series (Open Top Freezers)

2. Installing the Battery Backup Follow these instructions for the HEco Series, Cabinet Series, and MVE Series (Open Tops). These are instructions for mounting the Battery Backup either to the bracket previously installed in Section 1 using PN: 12885791 or to the freezer itself if PN: 11864171 was ordered.
2.1 Disconnect main power cord.
2.2 Disconnect LN2 supply.
2.3 Before installing the battery backup on the freezer, measure the voltage at the end connector for approximately 24VDC to 27VDC. Please reference Figure 6.
   2.3.1 If no voltage is present, the included fuse must be installed before connecting the battery to the main wire harness.
   2.3.2 Open the battery enclosure and unscrew the fuse harness.
   2.3.3 Install the fuse
   2.3.4 Close the fuse harness and the battery enclosure.

![Battery Backup Fuse](image)

Figure 6 - Battery Backup Fuse

2.4 With the fuse installed and the battery backup reading approximately 24-27VDC, locate the battery backup mounting location.
   2.4.1 For Cabinet Series and MVE (Open Top) Series, this will be on the back of the Freezer. Remove the rear panel of the cabinet. Remove screws securing purge coil clamps at the upper battery backup mount inside the rear enclosure. See Figure 7.

![Purge Coil Screws](image)

Figure 7 - Purge Coil Screws

   2.4.2 For HEco Series Freezers, the battery backup is located under the work platform. If needed, please see Section 3 for detailed instructions.
   2.4.3 For Variō Series, Stock Series, and High Efficiency Series, the battery will be mounted to the bracket installed in Section 1.

2.5 For all freezers (excluding HEco Series), fasten the battery backup to the mounting location using the screws included with the battery backup.
2.6 Verify that the TEC 3000 Controller will power on using the AC Power Supply only. 
   NOTE: Do not connect the battery backup to the main wire harness until the AC Power Supply has been verified to power up the controller.
2.7 Connect the battery backup to the proper connector on the TEC 3000 Wiring Harness. See Figure 8.
2.8 Please reference the TEC 3000 Technical Manual in the Additional Feature Settings Section to view and adjust the TEC 3000 settings and to enable the battery backup feature.

3. Installing the battery backup on the HEco Series Freezers.

3.1. HEco 800 Series

3.1.1. The battery backup will be placed on the 4 studs already located on the freezer. These are located on the bottom side of the workstation platform.

3.1.1.1. Open the workstation platform. First, loosen the Phillips head screws that fasten it to the freezer. Reference Figure 9 for screw location.
3.1.1.2. Locate the mounting location for installing the battery backup. It will mount to the studs in Figure 11 below.

3.1.1.3. Remove nuts from studs.
3.1.1.4. Place the battery backup on the studs with the washers between the battery backup and the platform. Position the battery backup with the pigtail facing towards the front of the freezer. **Note:** The battery backup is capable of being positioned with the pigtail facing forwards or backwards. It is recommended that the pigtail faces forward so the batteries inside the housing remain in an upright position.
3.1.1.5. Fasten nuts to studs. This will secure the battery backup to the workstation on the freezer.
3.1.1.6. Please see Section 3.4 to complete the installation.

3.2. HEco 1500 Series
3.2.1. The battery backup will be placed on the 4 studs already located on the freezer. These are located on the side of the workstation platform.
3.2.1.1. Open the workstation platform where the controller panel is located by loosening the two Phillips head screws. This is the panel on the right when facing front of the freezer. Reference Figure 12.

![Screw Location for HEco 1500 Series](image1)

**Figure 12 - Screw Location for HEco 1500 Series**

*Note: This picture is for reference only. This is the 1800 Series Freezer.*

3.2.1.2. Remove the back control panel by removing the 4 screws holding it in place on the back of the workstation (white). See Figure 14.

![Phillips Head Screws to Remove](image2)

**Figure 13 - Phillips Head Screws to Remove**

**Note:** This picture is for reference only. This is the 1800 Series Freezer.
3.2.1.3. Find the mounting location to install the battery backup. It will mount to the studs in Figure 15 below. This is on the side of the Plumbing Stack Cover.

3.2.1.4. Remove nuts from studs.
3.2.1.5. Place the battery backup on the studs with the washers between the battery backup and the platform. Position the battery backup with the pigtail facing towards the front of the freezer. Note: The battery backup is capable of being positioned with the pigtail facing forwards or backwards. It is recommended that the pigtail faces forward so the batteries inside the housing remain in an upright position.
3.2.1.6. Fasten nuts to studs. This will secure the battery backup to the workstation on the freezer.
3.2.1.7. Reinstall the back control panel.
3.2.1.8. Please see Section 3.4 to complete the installation.

3.3. HEco 1800 Series
3.3.1. The battery backup will be placed on the 4 studs already located on the freezer. These are located on the side of the workstation platform.
3.3.1.1. Open the workstation platform. First, loosen the Phillips head screws that fasten it to the freezer. Reference Figure 16 for screw location.
3.3.1.2. Locate the mounting location for installing the battery backup. It will mount to the studs in Figure 18 below.
3.3.1.3. Remove nuts from studs.
3.3.1.4. Place the battery backup on the bolts with the washers between the battery backup and the platform. Position the battery backup with the pigtail facing towards the front of the freezer. Note: The battery backup is capable of being positioned with the pigtail facing forwards or backwards. It is recommended that the pigtail faces forward so the batteries inside the housing remain in an upright position.
3.3.1.5. Fasten nuts to studs. This will secure the battery backup to the workstation on the freezer.
3.3.1.6. Please see Section 3.4 to complete the installation.

3.4. Verify that the TEC 3000 Controller will power on using the AC Power Supply only. **NOTE:** Do not connect the battery backup to the main wire harness until the AC Power Supply has been verified to power up the controller.

3.5. Connect the battery backup to the proper connector on the TEC 3000 Wiring Harness. See Figure 8.

3.6. Please reference the Additional Feature Settings Section to view and adjust the TEC 3000 settings and to enable the battery backup feature.
9.3. HEco TEC3000 (Back and Front Panel) Replacement

**Back Panel**
1. Disconnect the AC power cord from the back panel.
2. Open the working platform.
3. Disconnect the wiring harness from the plumbing connection interface.
4. Disconnect Temp A and Temp B probes along with the power input cable from the back panel.
5. Disconnect RJ45 cable from the front panel.
6. Remove 4 phillips head screws from the faceplate of the back panel.
   *Note: The power supply connection port will be grounded to one of the phillips head screws.
7. Remove the clear vinyl tubing from the back panel.
8. Gently remove the back panel from the working platform.
9. To install a new back panel, repeat steps 1-8 in reverse order; ensuring that the power supply is grounded properly.

**Front Panel**
1. Disconnect the AC power cord from the back panel.
2. Open the working platform.
3. Disconnect the wiring harness from the plumbing connection interface.
4. Disconnect RJ45 cable from the front panel.
5. Disconnect the front panel ground wire from the working platform and remove the 4 phillips head screws.
6. Gently remove the front panel.
7. To install a new front panel, repeat steps 1-6 in reverse order, ensuring that the front panel is grounded properly.

9.4. Replacement Parts and Accessories

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<th>Replacement Parts</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Number</td>
<td>Description</td>
</tr>
<tr>
<td>11648945</td>
<td>Inline Filter – 40 micron mesh</td>
</tr>
<tr>
<td>20669243</td>
<td>HEco Y Strainer (Filter) – 40 micron mesh</td>
</tr>
<tr>
<td>1810032</td>
<td>Relief Valve – 50 PSI (3.4 bar)</td>
</tr>
<tr>
<td>14224611S</td>
<td>SMC Solenoid Valve – Fill and Gas Bypass</td>
</tr>
<tr>
<td>13284954S</td>
<td>Purge/3-way Solenoid Valve</td>
</tr>
<tr>
<td>10713400</td>
<td>Gas Bypass Temperature Sensor – Pt-1000 RTD</td>
</tr>
<tr>
<td>11499812</td>
<td>Gas Bypass Muffler</td>
</tr>
<tr>
<td>11885449</td>
<td>Gas Bypass Muffler Deflector</td>
</tr>
<tr>
<td>20570663</td>
<td>Temperature Probe – All Chart Freezer Series (65&quot;)</td>
</tr>
<tr>
<td>14248744</td>
<td>HE Series 3-Tube Temperature Sensor Assembly – 26 inch (660 mm)</td>
</tr>
<tr>
<td>14248816</td>
<td>HE Series 3-Tube Temperature Sensor Assembly – 39 inch (990 mm)</td>
</tr>
<tr>
<td>14248752</td>
<td>HE Series 3-Tube Temperature Sensor Assembly – 44 inch (1118 mm)</td>
</tr>
<tr>
<td>11795030</td>
<td>Jerome Power Supply – Input: 110-230 VAC; Output: 30 VDC (AC cord not included)</td>
</tr>
<tr>
<td>14010103</td>
<td>Power Outlet Cord – 110 VAC (The Americas)</td>
</tr>
<tr>
<td>10995363</td>
<td>Power Outlet Cord – 230 VAC (Europe)</td>
</tr>
<tr>
<td>10718155</td>
<td>Battery Backup Replacement Battery – 12 VDC</td>
</tr>
<tr>
<td>11858467</td>
<td>Battery Backup Fuse – 4A 250V</td>
</tr>
<tr>
<td>13319459S</td>
<td>TEC 3000 Controller – Stand-alone with text display</td>
</tr>
<tr>
<td>13319467S</td>
<td>TEC 3000 Controller – Stand-alone with symbolic display</td>
</tr>
<tr>
<td>13223908</td>
<td>TEC 3000 Cabinet Back Panel</td>
</tr>
<tr>
<td>13223836</td>
<td>TEC 3000 Cabinet Text Display Panel</td>
</tr>
<tr>
<td>13223861</td>
<td>TEC 3000 Cabinet Symbolic Display Panel</td>
</tr>
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Accessories
<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
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<tr>
<td>20561020</td>
<td>MVE LN2 Level Dip Stick, 47&quot;</td>
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<tr>
<td>13376947</td>
<td>TEC COM USB Kit – TEC 2000/3000 – PC interface kit</td>
</tr>
<tr>
<td>10856321</td>
<td>Daisy Chain Kit – Network TEC 2000/3000s – One network cable and splitter</td>
</tr>
<tr>
<td>10740053</td>
<td>RJ-45 Network Cable</td>
</tr>
<tr>
<td>10856312</td>
<td>RJ-45 Jack Splitter</td>
</tr>
<tr>
<td>11358251</td>
<td>OFAF Master Cable</td>
</tr>
<tr>
<td>10784443*</td>
<td>Fill Valve Tee Assembly – Tee two freezer to one LN2 supply connection</td>
</tr>
<tr>
<td>1611592</td>
<td>Relief Valve Pipe Away Adapter – 3/8 inch NPT Outlet</td>
</tr>
<tr>
<td>1810092</td>
<td>Relief Valve Pipe Away Adapter – ½ inch NPT Outlet</td>
</tr>
<tr>
<td>13051579</td>
<td>Cool Reach Cryogenic Claw</td>
</tr>
<tr>
<td>9713159</td>
<td>LN2 Transfer Hose – 4 ft (1220 mm), ½ inch (12.7 mm) ODT</td>
</tr>
<tr>
<td>9713109</td>
<td>LN2 Transfer Hose – 6 ft (1829 mm), ½ inch (12.7 mm) ODT</td>
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<td>0606B-8SE-8SE</td>
<td>LN2 6ft Vacuum Jacketed Transfer Hose</td>
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<tr>
<td>1110862</td>
<td>LN2 Transfer Hose Coupler – Daisy chain two transfer hoses</td>
</tr>
<tr>
<td>11544943</td>
<td>Printer Kit – Includes serial printer and cables</td>
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<td>9717119</td>
<td>Cryo Gloves – Size: Medium; Length: Mid-arm</td>
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<td>9717129</td>
<td>Cryo Gloves – Size: Large; Length: Mid-arm</td>
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<tr>
<td>9717139</td>
<td>Cryo Gloves – Size: X-Large; Length: Mid-arm</td>
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<td>9717149</td>
<td>Cryo Gloves – Size: Medium; Length: Elbow</td>
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<td>Cryo Gloves – Size: Large; Length: Elbow</td>
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<tr>
<td>9717169</td>
<td>Cryo Gloves – Size: X-Large; Length: Elbow</td>
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<td>10464394</td>
<td>Cryo Apron</td>
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<td>13934911</td>
<td>Automatic LN2 Supply Switch</td>
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<td>13319512</td>
<td>Stand-alone TEC 3000 Upgrade Kit – MDC TEC 2000 to TEC 3000 kit</td>
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<td>13319504</td>
<td>Cabinet TEC 3000 Upgrade Kit – MDC TEC 2000 to TEC 3000 kit</td>
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<td>13319491</td>
<td>Stand-alone TEC 3000 Upgrade Kit – Lakeshore TEC 2000 to TEC 3000 kit</td>
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<td>13319475</td>
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*Verify adequate pressure
## 10. Troubleshooting Quick Reference

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<td>Auto Fill disabled</td>
<td>Press Start Fill to verify manual operation.</td>
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<td>Confirm auto fill settings</td>
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<td>Resistance Table</td>
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<td>Check resistance of purge valve (140 ohms)</td>
<td>Purge valve replacement</td>
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<td>Lid Gasket Replacement</td>
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<td>Purge level sensing annular line and clear any debris in the bottom of freezer. Complete freezer thaw and moisture removal may be necessary</td>
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<td>or quality surge protector</td>
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<td>Transition to generator power</td>
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<td>Inaccurate level readings</td>
<td>See &quot;Incorrect LN2 level readings&quot; above.</td>
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<td>Insufficient freezer venting</td>
<td>Increase lid gasket vent. Replace gasket/lid if necessary</td>
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</tr>
<tr>
<td>Insufficient venting</td>
<td>Increase lid gasket vent. Replace gasket/lid if necessary</td>
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<td>Lid open for extended period of time</td>
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<tr>
<td>Inadequate LN2 supply</td>
<td>Verify adequate LN2 supply</td>
<td>Verify Adequate LN2 Supply Page 115</td>
<td></td>
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<tr>
<td>Obstruction in level sensing line</td>
<td>Purge level sensing annular line and clear any debris in the bottom of freezer. Complete freezer thaw and moisture removal may be necessary</td>
<td>Complete Freezer Thaw and Moisture Removal Page 124</td>
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<tr>
<td>Potential vacuum failure</td>
<td>Contact your authorized MVE Distributor or Technical Service</td>
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11. EN Compliance Tables

Table 1: Guidance and manufacturer’s declaration – electromagnetic emissions for all TEC 3000s (See 5.2.2.1 C).

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<th>Compliance</th>
<th>Electromagnetic Environment – Guidance</th>
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</thead>
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<tr>
<td>RF emissions CISPR 11</td>
<td>Group 1</td>
<td>The TEC 3000 uses RF energy only for its internal functions. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.</td>
</tr>
<tr>
<td>RF emissions CISPR 11</td>
<td>Class B</td>
<td>The TEC 3000 is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.</td>
</tr>
<tr>
<td>Harmonic emissions IEC 61000-3-2</td>
<td>Class A</td>
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</tr>
<tr>
<td>Voltage fluctuations / Flicker emissions IEC 61000-3-3</td>
<td>Complies</td>
<td></td>
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</table>
Table 2: Guidance and manufacturer’s declaration – electromagnetic immunity – for all TEC 3000s (See 5.2.2.1 F)

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<tr>
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<th>IEC 60601 Test Level</th>
<th>Compliance Level</th>
<th>Electromagnetic Environment – guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electromagnetic Discharge (ESD)</td>
<td>±6 kV contact ±8 kV air</td>
<td>±6 kV contact ±8 kV air</td>
<td>Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%</td>
</tr>
<tr>
<td>IEC 61000-4-2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical fast transient/burst</td>
<td>±2 kV for power supply lines ±1 kV for input/output lines</td>
<td>±2 kV for power supply lines ±1 kV for input/output lines</td>
<td>Mains power quality should be that of a typical commercial or hospital environment.</td>
</tr>
<tr>
<td>IEC 61000-4-4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surge</td>
<td>±1 kV line(s) to line(s) ±2 kV line(s) to earth</td>
<td>±1 kV line(s) to line(s) ±2 kV line(s) to earth</td>
<td>Mains power quality should be that of a typical commercial or hospital environment.</td>
</tr>
<tr>
<td>IEC 61000-4-5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage dips, short interruptions and voltage variations on power supply input lines</td>
<td>&lt;5% UT (&gt;95% dip in UT) For 0,5 cycle 40% UT (60% dip in UT) For 5 cycles 70% UT (30% dip in UT) For 25 cycles &lt;5% UT (&gt;95% dip in UT) For 5 seconds</td>
<td>&lt;5% UT (&gt;95% dip in UT) For 0,5 cycle 40% UT (60% dip in UT) For 5 cycles 70% UT (30% dip in UT) For 25 cycles &lt;5% UT (&gt;95% dip in UT) For 5 seconds</td>
<td>Mains power quality should be that of a typical commercial or hospital environment. If the user of the TEC 3000 requires continued operation during power mains interruptions, it is recommended that the TEC 3000 be powered by an uninterruptible power supply or battery.</td>
</tr>
<tr>
<td>IEC 61000-4-11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power frequency</td>
<td>3 A/m</td>
<td>3 A/m</td>
<td></td>
</tr>
<tr>
<td>(50/60 Hz)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnetic field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEC 61000-4-8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOTE: UT is the AC mains voltage prior to application of the test level</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 4: Guidance and manufacturer’s declaration – electromagnetic immunity – for all TEC 3000s (See 5.2.2.2)

<table>
<thead>
<tr>
<th>Immunity Test</th>
<th>IEC 60601 Test Level</th>
<th>Compliance Level</th>
<th>Electromagnetic Environment – guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conducted RF</td>
<td>IEC 61000-4-6 3 Vrms</td>
<td>3 Vrms</td>
<td>Portable and mobile RF communications equipment should be used no closer to any part of the TEC 3000 including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance $d = 1,2\sqrt{P}$</td>
</tr>
<tr>
<td>Radiated RF</td>
<td>IEC 61000-4-3 3 V/m</td>
<td>3 V/m</td>
<td>$d = 1,2\sqrt{P}$</td>
</tr>
<tr>
<td></td>
<td>80 MHz to 2,5 GHz</td>
<td></td>
<td>$d = 2,3\sqrt{P}$</td>
</tr>
</tbody>
</table>

where $P$ is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and $d$ is the recommended separation distance in meters (m).

Field strengths from fixed RF transmitters as determined by an electromagnetic site survey, should be less than the compliance level in each frequency range.

Interference may occur in the vicinity of equipment marked with the following symbol:

NOTE 1: At 80 MHz and 800 MHz the higher frequency range applies

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

Field strengths from fixed transmitters such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM, and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the TEC 3000 is used exceeds the applicable RF compliance level above, the TEC 3000 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the TEC 3000.

Field strengths from fixed RF transmitters as determined by an electromagnetic site survey, should be less than 3 V/m.

a Field strengths from fixed transmitters such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM, and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the TEC 3000 is used exceeds the applicable RF compliance level above, the TEC 3000 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the TEC 3000.

b Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.
Table 6: Recommended separation distances between portable and mobile RF communications equipment and the TEC 3000 – for TEC 3000 systems that are not life supporting (See 5.2.2.2)

<table>
<thead>
<tr>
<th>Rated maximum output power of transmitter (W)</th>
<th>Separation distance according to frequency of transmitter (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>150 kHz to 80 MHz</td>
</tr>
<tr>
<td>0.01</td>
<td>1.2\sqrt{P}</td>
</tr>
<tr>
<td>0.1</td>
<td>0.38</td>
</tr>
<tr>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>10</td>
<td>3.8</td>
</tr>
<tr>
<td>100</td>
<td>12</td>
</tr>
</tbody>
</table>

For transmitters rated at a maximum output power not listed above, the recommended separation distance \( d \) in meters (m) can be estimated using the equation applicable to the frequency of the transmitter where \( P \) is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

NOTE: Medical Electrical Equipment needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in this manual.

NOTE: Portable and mobile RF communications equipment can affect Medical Electrical Equipment.

NOTE: The use of accessories, transducers and cables other than those specified, with the exception of transducer and cables sold by the manufacturer of this device as replacement parts for internal components, may result in increased emissions or decreased immunity of the TEC 3000 Controller.

NOTE: The TEC 3000 Controller should not be used adjacent or stacked with other equipment and that if adjacent or stacked use is necessary, the TEC 3000 Controller should be observed to verify normal operation in the configuration in which it will be used.

DISPOSAL OF PRODUCT:

Stainless Steel Freezer:

Freezers used to store biological materials require decontamination prior to disposal. Contact CHART MVE for decontamination information or reference page 147.

TEC 3000 Controller:

Local or national environmental laws and regulations may prohibit disposal of electrical and/or electronic equipment such as the TEC3000 controller. Contact the local city or town offices for instructions on proper disposal of electrical or electronic equipment. Alternately, CHART MVE may be contacted for disposal information.
## 12. Appendix

### 12.1. Reference Tables

**Table 9: Temperature vs. Resistance Output (ohms) for Pt-1000 Temperature Sensors**

<table>
<thead>
<tr>
<th>Temp°C</th>
<th>-10</th>
<th>-9</th>
<th>-8</th>
<th>-7</th>
<th>-6</th>
<th>-5</th>
<th>-4</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>-200</td>
<td>185.201</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-180</td>
<td>270.964</td>
<td>266.708</td>
<td>262.449</td>
<td>258.186</td>
<td>253.920</td>
<td>249.651</td>
<td>245.379</td>
<td>241.103</td>
<td>236.824</td>
<td>232.541</td>
<td>185.201</td>
</tr>
<tr>
<td>-170</td>
<td>313.350</td>
<td>309.126</td>
<td>304.898</td>
<td>300.667</td>
<td>296.434</td>
<td>292.197</td>
<td>287.956</td>
<td>283.713</td>
<td>279.467</td>
<td>275.217</td>
<td>185.201</td>
</tr>
<tr>
<td>-150</td>
<td>397.232</td>
<td>393.064</td>
<td>388.894</td>
<td>384.721</td>
<td>380.545</td>
<td>376.367</td>
<td>372.185</td>
<td>368.002</td>
<td>363.815</td>
<td>359.626</td>
<td>185.201</td>
</tr>
<tr>
<td>-140</td>
<td>438.764</td>
<td>434.622</td>
<td>430.478</td>
<td>426.331</td>
<td>422.182</td>
<td>418.030</td>
<td>413.876</td>
<td>409.719</td>
<td>405.559</td>
<td>401.397</td>
<td>185.201</td>
</tr>
<tr>
<td>-130</td>
<td>480.048</td>
<td>475.930</td>
<td>471.810</td>
<td>467.688</td>
<td>463.563</td>
<td>459.436</td>
<td>455.307</td>
<td>451.175</td>
<td>447.040</td>
<td>442.904</td>
<td>185.201</td>
</tr>
<tr>
<td>-120</td>
<td>521.098</td>
<td>517.003</td>
<td>512.906</td>
<td>508.806</td>
<td>504.705</td>
<td>500.601</td>
<td>496.495</td>
<td>492.386</td>
<td>488.276</td>
<td>484.163</td>
<td>185.201</td>
</tr>
<tr>
<td>-110</td>
<td>561.930</td>
<td>557.856</td>
<td>553.780</td>
<td>549.702</td>
<td>545.622</td>
<td>541.540</td>
<td>537.457</td>
<td>533.370</td>
<td>529.281</td>
<td>525.191</td>
<td>185.201</td>
</tr>
<tr>
<td>-100</td>
<td>602.558</td>
<td>598.504</td>
<td>594.448</td>
<td>590.391</td>
<td>586.331</td>
<td>582.269</td>
<td>578.205</td>
<td>574.139</td>
<td>570.072</td>
<td>566.002</td>
<td>185.201</td>
</tr>
<tr>
<td>-90</td>
<td>642.996</td>
<td>638.960</td>
<td>634.923</td>
<td>630.884</td>
<td>626.843</td>
<td>622.800</td>
<td>618.756</td>
<td>614.709</td>
<td>610.661</td>
<td>606.611</td>
<td>185.201</td>
</tr>
<tr>
<td>-80</td>
<td>683.254</td>
<td>679.236</td>
<td>675.217</td>
<td>671.195</td>
<td>667.172</td>
<td>663.149</td>
<td>659.120</td>
<td>655.092</td>
<td>651.062</td>
<td>647.030</td>
<td>185.201</td>
</tr>
<tr>
<td>-70</td>
<td>723.345</td>
<td>719.344</td>
<td>715.340</td>
<td>711.335</td>
<td>707.328</td>
<td>703.320</td>
<td>699.310</td>
<td>695.299</td>
<td>691.286</td>
<td>687.271</td>
<td>185.201</td>
</tr>
<tr>
<td>-60</td>
<td>763.278</td>
<td>759.292</td>
<td>755.304</td>
<td>751.315</td>
<td>747.324</td>
<td>743.331</td>
<td>739.337</td>
<td>735.341</td>
<td>731.344</td>
<td>727.346</td>
<td>185.201</td>
</tr>
<tr>
<td>-50</td>
<td>803.063</td>
<td>799.091</td>
<td>795.117</td>
<td>791.143</td>
<td>787.166</td>
<td>783.189</td>
<td>779.210</td>
<td>775.229</td>
<td>771.247</td>
<td>767.263</td>
<td>185.201</td>
</tr>
<tr>
<td>-40</td>
<td>842.707</td>
<td>838.748</td>
<td>834.789</td>
<td>830.828</td>
<td>826.865</td>
<td>822.902</td>
<td>818.937</td>
<td>814.970</td>
<td>811.003</td>
<td>807.033</td>
<td>185.201</td>
</tr>
<tr>
<td>-30</td>
<td>882.217</td>
<td>878.271</td>
<td>874.325</td>
<td>870.377</td>
<td>866.428</td>
<td>862.478</td>
<td>858.526</td>
<td>854.573</td>
<td>850.619</td>
<td>846.663</td>
<td>185.201</td>
</tr>
<tr>
<td>-20</td>
<td>921.599</td>
<td>917.666</td>
<td>913.732</td>
<td>909.797</td>
<td>905.861</td>
<td>901.923</td>
<td>897.985</td>
<td>894.044</td>
<td>890.103</td>
<td>886.160</td>
<td>185.201</td>
</tr>
<tr>
<td>-10</td>
<td>960.859</td>
<td>956.938</td>
<td>953.016</td>
<td>949.093</td>
<td>945.169</td>
<td>941.244</td>
<td>937.317</td>
<td>933.390</td>
<td>929.461</td>
<td>925.530</td>
<td>185.201</td>
</tr>
<tr>
<td>0</td>
<td>1000.00</td>
<td>996.091</td>
<td>992.181</td>
<td>988.270</td>
<td>984.358</td>
<td>980.440</td>
<td>976.529</td>
<td>972.613</td>
<td>968.696</td>
<td>964.778</td>
<td>185.201</td>
</tr>
</tbody>
</table>

### Reference Tables

1. **Appendix**
2. **Biological Systems**
3. **12.1. Reference Tables**
4. **Table 9: Temperature vs. Resistance Output (ohms) for Pt-1000 Temperature Sensors**
### 12.1.2. Table 10: LN2 Volume per Inch of Liquid in MVE Freezers

NOTE: The below values are accurate for the cylindrical portion of the freezer and do not take into account inventory components that will displace LN2.

<table>
<thead>
<tr>
<th>Freezer Model</th>
<th>Inches</th>
<th>Liters</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVE 205</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>MVE 510</td>
<td>1</td>
<td>5.5</td>
</tr>
<tr>
<td>MVE 616 / 616C</td>
<td>1</td>
<td>8.1</td>
</tr>
<tr>
<td>MVE T426 / T426C</td>
<td>1</td>
<td>13.0</td>
</tr>
<tr>
<td>MVE 1839</td>
<td>1</td>
<td>20.0</td>
</tr>
<tr>
<td>MVE 808</td>
<td>1</td>
<td>10.3</td>
</tr>
<tr>
<td>MVE 816P-2T-190</td>
<td>1</td>
<td>10.1</td>
</tr>
<tr>
<td>MVE 1318</td>
<td>1</td>
<td>20.2</td>
</tr>
<tr>
<td>MVE 1842P-150</td>
<td>1</td>
<td>40.8</td>
</tr>
<tr>
<td>MVE 1877P-2T-150</td>
<td>1</td>
<td>40.8</td>
</tr>
<tr>
<td>MVE 815P-150</td>
<td>1</td>
<td>10.1</td>
</tr>
<tr>
<td>MVE 815P-190</td>
<td>1</td>
<td>10.1</td>
</tr>
<tr>
<td>MVE 818P-190</td>
<td>1</td>
<td>10.1</td>
</tr>
<tr>
<td>MVE 819P-190</td>
<td>1</td>
<td>10.1</td>
</tr>
<tr>
<td>MVE 1536P-150</td>
<td>1</td>
<td>19.3</td>
</tr>
<tr>
<td>MVE 1536P-190</td>
<td>1</td>
<td>19.3</td>
</tr>
<tr>
<td>MVE 1539P-190</td>
<td>1</td>
<td>19.3</td>
</tr>
<tr>
<td>MVE 1879P-150</td>
<td>1</td>
<td>40.8</td>
</tr>
<tr>
<td>MVE 1879P-190</td>
<td>1</td>
<td>40.8</td>
</tr>
<tr>
<td>MVE 1892P-190</td>
<td>1</td>
<td>40.8</td>
</tr>
<tr>
<td>MVE 1539R-150</td>
<td>1</td>
<td>19.3</td>
</tr>
<tr>
<td>MVE 1542R-150</td>
<td>1</td>
<td>19.3</td>
</tr>
<tr>
<td>MVE 1542R-190</td>
<td>1</td>
<td>19.3</td>
</tr>
<tr>
<td>MVE 1881R-150</td>
<td>1</td>
<td>38.9</td>
</tr>
<tr>
<td>MVE 1881R-190</td>
<td>1</td>
<td>38.9</td>
</tr>
<tr>
<td>MVE 1894R-150</td>
<td>1</td>
<td>38.9</td>
</tr>
<tr>
<td>MVE 1894R-190</td>
<td>1</td>
<td>38.9</td>
</tr>
</tbody>
</table>
12.2. **TEC 3000 ASCII Interface**

American Standard Code for Information Interchange (ASCII) is a standard code used in data transmission, in which 128 numerals, letters, symbols, and special control codes are represented by a 7-bit binary number. Below is a chart for these binary codes.
# TEC 3000 ASCII Command List

## Control Commands

**`*IDN?`**

Identification Query  
**Input:** `*IDN?`  
**Returned:** MVE TEC 3000, Software ver. X.XX  
**Comments:** Used to query the controller ID. Command must include `*` preface. Returns controller model and firmware version.

**`ALMS`**

Set Alarm Status  
**Input:** `ALMS 0` or `ALMS 1`  
**Returned:** No response  
**Comments:** Used to set the audible alarm status where 0 = Off and 1 = On. Has same function as the Alarm Mute key.

**`ALMS?`**

Alarm Status Query  
**Input:** `ALMS?`  
**Returned:** 0 or 1  
**Comments:** Used to query the current audible alarm status where 0 = Off and 1 = On.

**`CALTA`**

Calibrate Temp A in LN2 (Single Point)  
**Input:** `CALTA`  
**Returned:** No response  
**Comments:** Used to perform a single point calibration of Temp A. Temp A sensor must be submerged in LN2. See the Temperature Calibration section of this manual.

**`CALTB`**

Calibrate Temp B in LN2 (Single Point)  
**Input:** `CALTB`  
**Returned:** No response  
**Comments:** Used to perform a single point calibration of Temp B. Temp B sensor must be submerged in LN2. See the Temperature Calibration Section of this manual.

**`CALVL`**

Set Level Offset  
**Input:** `CALVL ±XXX.X`  
**Returned:** No response  
**Comments:** Used to set the liquid level offset.

**`CALVL?`**

Level Offset Query  
**Input:** `CALVL?`  
**Returned:** ±XXX.X  
**Comments:** Used to query the current level offset value.

**`CODE?`**

Global Password Query  
**Input:** `CODE?`  
**Returned:** XXXX  
**Comments:** Used to query the current global password.

**`HITSTA`**

Temp A High Alarm Test  
**Input:** `HITSTA`  
**Returned:** No response  
**Comments:** Used to initiate the High Temp A Alarm Test. See the High Temperature Alarm Test section for more information.
**HITSTB**  
Temp B High Alarm Test  
*Input:* HITSTB  
*Returned:* No response  
*Comments:* Used to initiate the High Temp B Alarm Test. See the High Temperature Alarm Test section for more information.

**INITEE**  
Restore All Defaults  
*Input:* INITEE  
*Returned:* No response  
*Comments:* Used to restore all factory default settings.

**LNSATP**  
Set LN2 Saturation Temperature  
*Input:* LNSATP ±XXX.X  
*Returned:* No response  
*Comments:* Used to set the LN2 saturation temperature for single point calibration reference point.

**Temperature Commands**

**BPTMP?**  
Bypass Temp Query  
*Input:* BPTMP?  
*Returned:* ±XXX.X  
*Comments:* Used to query the current bypass temp sensor reading.

**HITA**  
Set Temp A High Alarm  
*Input:* HITA ±XXX.X  
*Returned:* No response  
*Comments:* Used to set the Temp A High Alarm value.

**HITA?**  
Temp A High Alarm Query  
*Input:* HITA?  
*Returned:* ±XXX.X  
*Comments:* Used to query the current Temp A High Alarm value

**HITAS?**  
Temp A High Alarm Status Query  
*Input:* HITAS?  
*Returned:* 0 or 1  
*Comments:* Used to query the Temp A High Alarm status where 0 = Off and 1 = On.

**HITAM**  
Set Temp A High Alarm Mask  
*Input:* HITAM 0 or HITAM 1  
*Returned:* No response  
*Comments:* Used to enable or disable the Temp A High Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

**HITAM?**  
Temp A High Alarm Mask Query  
*Input:* HITAM?  
*Returned:* 0 or 1  
*Comments:* Used to query the Temp A High Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.
HITB
Set Temp B High Alarm
Input:  HITB ±XXX.X
Returned:  No response
Comments:  Used to set the Temp B High Alarm value.

HITB?
Temp B High Alarm Query
Input:  HITB?
Returned:  ±XXX.X
Comments:  Used to query the current Temp B High Alarm value

HITBS?
Temp B High Alarm Status Query
Input:  HITBS?
Returned:  0 or 1
Comments:  Used to query the Temp B High Alarm status where 0 = Off and 1 = On.

HITBM
Set Temp B High Alarm Mask
Input:  HITBM 0 or HITBM 1
Returned:  No response
Comments:  Used to enable or disable the Temp B High Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

HITBM?
Temp B High Alarm Mask Query
Input:  HITBM?
Returned:  0 or 1
Comments:  Used to query the Temp B High Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOTA
Set Temp A Low Alarm
Input:  LOTA ±XXX.X
Returned:  No response
Comments:  Used to set the Temp A Low Alarm value.

LOTA?
Temp A Low Alarm Query
Input:  LOTA?
Returned:  ±XXX.X
Comments:  Used to query the Temp A Low Alarm value.

LOTAS?
Temp A Low Alarm Status Query
Input:  LOTAS?
Returned:  0 or 1
Comments:  Used to query the Temp A Low Alarm status where 0 = off and 1 = on.

LOTAM
Set Temp A Low Alarm Mask
Input:  LOTAM 0 or LOTAM 1
Returned:  No response
Comments:  Used to enable or disable the Temp A Low Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOTAM?
Temp A Low Alarm Mask Query
Input:  LOTAM?
Returned:  0 or 1
Comments:  Used to query the Temp A Low Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.
LOTB  Set Temp B Low Alarm  
Input: LOTB ±XXX.X  
Returned: No response  
Comments: Used to set the Temp B Low Alarm value.

LOTB?  Temp B Low Alarm Query  
Input: LOTB?  
Returned: ±XXX.X  
Comments: Used to query the Temp B Low Alarm value.

LOTBS?  Temp B Low Alarm Status Query  
Input: LOTBS?  
Returned: 0 or 1  
Comments: Used to query the Temp B Low Alarm status where 0 = off and 1 = on.

LOTBM  Set Temp B Low Alarm Mask  
Input: LOTBM 0 or LOTBM 1  
Returned: No response  
Comments: Used to enable or disable the Temp B Low Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOTBM?  Temp B Low Alarm Mask Query  
Input: LOTBM?  
Returned: 0 or 1  
Comments: Used to query the Temp B Low Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

TEMA?  Temp A Current Data Query  
Input: TEMPA?  
Returned: ±XXX.X  
Comments: Used to query the current Temp A sensor reading.

TEMPB?  Temp B Current Data Query  
Input: TEMPB?  
Returned: ±XXX.X  
Comments: Used to query the current Temp B sensor reading.

TUNI  Set Temp Units  
Input: TUNI C, TUNI F, or TUNI K  
Returned: No response  
Comments: Used to set the Temp units where C = Celsius, F = Fahrenheit, and K = Kelvin. Default setting is degrees Celsius.

TUNI?  Temp Units Query  
Input: TUNI?  
Returned: C, F, or K  
Comments: Used to query the Temp units where C = Celsius, F = Fahrenheit, and K = Kelvin. Default setting is degrees Celsius.
Level Commands

**BPFIL?**  
Bypass Status Query  
**Input:**  BPFIL?  
**Returned:**  0 or 1  
**Comments:**  Used to query the current hot gas bypass status where 0 = not bypassing and 1 = bypassing.

**FILAS?**  
Fill Time Alarm Status Query  
**Input:**  FILAS?  
**Returned:**  0 or 1  
**Comments:**  Used to query the Fill Time Alarm Status where 0 = off and 1 = on.

**FILL**  
Set Fill Status  
**Input:**  FILL 0 or FILL 1  
**Returned:**  No response  
**Comments:**  Used to set the current Fill Status where 0 = Stop Fill and 1 = Start Fill

**FILL?**  
Fill Status Query  
**Input:**  FILL?  
**Returned:**  0 or 1  
**Comments:**  Used to query the current Fill Status where 0 = not filling and 1 = filling.

**FILLM?**  
Auto Fill Status Query  
**Input:**  FILLM?  
**Returned:**  0 or 1  
**Comments:**  Used to query the Auto Fill Status where 0 = disabled and 1 = enabled.

**FILT**  
Set Max Fill Time  
**Input:**  FILT XXX  
**Returned:**  No response  
**Comments:**  Used to set the maximum fill time in minutes from 30 to 240 minutes.

**FILT?**  
Max Fill Time Query  
**Input:**  FILT?  
**Returned:**  XXX  
**Comments:**  Used to query the maximum fill time. Value returned in minutes.

**FILTIM?**  
Fill Duration Query  
**Input:**  FILTIM?  
**Returned:**  XXX  
**Comments:**  Used to query the duration of the current fill. Value returned in seconds.

**HFIL**  
Set High Level Setpoint  
**Input:**  HFIL XXX.X  
** Returned:**  No response  
**Comments:**  Used to set the High Level Setpoint. Input value uses the current level units, either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.
**HFIL?**

**High Level Setpoint Query**

**Input:** HFIL?  
**Returned:** XXX.X  
**Comments:** Used to query the High Level Setpoint. Value returned in either inches or millimeters depending on the current level units. There must be at least a 0.5 inch interval between each level setting and alarm.

---

**HILA**

**Set High Level Alarm**

**Input:** HILA XXX.X  
**Returned:** No response  
**Comments:** Used to set the High Level Alarm value. Input value uses the current level units, either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

---

**HILA?**

**High Level Alarm Query**

**Input:** HILA?  
**Returned:** XXX.X  
**Comments:** Used to query the High Level Alarm value. Value returned in either inches or millimeters depending on the current level units. There must be at least a 0.5 inch interval between each level setting and alarm.

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**HILS?**

**High Level Alarm Status Query**

**Input:** HILS?  
**Returned:** 0 or 1  
**Comments:** Used to query the High Level Alarm Status where 0 = off and 1 = on.

---

**HILM**

**Set High Level Alarm Mask**

**Input:** HILM 0 or HILM 1  
**Returned:** No response  
**Comments:** Used to enable or disable the High Level Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

---

**HILM?**

**High Level Alarm Mask Query**

**Input:** HILM?  
**Returned:** 0 or 1  
**Comments:** Used to query the High Level Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

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**LEVL?**

**Current LN2 Level Query**

**Input:** LEVL?  
**Returned:** XXX.X  
**Comments:** Used to query the current LN2 Level reading.

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**LFIL**

**Set Low Level Setpoint**

**Input:** LFIL XXX.X  
**Returned:** No response  
**Comments:** Used to set the Low Level Setpoint. Input value uses the current level units, either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.
LFIL?  
**Low Level Setpoint Query**  
**Input:**  LFIL?  
**Returned:**  XXX.X  
**Comments:** Used to query the Low Level Setpoint. Value returned in either inches or millimeters depending on the current level units. There must be at least a 0.5 inch interval between each level setting and alarm.

LOLA  
**Set Low Level Alarm**  
**Input:**  LOLA XXX.X  
**Returned:**  No response  
**Comments:** Used to set the Low Level Alarm value. Input value uses the current level units, either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

LOLA?  
**Low Level Alarm Query**  
**Input:**  LOLA?  
**Returned:**  XXX.X  
**Comments:** Used to query the Low Level Alarm value. Value returned in either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

LOLS?  
**Low Level Alarm Status Query**  
**Input:**  LOLS?  
**Returned:**  0 or 1  
**Comments:** Used to query the Low Level Alarm Status where 0 = off and 1 = on.

LOLM  
**Set Low Level Alarm Mask**  
**Input:**  LOLM 0 or LOLM 1  
**Returned:**  No response  
**Comments:** Used to enable or disable the Low Level Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOLM?  
**Low Level Alarm Mask Query**  
**Input:**  LOLM?  
**Returned:**  0 or 1  
**Comments:** Used to query the Low Level Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LUNI  
**Set Level Units**  
**Input:**  LUNI E, LUNI M, or LUNI %  
**Returned:**  No response  
**Comments:** Used to set the LN2 level units where E = English (inches), M = Metric (millimeters), and % = Percent.

LUNI?  
**Level Units Query**  
**Input:**  LUNI?  
**Returned:**  E, M, or %  
**Comments:** Used to query the current LN2 level units E = English (inches), M = Metric (millimeters), and % = Percent.

RATE?  
**Current Liquid Usage Query**  
**Input:**  RATE?  
**Returned:**  XXX.X  
**Comments:** Used to query the current LN2 liquid usage rate.
Level Percent Commands

**DSPN**
- Define 100% Point
- **Input:** DSPN XXX.X
- **Returned:** No response
- **Comments:** Used to set the 100% level setting in inches or millimeters.

**DSPN?**
- 100% Point Query
- **Input:** DSPN?
- **Returned:** XXX.X
- **Comments:** Used to query the 100% level setting.

**PCNT?**
- Current Percent Query
- **Input:** PCNT?
- **Returned:** XXX.X
- **Comments:** Used to query the current percent level reading.

**DZER**
- Define 0% Point
- **Input:** DZER XXX.X
- **Returned:** No response
- **Comments:** Used to set the 0% level setting in inches or millimeters.

**DZER?**
- 0% Point Query
- **Input:** DZER?
- **Returned:** XXX.X
- **Comments:** Used to query the 0% level setting.

Event Log Commands

**CLEVLG**
- Clear the Event Log
- **Input:** CLEVLG
- **Returned:** No response
- **Comments:** Used to clear all data from the event log. Data will be permanently lost when the event log is cleared.

**DATE**
- Set the Date
- **Input:** mm/dd/yy
- **Returned:** No response
- **Comments:** Used to set the current date in the format: mm/dd/yy (month/day/year).

**DATE?**
- Date Query
- **Input:** DATE?
- **Returned:** mm/dd/yy
- **Comments:** Used to query the current date.

**EVENT?**
- Last Event Query
- **Input:** EVENT?
- **Returned:** XXXXX, MM/DD/YY, HH:MM, XXX.X, XXX.X, XXX.X, XXX.X
- **Comments:** String returned: Date, Time, TempA, Temp B, LN2 Level, Liquid Usage, Event Codes

**EVNCT?**
- Event Log Count Query
- **Input:** EVNCT?
- **Returned:** XXXXX
- **Comments:** Used to query the number of event log records.
**EVNLOG?**  Event Log Record Query  
**Input:** EVNLOG? N  
**Returned:** XXXX, MM/DD/YY, HH:MM, XXX.X, XXX.X, XXX.X, XXX.X  
**Comments:** Used to query Event Record [n] where n = record number. String returned: Date, Time, TempA, Temp B, LN2 Level, Liquid Usage, Event Codes.

**LOGPER**  Set Event Log Interval  
**Input:** LOGPER XXX  
**Returned:** No response  
**Comments:** Used to set the event log interval between 1 and 240 minutes. Default setting is 240 minutes.

**LOGPER?**  Event Log Interval Query  
**Input:** LOGPER?  
**Returned:** XXX  
**Comments:** Used to query the current event log interval.

**TIME**  Set the Time  
**Input:** hh:mm:ss  
**Returned:** No response  
**Comments:** Used to set the controller Time in the format hh:mm:ss (hour:minute:second).

**TIME?**  Time Query  
**Input:** TIME?  
**Returned:** hh:mm:ss  
**Comments:** Used to query the current time.

**UNID**  Set Unit ID  
**Input:** UNID XXXXX  
**Returned:** No response  
**Comments:** Used to set the controller 5-digit Unit ID. TEC 3000 Unit ID should be between 1 and 200.

**UNID?**  Unit ID Query  
**Input:** UNID?  
**Returned:** XXXXX  
**Comments:** Used to query the controller Unit ID.
Sanitizing and Decontaminating Chart Aluminum and Stainless Steel Products

MVE aluminum dewars are constructed with an aluminum inner, which utilizes a fiberglass neck support. The stainless units are constructed with an inner entirely fabricated from stainless steel sheets. Any cleaning solution that does not react with aluminum or stainless can be used in the sanitation process of these dewars. In most cases, any household detergent or mild soap solution is suitable. The U.S. Custom Service uses a solution called EXPOR for incoming shipments from abroad. This is mixed 9 parts water mixed with sodium chloride & lactic acid. As mentioned above, however, any household cleaning solution can be used. These include bleach, detergents, and mild soaps. Other cleaners and disinfectants that can be safely used include hydrogen peroxide, chlorine/water and denatured alcohol. **NOTE: DO NOT USE ANY PETROLEUM BASED CLEANING SOLUTION.** It is important that the inner vessel is thoroughly rinsed with water and all cleaner residues have been removed. Spraying the solution into the inner vessel is preferred, although agitation of the solution inside the inner will suffice. Vapor shippers and Doble units will require filling the inner to its full capacity with cleaning mixture and then rinsing. Allow the unit to dry thoroughly before putting into service. With vapor shippers, we suggest setting dewar inverted to drain and dry. The process is not intended for use in older vapor shipper models manufactured prior to 1994.

The generally accepted practice of using 10% chlorine bleach with 90% water solution still holds as the best method for decontamination. However, with some of the bovine and swine virus strains showing up today, it is the conclusion of the agricultural professors at the University of Minnesota and Texas A & M that an increased mixture of chlorine bleach to 30% and 70% water will kill most known viruses except BSE.

To perform this sanitizing procedure, cover all inner surfaces with the solution, let stand for 30 minutes and remove. Rinse the decontaminated surfaces with clean water and remove rinse water. Allow dewar to dry before putting into service. For vapor shippers and Doble units, this means to place dewar on end (inverted) and allow drying. Note: Vapor dewars can be used immediately after rinsing but may take longer to recharge to 100% capacity.