In-Line Diffusion SYSTEM MANUAL

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INTRODUCTION

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HOW-TO-USE INSTRUCTIONS

Read this section so that you understand how to use the manual.

TECHNICAL HELP

- If you have problems when you install or operate the equipment, review the installation procedures.
- If you cannot correct a problem, contact your dealer or BTU. Use the telephone numbers from the title page. A representative will help you.
- Keep the reference manuals and serial number available when you call.
EQUIPMENT LABEL

- The serial number of the equipment is on the manual binder and on the equipment label (located near the electrical connections). Make sure that you know the serial number when you call for information.
- For a typical equipment label, refer to **Figure 1-1**.

---

**Figure 1-1: Equipment Label (Typical)**
REQUIRED TOOLS AND CONSUMABLE ITEMS

This section contains lists of required tools and required consumable items to perform preventative and corrective maintenance and replacement procedures. Any special tools or consumable items not listed here are identified in the applicable procedures.

<table>
<thead>
<tr>
<th>Require Tools</th>
<th>Required Consumable Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Ammeter, clip-on</td>
<td>• Brush, soft-bristle applicator</td>
</tr>
<tr>
<td>• Brush, stainless-steel wire</td>
<td>• Cleaning solution (90 percent water / 10 percent isopropyl alcohol)</td>
</tr>
<tr>
<td>• Grease gun</td>
<td>• Dope, nickel anti-seize pipe thread</td>
</tr>
<tr>
<td>• Hammer</td>
<td>• Grease, lubricating (EP-1)</td>
</tr>
<tr>
<td>• Multimeter, digital or analog (must be true RMS)</td>
<td>• High-temperature RTV gasket or sealant adhesive</td>
</tr>
<tr>
<td>• Pliers, needle-nose</td>
<td>• Identification labels</td>
</tr>
<tr>
<td>• Screwdriver set (Phillips and standard)</td>
<td>• Lint-free wipes</td>
</tr>
<tr>
<td>• Torque wrench, 0 – 50 in.-lb. (6.0 Nm)</td>
<td>• Oil, gear</td>
</tr>
<tr>
<td>• Torque wrench, 0 – 50 ft.-lb. (68.0 Nm)</td>
<td>• Oil, gear and chain lubricating</td>
</tr>
<tr>
<td>• Vacuum cleaner (with HEPA-rated filter bag)</td>
<td>• Tape, thread (Teflon®)</td>
</tr>
<tr>
<td>• Allen wrench set</td>
<td>• Water, distilled or purified (do not use de-ionized water)</td>
</tr>
<tr>
<td>• Wrench set, metric and SAE</td>
<td></td>
</tr>
<tr>
<td>• Adhesive, thread (Loctite No. 222 or equivalent)</td>
<td></td>
</tr>
<tr>
<td>• Brush, non-metallic, firm-bristle</td>
<td></td>
</tr>
</tbody>
</table>

**DANGER!**

**DANGEROUS SUBSTANCE!**

BTU International does not recommend any specific cleaning solution to remove production residue. Refer to your product manufacturer’s MSDS for a proper cleaning solution.

Do not use isopropyl alcohol to clean any internal components of the furnace. Refer to your material supplier’s documentation for all recommended safety and cleaning procedures before you do this procedure.

**CAUTION!**

**EXPLOSIVE SUBSTANCE!**

Some procedures in this manual recommend a cleaning solution of 90 percent water / 10 percent isopropyl alcohol. Isopropyl alcohol is explosive in a non-diluted state (flashpoint: 14°C (57°F)).

- Refer to the correct MSDS of any cleaning solution you may use.
- Do not make a cleaning solution on or near the furnace.
- Do not use any cleaning solution on a furnace in operation.
- Make sure there is sufficient ventilation when using cleaning solutions to clean the furnace and its components.
MANUAL DESCRIPTION

Refer to Table 1-1.

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 1, INTRODUCTION</td>
<td>Gives instructions to use this manual and references to technical resources that are available from BTU.</td>
</tr>
<tr>
<td>Chapter 2, SAFETY</td>
<td>Gives safety related practices that are used in this manual and dangers that are related to the use of the equipment.</td>
</tr>
<tr>
<td>Chapter 3, SYSTEM DESCRIPTION</td>
<td>Gives a description of the equipment.</td>
</tr>
<tr>
<td>Chapter 4, INSTALLATION</td>
<td>Gives equipment install data and instructions.</td>
</tr>
<tr>
<td>Chapter 5, OPERATION</td>
<td>Gives procedures to operate the equipment.</td>
</tr>
<tr>
<td>Chapter 6, TROUBLESHOOTING</td>
<td>Gives procedures to troubleshoot equipment operation.</td>
</tr>
<tr>
<td>Chapter 7, Preventive &amp; Corrective Maintenance</td>
<td>Gives procedures to maintain the equipment so that problems do not occur.</td>
</tr>
<tr>
<td>Chapter 8, COMPONENT REPLACEMENT</td>
<td>Gives procedures to replace parts of the equipment.</td>
</tr>
<tr>
<td>Appendix A, DRAWINGS, SPECIFICATIONS &amp; OPTIONS</td>
<td>Includes equipment-specific drawings.</td>
</tr>
<tr>
<td>Appendix B, RECOMMENDED SPARE PARTS</td>
<td>Includes parts that are available to support operation and maintenance of the equipment.</td>
</tr>
<tr>
<td>Appendix C, MATERIAL SAFETY DATA SHEETS</td>
<td>Includes MSDSs that may apply to hazardous materials related to your equipment.</td>
</tr>
<tr>
<td>Appendix D, CALIBRATION SHEETS</td>
<td>Includes the calibration sheets from the final test of your equipment.</td>
</tr>
<tr>
<td>Appendix E, VENDOR MANUALS</td>
<td>Includes vendor manuals that apply to your equipment.</td>
</tr>
</tbody>
</table>

RELATED DOCUMENTATION

For other documentation that is used to operate the equipment, refer to Table 1-2.

<table>
<thead>
<tr>
<th>Manual Title</th>
<th>Contents</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>WINCON Online Help</td>
<td>Gives instructions to operate WINCON software</td>
<td>1</td>
</tr>
</tbody>
</table>
**SYMBOLS, ABBREVIATIONS & TERMS**

For a list of symbols, abbreviations, and terms that are used in this manual, refer to **Table 1-3**.

<table>
<thead>
<tr>
<th>Symbol / Abbreviation / Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;</td>
<td>Less than</td>
</tr>
<tr>
<td>&lt;=</td>
<td>Less than or equal</td>
</tr>
<tr>
<td>=</td>
<td>Equal</td>
</tr>
<tr>
<td>&gt;</td>
<td>Greater than</td>
</tr>
<tr>
<td>&gt;=</td>
<td>Greater than or equal</td>
</tr>
<tr>
<td>°C</td>
<td>Degree Celsius</td>
</tr>
<tr>
<td>ac or AC</td>
<td>Alternating Current</td>
</tr>
<tr>
<td>Alarm</td>
<td>An alarm condition warning, generally halts the furnace operation unless it is a deviation alarm</td>
</tr>
<tr>
<td>Alert</td>
<td>An alert condition, warns of an impending alarm condition (usually, a temperature or gas condition has exceeded the alert deviation limits)</td>
</tr>
<tr>
<td>Bill of Materials</td>
<td>A list of all parts and assemblies that are used to build a system (also BOM)</td>
</tr>
<tr>
<td>BOM</td>
<td>Bill of Materials</td>
</tr>
<tr>
<td>Btu</td>
<td>British Thermal Units</td>
</tr>
<tr>
<td>CAP</td>
<td>Cooled Air Plenum</td>
</tr>
<tr>
<td>Catenary</td>
<td>The curve or loop that a flexible belt or chain forms when it is supported only at two points, as with an anchor chain or the conveyor belt on your furnace</td>
</tr>
<tr>
<td>CDA</td>
<td>Compressed, dry air</td>
</tr>
<tr>
<td>CE</td>
<td>Community of Europe</td>
</tr>
<tr>
<td>Circuit Breaker</td>
<td>An electrical device designed to open a circuit automatically on an overcurrent to prevent equipment damage</td>
</tr>
<tr>
<td>cm</td>
<td>Centimeter</td>
</tr>
<tr>
<td>cm/min</td>
<td>Centimeter per minute</td>
</tr>
<tr>
<td>CO</td>
<td>Carbon monoxide</td>
</tr>
<tr>
<td>CO2</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>Control Cabinet</td>
<td>The housing for the control panel, whether mounted on the furnace or separately mounted</td>
</tr>
<tr>
<td>Control Circuit</td>
<td>The circuit of a control apparatus or system that carries the electrical signals directing the performance of the controller</td>
</tr>
<tr>
<td>Controller</td>
<td>A device or group of devices that control furnace operation or other devices (also furnace Controller)</td>
</tr>
<tr>
<td>Cover Gas</td>
<td>Any process gas introduced into the process chamber to cover the product being processed.</td>
</tr>
<tr>
<td>dc or DC</td>
<td>Direct Current</td>
</tr>
<tr>
<td>Dewpoint Meter</td>
<td>Used to measure moisture in the process atmosphere (refer to Hygrometer)</td>
</tr>
<tr>
<td>Eductor</td>
<td>Cooling option for enhanced convection cooling in conveyor ovens</td>
</tr>
<tr>
<td>Symbol / Abbreviation / Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Emergency Stop Button</td>
<td>Used to stop the conveyor and shut off the heaters in an emergency while controller circuits and safety devices continue to operate</td>
</tr>
<tr>
<td>EMO</td>
<td>Emergency Off (see Emergency Stop Button)</td>
</tr>
<tr>
<td>EPB</td>
<td>Emergency Push Button (see Emergency Stop Button)</td>
</tr>
<tr>
<td>EPO</td>
<td>Emergency Power Off Button (see Emergency Stop Button)</td>
</tr>
<tr>
<td>Equilibrium Zone</td>
<td>The zone or zones of a furnace where the temperature continues to rise until the entire product reaches a uniform soak temperature</td>
</tr>
<tr>
<td>Explosive Gas</td>
<td>Any gas that will burn with explosive force when mixed with oxygen from the air or from an oxygen-rich compound (for example, methane or hydrogen)</td>
</tr>
<tr>
<td>FEC Heater</td>
<td>Fully enclosed coil heaters that have a durable iron-chromium-aluminum alloy resistance element embedded in a cast-fiber insulating plate to give clean, energy efficient continuous processing at temperatures up to 1150°C</td>
</tr>
<tr>
<td>Forming Gas</td>
<td>Any mixture formed by combining two or more gases. Where a furnace uses hydrogen as its principal process gas, the term forming gas usually refers to the mixture formed when a large amount of inert N₂ is mixed with a small amount of highly reactive hydrogen (often in a 96 percent N₂ : 4 percent hydrogen ratio). This kind of forming gas is used to displace an all hydrogen atmosphere from a process chamber. The slight mixture of hydrogen lets impurities in the product complete the process of binding with hydrogen, yet the new gas is non-explosive when mixed with outside air.</td>
</tr>
<tr>
<td>FRU</td>
<td>Field replaceable unit</td>
</tr>
<tr>
<td>ft.</td>
<td>Foot/Feet</td>
</tr>
<tr>
<td>FU</td>
<td>Fuse</td>
</tr>
<tr>
<td>Gas</td>
<td>Refers to cover gas, explosive gas, forming gas, inert gas, non-explosive gas, process gas and purge gas</td>
</tr>
<tr>
<td>GEM</td>
<td>Generic Equipment Module (see Generic Equipment Module)</td>
</tr>
<tr>
<td>Generic Equipment Module</td>
<td>A host communication software that is used with the windows version of the controller software</td>
</tr>
<tr>
<td>gpm</td>
<td>Gallons per minute</td>
</tr>
<tr>
<td>H₂O</td>
<td>Water</td>
</tr>
<tr>
<td>HAP</td>
<td>Heated Air Plenum</td>
</tr>
<tr>
<td>Host</td>
<td>A remote supervisory computer system that uses the management software to interface with the furnace</td>
</tr>
<tr>
<td>hp</td>
<td>Horsepower</td>
</tr>
<tr>
<td>Hr</td>
<td>Hour</td>
</tr>
<tr>
<td>HVAC</td>
<td>Heating, Ventilation, Air Conditioning</td>
</tr>
<tr>
<td>Hygrometer</td>
<td>Used to measure the amount of moisture in the process atmosphere (also Dewpoint meter)</td>
</tr>
<tr>
<td>Hz</td>
<td>Hertz</td>
</tr>
<tr>
<td>ID</td>
<td>Inside Diameter</td>
</tr>
<tr>
<td>in.</td>
<td>Inch</td>
</tr>
<tr>
<td>Inconel™ 601</td>
<td>A high-nickel, chromium and silicon alloy selected for its resistance to corrosion and its high heat transfer characteristics</td>
</tr>
</tbody>
</table>
### Symbol / Abbreviation / Term | Definition
--- | ---
Inert gas | A gas whose chemical properties make it non-reactive. For example, nitrogen or carbon dioxide are inert because they have no “free” electrons to form a molecular bond with other elements or compounds
Interlock | A switch device that limits or inhibits the operation of a unit or furnace to prevent damage or personal injury.
iph | Inch per hour
ipm | Inch per minute
ips | Inch per second
iwc | inches water column
kg | Kilogram
kPa | Kilopascal
kVA | Kilovolt-amperere
kW | Kilowatt
l | Liter
l/hr | Liter per hour
lb | Pound
LED | Light Emitting Diode
Lockout/Tagout | An OSHA safety standard (29 CFR 1910.147) procedure using locks, tags and hasps to disable equipment before maintenance, cleaning and inspection
lph, LPH | Liter per hour
lpm, LPM | Liter per minute
M | Meter
Magnehelic | An instrument for measuring static gas pressures (also manometer)
Manometer | An instrument for measuring static gas pressures, usually in inches of water column (also magnehelic)
Material Return Authorization Number | An authorization number assigned by BTU that is used when you return parts for warranty replacement (also MRA number)
MB | Megabyte
mbar | Millibar
MCP | Main Control Panel
Menu Driven | A type of software program that lets the operator make selections from a list of options or functions on the screen
mm | Millimeters
mm/min | Millimeters per minute
MSDS | Material Safety Data Sheet
µm | Micron
Muffle | The chamber that surrounds the product as it enters and leaves the furnace
N.m | Newton meter
N₂ | Nitrogen
<table>
<thead>
<tr>
<th>Symbol / Abbreviation / Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA</td>
<td>National Fire Protection Agency</td>
</tr>
<tr>
<td>Non-Explosive Gas</td>
<td>A gas or gas mixture that is inert and non-combustible such as N\textsubscript{2}</td>
</tr>
<tr>
<td>NPT</td>
<td>Nominal Pipe Thread</td>
</tr>
<tr>
<td>O\textsubscript{2}</td>
<td>Oxygen</td>
</tr>
<tr>
<td>OD</td>
<td>Outside Diameter</td>
</tr>
<tr>
<td>Orifice Plate</td>
<td>A perforated panel that is used to distribute an even flow of air or gas from the heaters to the process chamber (also Heated Air Panel)</td>
</tr>
<tr>
<td>OEM</td>
<td>Original Equipment Manufacturer; Products purchased from other manufacturers for use in the furnace (for example, the oxygen analyzer or the UPS).</td>
</tr>
<tr>
<td>OSHA</td>
<td>Office of Safety and Health Administration. Regulatory body that oversees workplace safety in the U.S.</td>
</tr>
<tr>
<td>OTM</td>
<td>Over-temperature module</td>
</tr>
<tr>
<td>PID</td>
<td>Proportional Integral Derivative</td>
</tr>
<tr>
<td>PLC</td>
<td>Programmable Logic Controller</td>
</tr>
<tr>
<td>PN</td>
<td>Part Number</td>
</tr>
<tr>
<td>ppm, PPM</td>
<td>Parts per million</td>
</tr>
<tr>
<td>Process Gas</td>
<td>The gas or gas mixture used in a chemical process within a furnace</td>
</tr>
<tr>
<td>Profile</td>
<td>A graphic composite of the process zone temperatures over the length of the furnace as monitored by profile thermocouples</td>
</tr>
<tr>
<td>Proportional Integral Derivative</td>
<td>A mathematical algorithm used to control to a setpoint</td>
</tr>
<tr>
<td>psi, PSI</td>
<td>Pounds per square inch</td>
</tr>
<tr>
<td>psia, PSIA</td>
<td>Pounds per square inch absolute</td>
</tr>
<tr>
<td>psig, PSIG</td>
<td>Pounds per square inch gage</td>
</tr>
<tr>
<td>Purge gas</td>
<td>Any non-explosive gas or gas mixture used to displace a process gas from the furnace process chamber. Because it is inert and relatively inexpensive, N\textsubscript{2} is usually the purge gas of choice.</td>
</tr>
<tr>
<td>PX</td>
<td>Proximity switch</td>
</tr>
<tr>
<td>qt/min</td>
<td>Quarts per minute</td>
</tr>
<tr>
<td>Ramp</td>
<td>Controlled heating process that, when graphed over time, would form a ramp-like incline or decline</td>
</tr>
<tr>
<td>RCF</td>
<td>Refractory Ceramic Fiber</td>
</tr>
<tr>
<td>RCS</td>
<td>Retractable Center Support</td>
</tr>
<tr>
<td>Ready State</td>
<td>A mode of operation when the furnace has stabilized and is ready to process products</td>
</tr>
<tr>
<td>REC</td>
<td>Rectifier</td>
</tr>
<tr>
<td>RECP</td>
<td>Receptacle</td>
</tr>
<tr>
<td>Refractory Ceramic Fiber</td>
<td>A type of high temperature insulation used in the furnace</td>
</tr>
<tr>
<td>RES</td>
<td>Resistor</td>
</tr>
<tr>
<td>Symbol / Abbreviation / Term</td>
<td>Definition</td>
</tr>
<tr>
<td>------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Return Authorization Number</td>
<td>An authorization number assigned by BTU that is used when returning parts for paid repair (also RA number)</td>
</tr>
<tr>
<td>scfh</td>
<td>Standard cubic feet per hour</td>
</tr>
<tr>
<td>scfm</td>
<td>Standard cubic feet per minute</td>
</tr>
<tr>
<td>SMEMA</td>
<td>Surface Mount Equipment Manufacturer’s Association (merged with Institute for Interconnecting and Packaging Electronic Circuits (IPC)). IPC/SMEMA includes suppliers to electronics assemblers. It starts and drives technical, managerial, and financial programs to enhance work relationships and equipment compatibility within the electronics assembly industry</td>
</tr>
<tr>
<td>SMG</td>
<td>System Monitor Graphic</td>
</tr>
<tr>
<td>Sparger</td>
<td>A device that introduces air or gas into the atmosphere surrounding product being processed to ensure thorough gas infiltration of the product and efficient evacuation of effluents</td>
</tr>
<tr>
<td>Spike</td>
<td>The high temperature or “reflow” zone of a furnace where the product is exposed to a rapid rise in temperature, which forms a spike in a heat profile graph</td>
</tr>
<tr>
<td>SSR</td>
<td>Solid Switch Relay</td>
</tr>
<tr>
<td>Thermocouple</td>
<td>a kind of thermometer consisting of two wires of different metals that are joined at both ends; one junction is at the temperature to be measured and the other is held at a fixed lower temperature; the current generated in the circuit is proportional to the temperature difference</td>
</tr>
<tr>
<td>Trim Pot</td>
<td>A miniature trimming potentiometer which usually has a small screw adjustment</td>
</tr>
<tr>
<td>True-RMS</td>
<td>The specific rating of an electrical device or instrument</td>
</tr>
<tr>
<td>Uninterruptable Power Supply</td>
<td>A device that is used as an emergency power supply when the primary source of power to the system is lost</td>
</tr>
<tr>
<td>UPS</td>
<td>Uninterruptable Power Supply</td>
</tr>
<tr>
<td>V</td>
<td>Volt</td>
</tr>
<tr>
<td>Vac</td>
<td>Volts Alternating Current</td>
</tr>
<tr>
<td>Vdc</td>
<td>Volts Direct Current</td>
</tr>
<tr>
<td>W</td>
<td>Watt</td>
</tr>
<tr>
<td>WINCON</td>
<td>Proprietary software that controls the operation of BTU thermal processing equipment that uses Microsoft Windows®</td>
</tr>
</tbody>
</table>
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<td>2-14</td>
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</table>
MATERIAL SAFETY DATA SHEETS

All potentially hazardous material provided by BTU includes a Material Safety Data Sheet (MSDS), located in Appendix C: MATERIAL SAFETY DATA SHEETS.

Any potentially hazardous materials included in an Original Equipment Manufacturer (OEM) product, such as the oxygen analyzer, includes a MSDS insert within the manufacturer's manual (refer to your Vendor Manual package).

It is your responsibility to provide MSDS inserts regarding use and disposal of all chemicals and processing materials not specified in this manual.

SAFETY PRECAUTIONS

DANGER!

DANGEROUS SUBSTANCE!

The customer must be aware of the outgasses and emissions of their process!

This furnace may use gases that pose danger from asphyxiation or suffocation. Also, industrial processes at this site may produce toxic gases. Make sure the site is adequately ventilated.

BTU International strongly recommends testing the exhaust periodically in reference to facility or local regulations; otherwise, serious injury or death to personnel may occur.

WARNING!

READ!

• Read this manual in its entirety before you install, operate, troubleshoot or maintain the furnace.
• Read a procedure in its entirety before you perform it.
• Always note and take any safety precautions recommended in this manual and other documentation before you perform any procedure; otherwise, severe personal injury or equipment damage may occur.

QUALIFIED PERSONNEL!

• Procedures include working with high amperage, high voltage and moving parts.
• Procedures must be performed by fully trained, fully qualified personnel.
• Most procedures require advanced knowledge of electrical, mechanical, and plumbing theories and issues.
• DO NOT PERFORM THE PROCEDURE IF YOU HAVE ANY DOUBTS ABOUT HOW TO ACCOMPLISH THE TASKS INVOLVED. Contact BTU International Customer Service; otherwise, severe personal injury or equipment damage may occur.
• If you do not obey all the safety precautions listed in this manual and any other associated documents, you risk the occurrence of death or serious injury to personnel and a cancelled manufacturer's warranty.

This equipment has high electrical voltages, high temperatures, high gas pressures and moving parts. Obey the instructions in this and other manuals when you install, operate and maintain the equipment. This reduces risk of personal injury.

For precautions that relate to the equipment, refer to Tables 2-1 through 2-7.
### Table 2-1: General Precautions

<table>
<thead>
<tr>
<th>Precaution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Do use only trained personnel to install, operate and do maintenance.</td>
</tr>
<tr>
<td></td>
<td>Do obey all DANGER, WARNING and CAUTION labels.</td>
</tr>
<tr>
<td></td>
<td>Do obey all procedures written in this manual (this will protect you from dangers that other methods can not prevent).</td>
</tr>
<tr>
<td></td>
<td>Do give instructions to all personnel in electrical, mechanical, compressed gas, chemical and other types of safeties that are related to operation and maintenance.</td>
</tr>
<tr>
<td></td>
<td>Do use teams of two or more persons to do maintenance. One person must monitor the controls and indicators, and one person must monitor the system operation.</td>
</tr>
<tr>
<td></td>
<td>Do wear safety glasses and protective clothing when you do maintenance on the system.</td>
</tr>
<tr>
<td></td>
<td>Do turn off compressed gases and electric power at the source before you do maintenance on the system, when possible.</td>
</tr>
<tr>
<td></td>
<td>Do turn off electric power to the system, in accordance with the lockout/tagout procedure, before you connect or disconnect cables.</td>
</tr>
<tr>
<td></td>
<td>Do close and latch all access panels or doors when you are not doing maintenance.</td>
</tr>
<tr>
<td></td>
<td>Do periodic checks of the operation of all safety interlocks.</td>
</tr>
<tr>
<td></td>
<td>Do be extremely careful when you use flammable solvents such as alcohol for cleaning. Make sure that the electric power is off and the equipment is cool enough to prevent a fire.</td>
</tr>
<tr>
<td></td>
<td>Do turn off the system and disconnect the power source before you move the system.</td>
</tr>
<tr>
<td></td>
<td>Do move equipment carefully. Jolts or drops can damage the equipment.</td>
</tr>
<tr>
<td></td>
<td>Do not remove warning labels from the system.</td>
</tr>
<tr>
<td></td>
<td>Do not operate damaged or leaking equipment.</td>
</tr>
<tr>
<td></td>
<td>Do not operate without cooling fluid available to the system (if applicable).</td>
</tr>
<tr>
<td></td>
<td>Do not wear watches and/or jewelry when you work on electrical equipment.</td>
</tr>
<tr>
<td></td>
<td>Do not override safety interlocks (if a procedure requires work while the power is on, obey the procedure).</td>
</tr>
</tbody>
</table>

### Table 2-2: Chemical Precautions

<table>
<thead>
<tr>
<th>Precaution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical</td>
<td>Dangerous materials are used for processes and maintenance procedures. Cleaning solvents, lubricants, adhesives and other chemicals are recommended in this manual. Refer to MSDSs and to all local, state and federal regulations, when you use chemicals, rags and brushes to operate and do maintenance. For hazardous items that are not identified in this manual, the end user must keep MSDSs.</td>
</tr>
</tbody>
</table>
Table 2-3: Electrical Precautions

<table>
<thead>
<tr>
<th>Precaution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DANGER!</strong></td>
<td>High voltage is used to operate the equipment. Death or serious injury can occur if you touch high-voltage connections.</td>
</tr>
</tbody>
</table>

**Electrical**

- In the U.S., give instruction in electrical handling procedures as specified in the National Fire Protection Association standard NFPA 70E, Standards for Electrical Safety Requirements for Employee Workplaces, 1988 edition.
- In countries other than the U.S., give instruction in the equivalent safety standards of your country.
- Do use all precautions to prevent contact with live circuits when you install and do maintenance (do not rely on the indicator lamps, since they may have burned out).
- Do be careful when any internal parts or wiring are exposed.
- Do de-energize, lockout and tagout the main power disconnect to prevent unauthorized use (if applicable).

Table 2-4: Exhaust Precautions

<table>
<thead>
<tr>
<th>Precaution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DANGER!</strong></td>
<td>DANGEROUS SUBSTANCE! The customer must be aware of the outgasses and emissions of their process! This furnace may use gases that pose danger from asphyxiation or suffocation. Also, industrial processes at this site may produce toxic gases. Make sure the site is adequately ventilated. BTU International strongly recommends testing the exhaust periodically in reference to facility or local regulations; otherwise, serious injury or death to personnel may occur.</td>
</tr>
</tbody>
</table>

**Exhaust**

- The exhaust system must comply with all local, federal and state codes. This prevents toxic gas from entering the area or polluting the environment. Do not operate the system if the exhaust system does not comply with these codes.
- Do have an exhaust system that is sufficient to remove all effluents from the equipment.

Table 2-5: Heat and Burns Precautions

<table>
<thead>
<tr>
<th>Precaution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heat and Burns</strong></td>
<td>Do not touch hot parts (for example, product that exits the equipment). Let the system cool before you do maintenance. Wear heat protective gloves as necessary.</td>
</tr>
</tbody>
</table>
Table 2-6: Gas Precautions

<table>
<thead>
<tr>
<th>Precaution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DANGER!</strong></td>
<td>Nitrogen may be used as a process gas. Nitrogen is inert and makes up 80 percent of the air we breathe, but will cause death without sufficient oxygen. Make sure that workspaces where nitrogen is used are vented. This equipment may use hydrogen. Hydrogen is explosive when mixed with air. Make sure that the nitrogen to the plenums is more than the hydrogen (cover gas) flow rate into the exhaust.</td>
</tr>
</tbody>
</table>

**Gas**
- Do be careful when you handle inert gases, like nitrogen. Inert gases can cause you to suffocate because of the lack of oxygen.
- Do give instruction to correctly handle pressurized gases.
- Do have instruction to correctly handle pressurized gases.
- Do have sufficient fresh air to compensate for the nitrogen and exhaust system requirements.
- Do have all related medical information available to personnel.
- Do obey all local codes for gas plumbing and gas handling.
- Do install gas supply systems in accordance with local fire and building codes, NFPA and the Compressed Gas Association.
- Do install automatic shutout devices on all gases.
- Do weld plumbing lines and do not use fittings (for high gas concentrations).
- Do install flow-regulating devices at the gas source.
- Do keep compressed gas in cabinets that have vents and sprinklers, and that meet safety codes.
- Do make sure that all supply lines are clearly marked every 2 ft., with both contents and use.

Table 2-7: Insulation, Moving Parts, Noise, and Plumbing Precautions

<table>
<thead>
<tr>
<th>Precaution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation</td>
<td>Insulation may contain RCF insulation that can irritate your skin. You should not become exposed to RCF. If you do, do not breathe the fibers. Use a protective dust mask, clothing and gloves. Refer to the MSDS.</td>
</tr>
<tr>
<td>Moving Parts</td>
<td>Be careful when you do maintenance procedures. When possible, use the lockout/tagout procedure to de-energize the system before you do work on any moving part.</td>
</tr>
<tr>
<td>Noise</td>
<td>OSHA set the maximum safe operating noise level at 70 db. Depending on the equipment features, the usual acoustic noise level may exceed the maximum safe noise level. Ear protection is recommended.</td>
</tr>
<tr>
<td>Plumbing</td>
<td>Plumbing lines have labels with the contents and direction of flow (labels have a green background with white lettering). When you do maintenance, obey the labels. Use the lockout/tagout procedure on gas lines when you do maintenance on the gas system.</td>
</tr>
</tbody>
</table>
SAFETY IDENTIFICATION

Dangers, Warnings, Cautions, and Notes

Procedural safety precautions and notes used in this manual are identified by one of four levels. Each level of safety precaution is described below:

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANGER!</td>
<td>Shows that an event or an unsafe practice may occur that will cause death to personnel.</td>
</tr>
<tr>
<td>WARNING!</td>
<td>Shows that an event or an unsafe practice may occur that will cause serious injury to personnel.</td>
</tr>
<tr>
<td>CAUTION!</td>
<td>Shows that an event or an unsafe practice may cause minor injury to personnel and/or damage to equipment.</td>
</tr>
</tbody>
</table>

NOTE: Gives any additional, but not safety related, information about a procedure.

Electrical Hazards

The type of electrical hazard is identified at the beginning of maintenance procedures that include electrical work (Table 2-8).

<table>
<thead>
<tr>
<th>SEMI Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>Equipment is fully de-energized (electrically cold). Follow lockout / tagout procedures.</td>
</tr>
<tr>
<td>Type 2</td>
<td>Equipment is energized. Live circuits are covered or insulated. Work is performed at a remote location to preclude accidental shock.</td>
</tr>
<tr>
<td>Type 3</td>
<td>Equipment is energized. Live circuits are exposed and accidental contact is possible. Potential exposures are less than 30 volts RMS [or DC], 42.2 volts peak, 240 volt-amps and 20 Joules. (See NFPA 79-14.3, IEC 204, UL 1950 &amp; 1262, IEC 950.)</td>
</tr>
</tbody>
</table>
Safety Labels

Safety labels are used in various locations on the equipment and in the manual to warn of potential hazards when installing, operating or maintaining the equipment. **Figure 2-1** shows a few examples of the most commonly used safety labels on BTU furnaces. Safety labels conforming to SEMI S2 standards indicate the level of hazard by the background color of the label (Table 2-9).

### Table 2-9: SEMI S2 Safety Labels Background Colors

<table>
<thead>
<tr>
<th>Color</th>
<th>SEMI Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Equipment is energized. Live circuits are exposed and accidental contact is possible. Voltage potentials are greater than 30 volts RMS [or DC], 42.2 volts peak, 240 volt-amps, 20 Joules, or radio frequency (rf) is present.</td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>SEMI Category</td>
<td>Description</td>
</tr>
<tr>
<td>Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** High voltage labels are on all access panels of electrical cabinets that contain voltages of more than 110 VAC.
STANDARD AND OPTIONAL SAFETY EQUIPMENT

Standard Equipment

Refer to Table 2-10.

Table 2-10: Safety Features

<table>
<thead>
<tr>
<th>Device</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMO</td>
<td>EMOs stop equipment operation in an emergency.</td>
</tr>
<tr>
<td>Interlocks</td>
<td>Interlocks de-energize power and prevent part damage.</td>
</tr>
<tr>
<td></td>
<td>Interlocks are installed on doors, access panels, exhaust ducts, lids and gas supply lines.</td>
</tr>
<tr>
<td>Temperature alarms,</td>
<td>Temperature deviation alarms, over-temperature thermal switches and thermocouples in each heated zone, protect the system from over-temperature. Alarms are set in the recipe through the furnace controller.</td>
</tr>
<tr>
<td>temperature switches</td>
<td></td>
</tr>
<tr>
<td>Belt stop alarm</td>
<td>The belt stop alarm is an electro-mechanical alarm that indicates when operation is stopped or moving too slowly.</td>
</tr>
<tr>
<td>Main disconnect switch</td>
<td>Lockable switch that lets you energize and de-energize the furnace. It also provides over-current protection that can be reset.</td>
</tr>
<tr>
<td>[Option]</td>
<td></td>
</tr>
</tbody>
</table>

DANGER!

The UPS remains energized when the main power disconnect switch is set to OFF.

The main power switch can be locked in the off position to prevent unapproved use. The red tab on the switch handle can be pulled out (off position) and locked with a padlock. If the furnace has a UPS, the backup power is disabled when the main power disconnect switch is in the off position.

Optional Equipment

NOTE: You (the customer) are responsible for approving, procuring, installing, operating and performing maintenance of safety items that are used at your (the customer) facility.

You (the customer) must protect your equipment and employees. The safety equipment that is listed does not protect equipment or employees from all dangers.

You must have the following safety equipment available:

- Fire protection equipment
- Safety glasses
- Protective clothing
- Ear protection
- Self-contained breathing device
- Heat-resistant gloves
- Dust mask
SAFETY PROCEDURES

Safety Interlocks

Safety interlocks shut down heat, gas and blower motors. The system identifies a tripped interlock with a visual alarm on the light tower and in WINCON.

WARNING!

EQUIPMENT SAFETY!

Make sure only an authorized technician overrides the hood lift interlock; otherwise, severe personal injury may occur.

Never keep equipment unattended with any interlock defeated.

NOTE: The above illustration is a typical example. Your furnace may be different.
Lockout / Tagout Procedure

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
</table>
| Special Tools:      | • Lockout / Tagout signs  
|                     | • Padlock  
|                     | • Voltmeter |
| Related Documents:  | WINCON Online Help |
| Exit Criteria:      | The furnace has been de-energized, all applicable components and associated equipment has been locked with a padlock, and lockout tags have been hung on all applicable and associated equipment. |

For safety purposes, the main power disconnect switch can be locked off to prevent unauthorized use. The main power disconnect switch is normally located on the furnace near the power input cable.

**NOTE:** Energy isolation and lockout / tagout are to be applied only by trained employees that are authorized to perform service or maintenance. Before lockout / tagout is applied, all employees who work in the affected area must be notified. This procedure does not override your facility's lockout / tagout procedure.

**To perform a Lockout / Tagout procedure:**

1. Notify all appropriate personnel that a lockout / tagout is being performed.

2. In WINCON, run a cooldown recipe. Refer to *WINCON Online Help*.

3. Examine the internal furnace temperature in WINCON. Wait until the temperature is 60°C or less.

4. Shut down WINCON. Refer to *WINCON Online Help*.

5. De-energize the personal computer. Refer to the applicable vendor manual.

6. If applicable, de-energize the UPS. Refer to the applicable vendor manual.

7. If applicable, disconnect all wires from the UPS. Lock all wires with a plug-locking device.

8. Set the main power disconnect switch (1) to **OFF**.

9. Using a padlock, lockout the main power disconnect switch.

10. Hang a lockout / tagout sign on the main power disconnect switch.

**WARNING!**

**BURN HAZARD!**

You will be severely burned if you touch hot equipment!

Wait until the internal temperature of the furnace is at or less than 60°C before performing the lockout / tagout procedure. Make sure the furnace and its components are cool to the touch before performing any maintenance procedure.
Using a voltmeter, examine the electrical system for any residual voltage.

Shut off all liquid and gas supplies. Put a lockout / tagout sign on the shutoff valves.

**Lockout / Tagout Removal Procedure**

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>WINCON Online Help</td>
</tr>
</tbody>
</table>

To remove a Lockout / Tagout:

1. Make sure the equipment is fully assembled and safe to operate.
2. Remove all tools from the work area.
3. Notify all appropriate personnel that a lockout / tagout is being removed.
4. Remove all lockout / tagout devices.
5. Turn on all liquid and gas supplies.
6. Set the main power disconnect switch to **ON**.
7. Energize the UPS (unlock and connect cables, if applicable) and the personal computer. Refer to the appropriate vendor manual.
8. Press **START / RESET** on the main control panel.
9. Start WINCON and run the correct recipe. Refer to **WINCON Online Help**.
10. Operate the furnace.
1 ON (I) position, unlocked
2 OFF (O) position, locked with padlock
3 ON (I) position, unlocked
4 OFF (O) position, locked with padlock

Figure 2-3: Main Power Disconnect Switch
EMO (Emergency Off)

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>WINCON Online Help</td>
</tr>
</tbody>
</table>

In an emergency, press an EMO at one of the following locations:

**NOTE:** In a typical setup, there are two EMOs at the entrance end, two at the middle, and two at the exit end. Your particular furnace may have more, depending upon the options ordered. Refer to the Installation Drawing for the specific EMO locations on your furnace.

When you press an EMO the following items de-energize: heaters, conveyor system, 6-kVA power transformer and all subsystems except the 24V control circuits.

When you press an EMO, the following items stay energized: Intellimax, personal computer and the 1.5-kVA instrument transformer.

**NOTE:** Power stays OFF until you disengage all activated EMOs.

**To energize the furnace after an emergency:**

1. Turn the EMO 1/8-turn counterclockwise. The EMO extends.

   **NOTE:** If possible, remove product to prevent heat damage.

2. Press **START/RESET** on the main control panel to energize the conveyor system and heaters.

3. Restart the product recipe and clear the EMO alarm in WINCON.

4. When the furnace is READY, load product.
Disposal of Equipment

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
</table>
| Special Tools:      | • Lifting equipment  
|                     | • Common hand tools  |
| Related Documents:  | WINCON Online Help |

Environmentally Responsible Recycling of Equipment

BTU believes in environmentally responsible recycling of equipment. If the equipment is no longer needed, consider the following:

- Can you extend the life of the equipment?
- Can you upgrade the equipment to your present requirements?
- Can you use the equipment elsewhere in your facility or company?
- Can you sell the equipment for further use?

End-of-Life Decommissioning

**NOTE:** Disassemble and sort the parts by material type (i.e., steel, stainless steel, aluminum, insulation, etc.).

1. Disassemble the Equipment.
2. Sort parts by material type.

**CAUTION!**

In normal operation, the only parts that are exposed to process chemicals are internal areas of the process chamber and the exhaust stacks.

3. Remove process materials from parts, if applicable.

4. Dispose of hazardous and non-hazardous materials in an environmentally responsible manner.
   - For information about hazardous materials related to maintenance and operation of your equipment, refer to Appendix C: MATERIAL SAFETY DATA SHEETS or the standard practice of your facility.
   - Hazardous maintenance materials include lithium batteries, contaminated rags, etc.
   - Dispose of hazardous materials in accordance with local, state, and federal regulations.
CHAPTER 3
SYSTEM DESCRIPTION

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THEORY OF OPERATION

Product is loaded onto the conveyor belt at the entrance end of the furnace. The product enters the process chamber through an atmospheric barrier called an atmosphere curtain, which keeps processing atmosphere within the furnace, and ambient atmosphere out. As the conveyor belt moves through the process chamber, product is carried through a series of individually controlled heated zones, in reference to a thermal profile.

A typical thermal profile first begins with a rapid temperature increase, also known as “ramping up.” Ramping up typically occurs in the first few heated zones. Ramping up brings the product to processing temperature within a controlled state.

Once the first designated temperature of the profile has been obtained, the other heated zones (called “soak zones”) are typically programmed to produce a uniform temperature so that the entire product stabilizes at the same temperature.

After the heated process chamber, the product is then carried through the cooling section, which is designed to slowly cool the product so that it is not susceptible to thermal shock as it exits the furnace. The cooling section is controlled by adjusting the flow of water through the water jackets.

After cooling, product is carried through another atmospheric barrier onto the exit end of the furnace for unloading.

As the product is carried through the furnace, the processing atmosphere flows counter to the product direction of travel. This flow is known as a “counter flow.” The counter flow helps remove impurities from the product and the processing chamber so that product is always being carried through a progressively cleaner atmosphere.

Direction of Product Travel

To accommodate various production facilities, conveyor furnaces can be configured at purchase for either left-to-right or right-to-left direction of product travel:

- Left-to-right: The operator controls are on the right-hand side (exit end) of the furnace as you face the furnace from the front.
- Right-to-left: The operator controls are on the left-hand side (exit end) of the furnace as you face the furnace from the front.

To determine the configuration of your furnace, refer to the Installation Drawing in Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS.
## EQUIPMENT FEATURES / OPTIONS

**NOTE:** Your equipment may not have all the listed features and options.

### Table 3-1: Overall Furnace

<table>
<thead>
<tr>
<th>Item</th>
<th>Air / N₂</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE Certification</td>
<td>O</td>
<td>Certifies the furnace meets safety standards for the Community of Europe (CE). Safety labels and other European safety features are included.</td>
</tr>
<tr>
<td>Entrance Section</td>
<td>S</td>
<td>The entrance section consists of an entrance load table and an entrance muffle section. Product is placed on the entrance conveyor for processing. The entrance muffle immediately follows the entrance table and isolates the internal and external atmosphere.</td>
</tr>
<tr>
<td>Exit Section</td>
<td>S</td>
<td>The exit section consists of the exit muffle and the exit off-load table. The exit muffle follows the cooling section and isolates the internal and external atmosphere. The exit table follows the exit muffle and is where processed product is retrieved from the conveyor.</td>
</tr>
<tr>
<td>Extended Onload and Offload Table</td>
<td>O</td>
<td>Increases the onload and offload area. More area may be necessary if the equipment operates at high throughput, or if manual product handling is required upon entering or exiting. Sections start with a 12 in. length and can be extended in 12 in. increments. Legs can be included to maintain a horizontal conveyor.</td>
</tr>
<tr>
<td>Separation Joint</td>
<td>O</td>
<td>A separation joint in the entrance or exit muffle or in the process chamber lets the equipment be broken down into separate sections for shipment.</td>
</tr>
<tr>
<td>Spare Parts Kit</td>
<td>O</td>
<td>Furnace specific recommended spare parts.</td>
</tr>
<tr>
<td>Special Color</td>
<td>O</td>
<td>Choice of colors (external panels only)</td>
</tr>
</tbody>
</table>

**O** = Option, **S** = Standard

### Table 3-2: Conveyor System

<table>
<thead>
<tr>
<th>Item</th>
<th>Air / N₂</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belt Speed Module</td>
<td>S</td>
<td>The belt speed module receives the speed signal from the Intellimax and gives the correct voltage and power to drive the conveyor drive motor.</td>
</tr>
<tr>
<td>Belts</td>
<td>S</td>
<td>29 or 36-in. Nichrome V.</td>
</tr>
<tr>
<td>Brush Belt Cleaner</td>
<td>O</td>
<td>The brush cleaner consists of rotating brushes that physically scrub the conveyor belt or loose debris. The belt continuously passes through a motor-driven set of top / bottom rotating brushes. The rotary brush cleaner is software-controlled via WINCON recipe. For more information, refer to WINCON Online Help.</td>
</tr>
<tr>
<td>Conveyor Belt and Idler Pulley</td>
<td>S</td>
<td>The conveyor belt is supported on a large idler pulley. Next to the pulley is a proximity switch which measures the rotation of the belt.</td>
</tr>
<tr>
<td>Drive System</td>
<td>S</td>
<td>The drive motor and gear reducer box, drive chain, pulley, shear pin assembly, and pressure pulley assembly are at the exit end of the furnace. Your system may be different. The drive unit is covered to keep it free of contamination and to ensure operator safety.</td>
</tr>
<tr>
<td>Hand Crank</td>
<td>O</td>
<td>Used to manually advance the conveyor to remove product from the process chamber in the event of a power failure or a drive shear pin failure.</td>
</tr>
<tr>
<td>Ultrasonic Belt Cleaner</td>
<td>S</td>
<td>The ultrasonic belt cleaner efficiently cleans irregular conveyor belt surfaces by using sound to agitate a tank of deionized (DI) water through which the belt passes. An air rake removes excess water by spraying compressed air on the belt as it exits the tank. The air is sprayed through a perforated metal cylinder that is horizontal to the furnace floor. The standard ultrasonic belt cleaner is equipped with a multi-frequency generator and an immersible transducer. The system includes a double-walled, stainless steel tank with a solenoid-operated water inlet valve, a float switch, and a solenoid-operated valve on the drain. Use the ultrasonic belt cleaner on a maintenance schedule at sufficient intervals to ensure an acceptable level of cleanliness for the specific product process. Do not use the ultrasonic belt cleaner during product processing, otherwise, the moisture from Ultrasonic Belt Cleaner will increase dew point levels and affect product process. The ultrasonic belt cleaner is software-controlled via WINCON recipe. Refer to WINCON Online Help for operating information and to the Vendor Manual located in Appendix E: Vendor Manuals.</td>
</tr>
</tbody>
</table>

**O** = Option, **S** = Standard
### Table 3-3: Electrical and Control System

<table>
<thead>
<tr>
<th>Item</th>
<th>Air / N₂</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit Breakers</td>
<td>S</td>
<td>Circuit breakers or fuses protect specific electrical circuits. For more information, refer to Appendix A: DRAWINGS, SPECIFICATIONS &amp; OPTIONS.</td>
</tr>
<tr>
<td>EMOs (Emergency Off Switch)</td>
<td>S</td>
<td>EMOs de-energize the conveyor system and heaters. Depending on the configuration, some equipment may de-energize all power. The EMOs are located at the entrance and exit sections. Optionally, the door panels may be equipped with interlock switches to de-energize power.</td>
</tr>
<tr>
<td>Intellimax Controller</td>
<td>S</td>
<td>The Intellimax controller works with WINCON software to continuously monitor and control the furnace.</td>
</tr>
<tr>
<td>Multi-language WINCON</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>Dual Monitor, Keyboard and Mouse</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Light Tower</td>
<td>S</td>
<td>Lights indicate system status.</td>
</tr>
<tr>
<td>Over-temperature Protection</td>
<td>S</td>
<td>Provides equipment over temperature protection by utilizing two features: zone specific temperature deviation alarm settings stored in WINCON recipes, and a separate OverTemperature Unit. Dual thermocouples, located in each heated zone, monitor the temperature of that zone. If an over-temperature condition exists, an audio/visual alarm occurs, and all heater power is removed. The conveyor continues to run to allow safe removal of the product from the furnace.</td>
</tr>
<tr>
<td>Computer, Keyboard, and Monitor</td>
<td>S</td>
<td>A dedicated computer-based control system interface includes hardware and software that are used to perform specific tasks including recipe programming, product processing, status reporting, system setup, system maintenance and adjustments.</td>
</tr>
<tr>
<td>Dual Monitor, Keyboard and Mouse</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Profiling System (Thermocouple Ports)</td>
<td>S</td>
<td>Thermocouples, used to profile the furnace, can be connected to the profile jack panel under the entrance table and used with profiling software to capture, display, print out, and store profiling data. The computer has high resolution capability to display dynamic left center-right temperature profiles with minimum and maximum temperatures.</td>
</tr>
<tr>
<td>Thermocouple Reel</td>
<td>O</td>
<td>The thermocouple reel assembly consisting of a stand, a reel and a mounting clamp is used to anchor and control a profile thermocouple as it is fed through the furnace.</td>
</tr>
<tr>
<td>Remote Diagnostics</td>
<td>O</td>
<td>Provides remote access to the control system through modem or ethernet networking. Can be used by BTU field service to reduce downtime by remotely diagnosing problems. Includes modem and software required to operate the furnace from a remote location.</td>
</tr>
<tr>
<td>SSRs</td>
<td>S</td>
<td>SSRs control power to heaters and other components. For more information, refer to Appendix A: DRAWINGS, SPECIFICATIONS &amp; OPTIONS.</td>
</tr>
<tr>
<td>Temperature Deviation Alarm Settings</td>
<td>S</td>
<td>Temperature deviation protection is provided by alarm settings stored in WINCON recipes. The limits can be programmed through the Recipe Edit pages in WINCON. Temperature deviation alarm settings are used to set the acceptable upper and lower temperature limits that can be reached before activating an alarm. Temperature deviation alarm settings are zone specific. When a thermocouple detects a temperature that exceeds the zone's programmed setpoint values (plus or minus the high or low alarm values), WINCON initiates an alarm. (For example, if a zone's temperature setpoint is 200°C, and the high and low temperature alarm values are 10, the temperature deviation alarm will occur when the temperature registers above 210°C or below 190°C).</td>
</tr>
<tr>
<td>Temperature Alerts</td>
<td>S</td>
<td>Alert limits warn the operator that a deviation is occurring and may be approaching alarm conditions.</td>
</tr>
<tr>
<td>UPS</td>
<td>O</td>
<td>The UPS protects equipment from blackouts, brownouts, surges, spikes, and interference conditions. The UPS automatically converts to battery/inverter on 3-phase power fault and provides power for approximately 30 minutes. (Actual time varies, depending on power needs.) The system automatically synchronizes and transfers on 3-phase power recovery. When the UPS is active, normal operation continues for the following items: the computer, microprocessor controller, overtemperature system, conveyor speed control, printer, and optional host communication system.</td>
</tr>
<tr>
<td>Voltage: 380/220V, 50/60 Hz, 3 Phase, 4 Wire</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Voltage: 400/230V, 50/60 Hz, 3 Phase, 4 Wire</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Voltage: 415/240V, 50/60 Hz, 3 Phase, 4 Wire</td>
<td>O</td>
<td></td>
</tr>
</tbody>
</table>
Table 3-4: Atmosphere System

<table>
<thead>
<tr>
<th>Item</th>
<th>Air / N₂</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dewpoint Analyzer (Panametric)</td>
<td>O</td>
<td>This option measures the moisture concentration of the process atmosphere within a certain temperature range, and displays a visual readout for the operator. The dewpoint analyzer is mounted in the furnace control panel, and is connected to WINCON for monitoring alarms and data collection. For more information, refer to the vendor manual in Appendix E: Vendor Manuals.</td>
</tr>
<tr>
<td>Dual Venturi Exhaust with Gate</td>
<td>O</td>
<td>The dual exhaust venturi with gate is used for processes that require an atmosphere separation and separate exhaust controls for adjacent areas. Atmosphere is drawn to a single location with individual control of gases from the entrance and exit ends of the furnace without concern for the atmosphere crossing this point. This separation is assured by the gate being lowered to very near the traveling product, thereby preventing the atmosphere from flowing through. A separate control valve and two N₂ flowmeters are required, one for the venturi exhaust on each side of the gate.</td>
</tr>
<tr>
<td>Exhaust Stack Monitoring System</td>
<td>O</td>
<td>This option records data regarding the measurable parameters (pressure and temperature of each local exhaust stack) within the exhaust system. Includes a thermocouple, a 1 to 5 volt negative pressure transmitter, and two loops of analog circuitry to monitor each exhaust stack in the furnace for pressure and temperature. Using the furnace controller, values of deviation can be assigned to report any changes and to set alarm conditions.</td>
</tr>
<tr>
<td>Dual Venturi Exhaust</td>
<td>S</td>
<td>Dual venturi exhaust stacks located towards the entrance are standard. The exhaust system includes heaters, effluent traps, and venturis for effective exhaust removal.</td>
</tr>
<tr>
<td>Flowmeters</td>
<td>S</td>
<td>Regulate gas flow to the gas dispersion tubes and the venturi-controlled exhaust stacks. Located on the flowmeter panel. For locations, refer to Appendix A: DRAWINGS, SPECIFICATIONS &amp; OPTIONS.</td>
</tr>
<tr>
<td>Gas Pressure Alarms</td>
<td>S</td>
<td>Gas safety devices include low gas flow alarms that sense a low compressed gas or nitrogen supply.</td>
</tr>
<tr>
<td>Mass Flow Controllers</td>
<td>O</td>
<td>With this option, recipe setpoints are controlled by the Intellimax. The MFC sends an analog flow signal to the microprocessor so that the alarm monitoring system can initiate either an alert or alarm condition for an out-of-range value. With two master flow controllers, gases can be mixed in any proportion.</td>
</tr>
<tr>
<td>O₂ Analyzer (Zirconium Oxide)</td>
<td>O</td>
<td>This option uses a portable analyzer with a built-in pump to extract sample gas for periodic testing of O₂ levels. It does not contain any electrolyte fluid. Range of operation is 0 PPM to percent O₂ scaling or equivalent. A Zirconium Oxide analyzer is preferred for fast response. When ordered as a standalone option, this option must include a flexible sample line to connect to furnace gas sampling ports. This analyzer operates well with an optional air / N₂ mixing system or auto sampling system.</td>
</tr>
<tr>
<td>O₂ Analyzer (Delta F)</td>
<td>O</td>
<td>This oxygen analyzer allows for periodic testing of O₂ levels. It includes an electrolyte fluid cell and a built-in pump for extracting sample gases. The range of operation is 0 to 1000 PPM scaling or equivalent. When used with the automatic gas sampling system, the analyzer is connected to the gas sampling ports making feedback to the furnace controller possible. The O₂ Analyzer connects to WINCON for monitoring, alarms, and data collection. For directions on how to use the O₂ Analyzer, refer to the instruction manual in Appendix E: Vendor Manuals.</td>
</tr>
</tbody>
</table>

O = Option, S = Standard

Table 3-5: Heating System

<table>
<thead>
<tr>
<th>Item</th>
<th>Air / N₂</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Section</td>
<td>S</td>
<td>The heating section is divided into zones. Each zone has heaters that are monitored by thermocouples.</td>
</tr>
<tr>
<td>Heater Contactor</td>
<td>S</td>
<td>Heater contactors de-energize zone heaters when EMOS are activated or the computer detects a zone temperature that exceeds a certain temperature over the preset value.</td>
</tr>
<tr>
<td>Quartz Liner</td>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>

O = Option, S = Standard
Table 3-6: Cooling System

<table>
<thead>
<tr>
<th>Item</th>
<th>Air / N₂</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case Cooling</td>
<td>S</td>
<td>Case cooling prevents heat buildup within the case and the electrical cabinet. The case cooling design uses a blower in the case exhaust duct to evacuate case heat. The case cooling exhaust port connection is located at the top of the process chamber. This duct can be connected to the facility exhaust system, thus decreasing the load on the room air conditioning. If you make this kind of connection, make sure the exhaust blower has enough power to handle this extra load.</td>
</tr>
<tr>
<td>Cooling System Drip Tray</td>
<td>S</td>
<td>Drip trays collect water from cooling system leaks and condensation. Drip trays drain to floor of frame.</td>
</tr>
<tr>
<td>Product Cooling Fan Module</td>
<td>O</td>
<td>The offload table can be equipped with a cooling fan module to give more product cooling after product exits. This module is mounted over the exit table. An optional fan speed control is also available for this cooler. The product cooling fan module may include an optional dial that adjusts the speed of the cooling fans.</td>
</tr>
<tr>
<td>Cooling, Water</td>
<td>S</td>
<td>Includes copper tubes on the outside of the metal muffle. The water cooling tubes are attached to the muffles with high conductivity aluminum heat sinks. This system has a better rate of heat transfer per unit under identical water flow rates and heat load compared to other designs.</td>
</tr>
<tr>
<td>Water Flow Switch</td>
<td>S</td>
<td>Inside the access panel opposite the operator control panel is a water flow switch, which verifies a continuous water flow. The switch is connected to the main outflow pipe inside the cooling section. Lack of water flow generates a WINCON alarm.</td>
</tr>
<tr>
<td>Water Valves</td>
<td>O</td>
<td>Water valves in the cooling section have fixed orifices so that they do not fully close and so that they collect steam. Equipment with water-cooled muffles [option] have a temperature-actuated valve in the water supply line. A temperature probe opens the valve automatically as the temperature increases, and closes it as the temperature increases.</td>
</tr>
<tr>
<td>Thermocouples</td>
<td>S</td>
<td>Thermocouples for each zone are connected to the computer.</td>
</tr>
</tbody>
</table>

O = Option, S = Standard
EQUIPMENT LOCATOR AND SUBSYSTEMS

The In-Line Diffusion furnace contains the following subsystems:

- Frame & Panel System
- Entrance Table
- Conveyor & Drive System
- Electrical & Control System
- Atmosphere System
- Heating System
- Cooling System

Figure 3-1: In-Line Diffusion Furnace Major Components (Typical)
FRAME & PANEL SYSTEM

Frame

The modular frame is made from heavy gauge steel. The frame houses the electrical wiring, plumbing, controls, conveyor system, and process chamber. The electrical cabinet is integral with the bottom half of the furnace framework, and is accessible after you remove the front and rear panels. The Intellimax controller and associated components are located in the electrical cabinet. Adjustable legs support the frame 102 to 152 mm (4 to 6 in.) above the facility floor, enabling you to level the furnace on an uneven surface. This raised position allows air to flow upward from floor level, supplying the required ventilation.

Panels

The outer surface of the furnace consists of removable access panels, which provide access to the subsystems within. The access panels protect personnel from contact with potential electrical hazards and hot surfaces, and delicate components from dirt or damage. The top covers are typically perforated. The side covers are insulated to protect personnel from hot components. For operator safety, access panels are designed to keep the external surfaces of the furnace to temperatures less than 38°C (100°F).

ENTRANCE TABLE

The stainless steel entrance table is bolted to the furnace frame and can be separated for shipping or moving. An extended entrance table is offered as an option.

The entrance table contains the following components:

- Belt return idler pulley
- Belt motion alarm sensor
- Profile thermocouple ports
CONVEYOR & DRIVE SYSTEM

Conveyor System

Product is placed on and carried by a steel-mesh conveyor belt through the process chamber. Standard belts are available in a variety of widths. The conveyor belt height is typically 965 mm (38 in.) above the floor, but can vary. Conveyor belt specifications for your furnace can be found in Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS.

Conveyor Control

The conveyor system is controlled by WINCON, the Intellimax controller, and the belt speed module.

WINCON software along with the Intellimax controller provide tight, closed loop speed control of the conveyor belt, including:

- belt speed setpoint
- actual belt speed
- belt motion alarm
- belt stretched alarm
- high and low deviation alarms

For instructions on using WINCON, refer to WINCON Online Help.

Belt Speed Deviation Alarm

On the entrance table, the conveyor belt is supported by the idler pulley. Next to the idler pulley is a proximity switch that measures conveyor speed as part of a closed-loop control system. If the idler pulley speed does not match the drive motor speed, a belt motion alarm is generated in WINCON. For more information, refer to page 5-8, System Alerts and Alarms.

Drive System

The drive system is designed to move the belt at the speed required to maintain the recipe controlled process parameters. The drive system operates by moving the conveyor belt over a series of parallel quartz tubes. The quartz tubes have a low coefficient of friction and enable smooth belt travel.

The drive system (Figure 3-2), located on the exit table, consists of the following components:

- DC drive motor
- Drive chain
- Drive pulley and shaft
- Gear reducer assembly
- Pressure-pulley assembly
- Motor shaft speed encoder
- Shear pin assembly or torque limiter
- Drive sprocket
Shear Pin Assembly

If equipped, a shear pin assembly is located on the drive shaft (Figure 3-2) and is designed to break if an excessive load is applied to the conveyor belt. The breaking shear pin prevents extensive damage from occurring if the conveyor jams. In the event of a shear pin failure, a WINCON alarm is generated. Spare shear pins are provided with your furnace.

Torque Limiter

If equipped, the torque limiter is a detente-type, oil-filled slip clutch that will disengage the conveyor belt from the drive system if an excessive load is applied to the conveyor belt.
ELECTRICAL & CONTROL SYSTEM

The electrical and control systems consists of the following components:
• Operator Control Panel
• Light Tower
• WINCON Furnace Control Software
• Intellimax Furnace Controller
• PID Temperature Control
• Emergency Off Switches (Refer to page 2-13, EMO (Emergency Off).)
• Main Power Disconnect Switch (Refer to Table 2-10 and Figure 2-3.)

Operator Control Panel

The operator control panel is typically located on the front of the furnace close to the exit end. The controls and indicators on the operator control panel include the following (Figure 3-4):

• **START/RESET:** a green push button, which energizes the conveyor and heating systems. When these systems are energized, the START/RESET indicator comes on. You must press START/RESET to reset the system after an emergency stop and other fault conditions.

• **Alarm chime:** an audible alarm that sounds during alarm conditions; a black dial adjusts the volume of audible alarm.

• **E-stop:** a red push button, which de-energizes the heat and conveyor systems in the event of an emergency.

![Figure 3-3: Operator Control Panel](BELT1012_1)

1 START/RESET push button  2 Alarm chime dial  3 E-stop push button

**Figure 3-3:** Operator Control Panel
Light Tower

The light tower is used as a visual indicator of the status of the furnace. The standard configuration for the light tower is described below. If the light tower is customized, refer to Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS.

**Table 3-7: Standard Light Tower Indicators**

<table>
<thead>
<tr>
<th>Color</th>
<th>Condition</th>
<th>3-Color</th>
<th>4-Color</th>
<th>Description</th>
<th>User Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Alarm</td>
<td>X</td>
<td>X</td>
<td>An alarm condition exists</td>
<td>Acknowledge the alarm, correct the alarm condition and restart</td>
</tr>
<tr>
<td>Yellow</td>
<td>Alert</td>
<td>X</td>
<td>X</td>
<td>An alert condition exists</td>
<td>Correct the alert condition and restart</td>
</tr>
<tr>
<td>Green</td>
<td>Ready</td>
<td>X</td>
<td>X</td>
<td>The furnace is operating within the parameters specified in the recipe currently being run in WINCON</td>
<td>None</td>
</tr>
</tbody>
</table>

**WINCON Furnace Control Software**

All furnace functions (system setup, calibration, programming, scheduling, operating, and monitoring functions) are controlled via WINCON software. WINCON software is pre-loaded and menu-driven. A backup of WINCON software is included with the equipment.

Software functions can be accessed from WINCON’s Main Temperature Screen, which is displayed when the system is first powered-up. For a brief overview of WINCON’s Main Temperature Screen, refer to Table 3-8. All instructions for using WINCON software are contained in WINCON Online Help. A separate WINCON Quick Guide is located in the back of this binder.

**Table 3-8: Software (System Power-up and Main Temperature Screen)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Displays</th>
<th>Uses</th>
<th>Options Include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarms</td>
<td>Alarm Status Screen</td>
<td>View, silence, and clear alarms, and view Intellimax communication status</td>
<td>- -</td>
</tr>
<tr>
<td>Temperatures</td>
<td>Temperature Screens (several)</td>
<td>View temperature data, mass flow controllers, and belt speed data</td>
<td>- -</td>
</tr>
<tr>
<td>Profile</td>
<td>Profile Menu</td>
<td>- -</td>
<td>Setup (start) View, Stop</td>
</tr>
<tr>
<td>Logging</td>
<td>Logging Menu</td>
<td>- -</td>
<td>Demand Log and Setup</td>
</tr>
<tr>
<td>Recipe</td>
<td>Recipe Menu</td>
<td>- -</td>
<td>Edit Displayed, Edit Active, Edit Stored, Run Stored, Make Schedule, and Change Directory</td>
</tr>
<tr>
<td>System</td>
<td>System Menu</td>
<td>- -</td>
<td>Authorization, Time Limits and Delays, Setup, Communication, Belt Calibration, Input Calibration, Discrete Input/Output, Printer Setup, and Test)</td>
</tr>
<tr>
<td>Exit</td>
<td>Returns to the computer operating system.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Intellimax Furnace Controller

The furnace is controlled by the Intellimax controller which is mounted on the inside of the furnace enclosure. The Intellimax is connected to a personal computer, at the exit panel of the furnace enclosure and uses a RS 232 port which is capable of GEM compatible host communications. The PC interfaces to the operator using a window based operating system program called WINCON. The following is a partial list of the features and options which the Intellimax controls.

- Flexible password and operator level furnace control
- Data collection and reporting with alarm trending
- Control of the furnace drive system
- Product profiling
- Recipe scheduling and sequencing
- Help file for operation of the furnace
- Windows based multitasking
- Testing of inputs and outputs from the PC
- Control and or display of mass flow controllers
- Control and or display of O₂ analyzer
- Control and or display of dewpoint monitor
- Control and or display of various furnace sensors

PID Temperature Control

Temperature setpoints are programmed in WINCON software, and maintained by the Intellimax controller using PID temperature control loops. The temperature of each heated zone is regulated by three control co-efficients. Control co-efficients are mathematical variables used to calculate the electrical power required to maintain temperature setpoints.

The adjustable PID temperature coefficients include the following:

- **Proportional Band** is a temperature range (displayed in °C) for each zone, using the temperature setpoint as the median.
- **Integral** adds or subtracts increments of electrical power to the existing proportional band to bring the temperature deviation to zero.
- **Derivative** calculates the expected temperature change and attempts to prevent or decrease overshooting or undershooting the temperature setpoint by adding or subtracting increments of electrical power.

For more information on PID temperature control, refer to WINCON Online Help. **Figure 3-4** shows a signal-flow diagram of a basic temperature control loop for one zone. **Figure 3-5** shows a signal-flow diagram of a basic temperature control loop for a furnace that has separate top and bottom zones.
The desired temperature setpoint for each zone is programmed in the applicable WINCON recipe. The Intellimax receives actual temperature indications from thermocouples in each zone and compares each temperature indication with the temperature setpoint. If necessary, the Intellimax has the applicable solid-state relays (SSRs) apply the required amount of power to each heater to maintain the temperature setpoint.

**Left-Center-Right Bias Trim**

Each heated zone may be equipped with three bottom heaters, and where applicable, three top heaters as well (Figure 3-6). The three heaters are identified as left, center, and right (as viewed from the furnace entrance). This heater arrangement provides more precise and uniform temperature control across the width of the conveyor belt. For your specific heater configuration, refer to Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS.
Figure 3-6: Left-Center-Right Heater Configuration as Viewed from Entrance End
ATMOSPHERE SYSTEM

Atmosphere Control

Various features are used in conjunction with each other to process product in a controlled atmosphere. A typical process chamber layout is illustrated in Figure 3-7.

Dual Venturi Exhaust Stacks

Dual venturi exhaust stacks (Figure 3-8) remove process chamber exhaust from the process chamber, and maintain a slightly positive pressure within the furnace. Flowmeters regulate the exhaust flow rate.

Excessive venturi exhaust flow will decrease the pressure inside the process chamber to an insufficient level. Insufficient pressure uses more gas and degrades the process atmosphere.

Venturi exhaust stacks work by introducing nitrogen through a gas inlet on the side of the exhaust stack. This introduction of nitrogen creates a negative pressure in the lower portion of the stack, which removes exhausted gases from the process chamber. The venturi stack operates at approximately a 10-to-1 efficiency; in other words, for every 1 LPM of gas introduced by the venturi gas inlet, 10 LPM is removed by the exhaust stack.

As exhaust leaves the process chamber, it is heated to ensure it does not condensate and fall back into the process chamber. As the heated exhaust enters the exhaust stack, cooling nitrogen is circulated around the stack and exhausted into the facility duct. The resulting condensation traps some exhaust effluents which fall into a trap fitted to the lower section of the exhaust stack.
Atmosphere Curtains

Located on the entrance and exit modules, the atmosphere curtains:

- Prevent ambient atmosphere from entering the process chamber
- Remove ambient atmosphere from the incoming product
- Prevent process atmosphere from exiting the process chamber

Each atmosphere curtain assembly consists of a series of hinged, light-weight curtains, and gas-feed plenums, located at the top or at both the top and bottom of the assembly. A flowmeter lets you manually control the gas flow to the plenum(s). The curtains provide a physical barrier, and the plenums provide a gaseous barrier between the baffle curtains. The gas typically used is nitrogen. Longer curtain assemblies and fabric curtains are available as options.

CAUTION!

Do not trim or modify the atmosphere curtains. Trimming the curtains reduces the effectiveness of this atmosphere barrier, which increases gas consumption.

If you are having issues with product clearance, call BTU Customer Service.
HEATING SYSTEM

The process chamber is divided into separately controlled heated zones. Each zone has upper and lower sections named in reference to their position, e.g., T1 indicates that the section is the top of zone 1; B1 indicates that the section is the bottom of zone 1. Individually controlled heaters are located at the top and bottom of each zone, and some furnaces may have additional side heaters.

Product heating is done by radiation. The locations of heating elements were chosen for optimum temperature control and energy efficiency. Depending upon the configuration of your furnace, it may take between 2 and 18 hours to heat and stabilize the process chamber. Other factors include the following:

- the size and type of muffle
- the size and type of conveyor belt
- the amount and type of insulation used
- the operating temperature range
- facility power available

Fully Enclosed Coil (FEC) Heaters

Your furnace is equipped with fully enclosed coil (FEC) heaters, which are manufactured by BTU International. These heaters consist of an iron-chromium-aluminum alloy heating element made into a resistance wire coil that is embedded in a ceramic fiber plate. The FEC heaters provide clean, continuous, energy-efficient operation at temperatures up to 1150°C (2102°F). Heaters are located on the top and bottom of the process chamber. Refer to Figure 3-9.

![Figure 3-9: Process Chamber](image)

Shadow Walls [Option]

Some furnaces may include optional shadow walls. Shadow walls are one-inch ceramic walls that create a thermal barrier between heated zones and help maintain the independent thermal control in each zone.
Temperature control

Using WINCON recipes and the Intellimax controller, the temperatures within each zone are controlled to expose product to the appropriate thermal process as it moves through the process chamber.

The specific requirements of your product will determine the temperatures required. You can set zone temperatures to create the following “environments” within the process chamber:

- **Preheat/Burnout Environment:** Binder and other impurities are burned off as product is brought to temperature in the preheat zone(s).

- **Equilibrium Environment:** Product temperature continues to increase in the equilibrium zones until the entire product gets to a uniform temperature.

- **Firing Environment:** After the preheat and equilibrium environments, product is further heated in a clean environment.

The necessary temperature setpoint, used to maintain zone temperature for each zone, is programmed through WINCON software. The Intellimax controller receives the actual temperature data from a thermocouple that is located in each zone and compares this information to the programmed temperature setpoint. The controller then opens and closes the SSRs, which apply power to each set of heaters to maintain temperature at setpoint.

Each furnace zone has two thermocouple assemblies that measure and record the zone temperature. One thermocouple monitors the temperature; the other provides over-temperature protection.

For a typical temperature control loop, refer to **Figure 3-10**.

---

**Figure 3-10:** Temperature Control Loop (Typical)

1. SSR
2. Relay Control Signal
3. Intellimax
4. Thermocouple Input
5. Heater
6. Power
COOLING SYSTEM

Product must be cooled at a controlled rate or thermal damage may occur. The cooling system provides controlled cooling using several methods:

Passive Cooling:
  • Insulated Cooling

Active Cooling:
  • Water Cooling Jackets
  • Case Cooling

Passive Cooling

Insulated Cooling Module

After thermal processing, product enters the insulated cooling module, which is located after the heated zones and before the cooling module. It is here where product begins to cool by natural dissipation of heat before entering the cooling section.

Active Cooling

Water Cooling Jackets

Water jackets, a series of copper tubes, are located on the top and bottom of the cooling muffle. Cool, facility-supplied water is sent through the water jackets. The water absorbs and removes the heat emitted by product. To increase or decrease cooling rates, the water flow rate is adjustable. The water flow is controlled by stop and waste valves or by optional thermostatic flow regulators. A drip tray underneath the cooling module collects any condensation. Another set of water jackets may surround the separation joint gasket for protection against thermal stress.
  • Thermostatic Control

For furnaces equipped with water-cooled muffles, this option provides a temperature-actuated valve inside the water supply line. A thermal probe on the water system causes the valve to open if the temperature increases and to close if the temperature decreases.

Case Cooling

To keep the furnace case and electrical cabinet cool, BTU high-heat belt furnaces have either a case-cooling fan or a series of perforated access panels located on top of the furnace, which allow heat escape from the furnace.
CHAPTER 4
INSTALLATION

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CUSTOMER SITE REQUIREMENTS

All site requirements must be understood and completed before furnace installation.

Equipment Location

- All BTU furnaces require a sturdy, level floor to support the equipment.
- Refer to the Installation Drawing located in Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS for the exact dimensions of the furnace.
- There must be sufficient airflow around the equipment. Do not locate the equipment near doors, fans, or other sources of draft. Drafts cause increased oxygen levels, which affects process temperature and gas flow profiles.
- Allow sufficient clearance (36-in.) to move and perform maintenance on the equipment.
- The furnace must be positioned in a location that allows for access to the facility exhaust ducts/hood.

Store the system equipment:

If you need to store the system equipment for an extended period of time, make sure that you use a desiccant to absorb moisture and keep electrical and mechanical components dry. Calculate the requirement amount of desiccant by determining the volume of the storage container.

- in the original shipping containers
- in an area with a nominal ambient temperature of 21°C (70°F) and that is not exposed to frequent or rapid changes in nominal ambient temperature
- in an area that is free of excessive moisture and with a nominal relative humidity between zero and 50 percent

HVAC Requirements

- Air conditioning and heating systems must be sufficient to keep the equipment within the recommended ambient temperature range of 10 to 35°C (55 to 95°F). Recommended nominal ambient temperature is 21°C (70°F) and the furnace should not be exposed to frequent or rapid changes in nominal ambient temperature.
- If necessary, move thermostats or heating/cooling ducts to keep the equipment within the above recommended ambient temperature range.
- Ensure the fresh air supply equals the exhaust system volume minus any gas supplied to the equipment (usually 80 percent of the exhaust blower requirements).
- The furnace may use gases that might promote suffocation or asphyxiation. For example, nitrogen is consider harmless in small quantities; however, in large quantities nitrogen may prevent breathing in a sufficient amount of oxygen to maintain proper breathing. In addition, the production process may produce toxic gases like carbon dioxide. Be sure that the location of the furnace has sufficient ventilation.

Humidity Requirements

The maximum dew-point requirement required for BTU International equipment is 50 percent nominal relative humidity. This requirement is for the prevention of corrosion to electrical and mechanical components, especially components located in the electrical console and any exposed (i.e., unpainted) metal (e.g., steel) surface. BTU International has taken precautions by coating, painting, and changing materials wherever possible to protect critical components.
Exhaust Requirements

The following standards are provided as a guideline for installing an exhaust system that will properly exhaust effluents from the furnace. All exhaust systems must comply with all local, state, and national codes.

The specific utility requirements and connection locations for your furnace are located in Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS.

NOTE: Each furnace installation is unique. Make sure that the exhaust system is sized properly to expel furnace effluents so they do not collect indoors. Consult a qualified exhaust system engineer, HVAC engineer, or the site facilities engineer to determine the proper exhaust system requirements for the furnace location.

Exhaust specific guidelines:

• Sufficient fresh air must be available to compensate for the exhaust system requirements.
• To prevent fumes from the furnace from entering the room, sufficient air must be drawn into the exhaust system to gather all effluent gases and vapors. The ratio of room air to effluent gases should be 3:1 at the inlet. The exhaust system should be capable of handling more than the volume of gas supplied to the furnace. For the recommended exhaust flow, refer to Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS.

NOTE: Duct sizes are in reference to the supply connections at the furnace. The size of the pipes must be sufficient to support the necessary volume at the furnace inlet.

• There must be sufficient clearance between the exhaust stack and exhaust hood to prevent excess process atmosphere pull from the furnace and back pressure that can cause poor processing.
• A plugged test hole must be installed above the exhaust hood to measure static pressure readings with a low pressure gage. These readings are used to adjust and monitor the system.
• Install a filtration system in the facility exhaust system to prevent contamination of the ducts.
• Install dampers to adjust ducts that are part of a common exhaust system (if one duct is shut you can adjust the dampers to balance the flow to keep a steady atmosphere), to create a balance between the entrance end and the exit end, and to keep neutral to positive pressure in the process chamber at startup

NOTE: Exhaust temperature is related to furnace operation and damper setting.

• To sense a loss of flow in the facilities exhaust duct, wire an external pressure switch from the exhaust duct to a terminal block provided in the furnace. This will provide an exhaust fail alarm to the system. Refer to Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS.

Site Plumbing Requirements

Only a full-qualified, licensed plumber shall install the plumbing system.

• Install all plumbing connections tightly.
• Install all plumbing pipes straight and with minimal bends.
• Install pipe that has the approximate diameter and minimum length.
• Keep reductions near the inlet/outlet.
• Insulate any longer plumbing pipes to prevent decreased cooling capacity.
• For connection locations refer to Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS.
Cooling Water Requirements

CAUTION!

If you purchased a water-cooling option, make sure the water supply to the cooling system is in place before you energize the furnace, otherwise gaskets and heat exchangers will be damaged.

Refer to the installation drawing in Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS for all furnace-specific water requirements. The following table contains site water cooling requirements.

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirements</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water filter</td>
<td>5 micron</td>
<td>Water filters remove particles from facility water supply lines and protect the re-circulating pump.</td>
</tr>
<tr>
<td>Water hardness range</td>
<td>Less than 200 ppm calcium carbonate</td>
<td>If hard water is an issue, BTU recommends that you install a water softener to prevent contamination to the heat exchangers.</td>
</tr>
<tr>
<td>Water line material</td>
<td>Stainless steel, copper, or plastic</td>
<td>Water lines may be made of a variety of materials. Wrap water lines in insulation to prevent condensation.</td>
</tr>
<tr>
<td>Water line connector</td>
<td>12.7 mm (0.5 in.) NPT</td>
<td>--</td>
</tr>
<tr>
<td>Pressure / Flow</td>
<td>30 - 85 psi at the furnace</td>
<td>If furnace contains the water-cooling option, make sure there is a pressure relief valve. Heat causes water to expand, increasing pressure. Measured water pressure to be minimum of 30 psi at the furnace. The nominal water flow is 2.5 GPM for each heat exchanger. Make sure that there is a difference of at least 30 psi between the incoming pressure and the drain.</td>
</tr>
<tr>
<td>Water temperature range</td>
<td>5 (41) - 30°C (86°F) (minimum/maximum)</td>
<td>Make sure that the water temperature is within the acceptable range.</td>
</tr>
<tr>
<td>Nominal operating water</td>
<td>20°C (68°F)</td>
<td>The nominal water operating temperature is 20°C. If the furnace has a cooler, the minimum water operating temperature can be as low as 5°C.</td>
</tr>
</tbody>
</table>
Table 4-1: Recommended Cooling Water Requirements

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirements</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in water temperature</td>
<td>5°C (41°F) nominal</td>
<td>During operation, the nominal increase in water temperature should be approximately 5°C. The actual operating temperature is in reference to the current profile and furnace settings. If the water temperature is less than the minimum requirements, condensation will occur. If the water temperature is more than the maximum requirements, the cooling system may not remove a sufficient amount of heat.</td>
</tr>
</tbody>
</table>

CDA and Nitrogen Requirements

Only fully qualified personnel must calculate CDA (compressed dry air) and nitrogen requirements. For furnace-specific requirements, refer to Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS.

Air/Gas Filters

The In-Line Diffusion furnace does not have any internal air / gas filters. Install a pressure regulator and filter in all gas / air supply lines before connection to the furnace. Refer to Figure 4-1.

- Keep the velocity of air constant. To keep the velocity of air flowing through filters constant, which maximizes the ability of the filter to remove particulates from the air, do not decrease the size of the airline within approximately 1 meter (about 3-ft.) before the filter.
- Compressed air must be filtered to 99.99 percent efficiency for 0.01-micron particles and droplets. The size of the filter port must be equal to or larger than the line size to minimize the occurrence of line restrictions.
- Install filters as close to the point of application (e.g., the spray coater) as possible. This decreases the occurrence of additional water and oil vapor condensing after the filter.
- Install filters in a vertical position. Do not install filters downstream of quick-opening valves or expose filters to reverse flow conditions.
- Make sure that there is sufficient space underneath the filters so that you can easily replace filters.
- Install a differential pressure gage to check the pressure decrease through the filters.
- Purge pipes that connect filters to the equipment.
- Regulators must have an accuracy of +/-1 percent of rated outlet pressure.
• Do not use a vented regulator for nitrogen or hydrogen if low oxygen levels are required by your process.
• For connection locations, see Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS.

Filter Drains
Provide a facility to remove collected liquids from the filter drains using correctly sized tubing.
BTU International strongly recommends an automatic drain to decrease the amount of maintenance as well as differential pressure gage or an indicator to monitor the pressure decrease among the filters. This provides a method to visual monitor the condition of filter elements.
• Install a drain to collect liquid removed by filters.
• Install an automatic drain at the compressor.
• Make sure there are no obstructions in the drain pipe.

![Diagram of CDA / Gas Filter Recommendations (Typical)](image)

1 Air purifying system [Option] 5 Pre-filter 9 Flow out
2 Oil-free compressor 6 Fine filter 10 Air dryer
3 Aftercooler 7 Bypass valves 11 Drain flow
4 Separator 8 Air filter

**Figure 4-1:** CDA / Gas Filter Recommendations (Typical)

**Electrical Requirements**

The utility requirements and connection locations for your specific furnace are located in Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS.
• Electrical installation shall only be performed by a licensed electrician.
• Electrical connections can be brought into the furnace by punching through the top cover, end panel or furnace floor in the area of the electrical disconnect switch.
• Electrical conductors must be protected by conduit or tubing according to local and national electrical codes.
• Power wiring connections should be at the main disconnect switch and at the main disconnect switch and main ground block.
• Ensure that all electrical conductors and terminations are fully shrouded and protected. There should be no exposed live conductors or terminations.
• Ensure that main incoming power cables are not in contact with any hot surfaces, sharp or rough edges, or any other potentially damaging surfaces.
• This electrical installation must be inspected by your local authorized electrical inspector prior to being energized.

**DANGER!**

**ELECTRICAL HAZARDS!**

The furnace uses dangerous levels of high-voltage, high-amperage electricity. High-voltage, high-amperage electricity may cause severe personal injury or death.

**To prevent electrical hazards:**

• Do not perform any procedure by yourself. Always have at least one other person working with you in case an emergency situation occurs.
• All electrical connections shall be performed by a licensed electrician and done in reference to all applicable codes and laws.
• Make sure the furnace is grounded properly in reference to your local electrical codes. In the United States, refer to the *National Electrical Code* published by the National Fire Protection Association.
• Do not wear any jewelry (e.g., rings, ear rings, necklaces, watches, etc.) while performing any procedure involving the electrical system. Jewelry is often conductive, and may come in contact with energized circuits.
• If you do not obey all the safety precautions listed in this manual and any other associated documents, you risk the occurrence of serious injury or death and a cancelled manufacturer's warranty.
INSTALLATION PROCEDURES

Receive Equipment

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
</tbody>
</table>
| Related Documents:  | • Packing list  
                     • Damage claim (if necessary) |
| Exit Criteria:      | The furnace has been received correctly. All components have been identified and verified in reference to the packing list. If necessary, a damage claim has been filed. |

To receive the equipment:
Equipment is shipped on skids (small items) and in wooden crates. Keep packing materials until you do a full incoming inspection. If more than one furnace is delivered, keep parts with the correct furnace.

NOTE: Not all items may be applicable to your furnace.

<table>
<thead>
<tr>
<th>Items that may be packed separately from the furnace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light tower</td>
</tr>
<tr>
<td>Personal Computer</td>
</tr>
<tr>
<td>Monitor</td>
</tr>
<tr>
<td>Keyboard</td>
</tr>
<tr>
<td>Adjustable Legs</td>
</tr>
</tbody>
</table>

Perform an incoming inspection:

1. Verify that all equipment on the packing list is received.
2. Inspect components for visible signs of damage done in transit. If you find damage:
   a. Sign the delivery receipt. Verify that you recorded the visible damage and immediately notify the carrier of the damage.
   b. In the USA, file a damage claim with the transportation carrier under the regulations of the Interstate Commerce Commission.
   c. If you need more information for insurance purposes, call BTU International.
Remove Crates

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
</table>
| Special Tools:      | • Pry bar, crow bar or flat claw bar  
                      | • Claw hammer  
                      | • Keyhole saw for metal (or an electric reciprocating saw)  
                      | • Heavy duty cutting pliers or bolt cutter |

Related Documents: None

To remove the shipping crates:

1. Pull the plywood end pieces from the wooden frame enough to slip in a saw blade or cutting tool. (Nails can break through the plywood.)

   **NOTE:** Be careful of nails when you disassemble the crate. Exposed nails can cause personal injury or equipment damage.

2. Cut the nails with a saw, heavy duty cutting pliers or bolt cutter.

3. Remove the plywood end pieces. This allows you to see inside the crate so that you can plan the removal procedure.

4. Pull the plywood side pieces from the wooden frame enough to slip in a saw blade or cutting tool. (Nails can break through the plywood.) The frame studs of the crate are now exposed.

5. Pull the bottom frame studs from the skid.

6. Cut the nails with a saw, heavy duty cutting pliers or a bolt cutter.

   **NOTE:** Do not remove furnace from the skid until it is moved to a permanent location.

7. You can continue to disassemble the crate from the top and sides, or lift the entire crate.

8. Discard the crate.
Move the furnace

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Tools:</td>
<td>Forklift Method</td>
</tr>
<tr>
<td></td>
<td>• Heavy-duty industrial casters or dollies</td>
</tr>
<tr>
<td></td>
<td>• Two heavy-duty forklift trucks or one overhead crane</td>
</tr>
<tr>
<td></td>
<td>Crane Method</td>
</tr>
<tr>
<td></td>
<td>• Lifting jack</td>
</tr>
<tr>
<td></td>
<td>• Two lifting straps</td>
</tr>
<tr>
<td></td>
<td>• Crane support</td>
</tr>
<tr>
<td></td>
<td>• Four 5 by 21 cm (2 by 8 in.) wood boards, 5cm (2-in.) longer than furnace width</td>
</tr>
</tbody>
</table>

| Related Documents: | None |

**WARNING!**

**THE OWNER’S RESPONSIBILITY!**
BTU International is not responsible for any damage that occurs to the furnace if you unpack and move the furnace yourself. Read the following procedure carefully. If you have any doubt about how to move the furnace, DO NOT MOVE THE furnace, and contact BTU International Customer Service; otherwise, severe personal injury or equipment damage may occur.

**WEIGHT HAZARD!**
The furnace weighs more than two tons! When moving the furnace, take all necessary precautions to prevent any body parts from any potential crush hazards; otherwise, severe personal injury or equipment damage may occur.

**EQUIPMENT DAMAGE!**
• Do not remove the furnace from the shipping skid until you have put the furnace in a permanent location; otherwise, you may cause severe equipment damage.
• Do not lift or move the furnace from any location other than the furnace lift points; otherwise, you may cause severe equipment damage.
• If the furnace is more than 30 ft. long, do not try to move it. It must first be disassembled into smaller sections; otherwise, you may cause severe equipment damage and injuries to personnel.
• Do not attach components to one another until the furnace is in the final position.

To move the furnace:

1. Mark the equipment footprint on the building floor. For dimensions, refer to Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS.
2. Remove all hardware that attaches the equipment to the shipping skid.
3. Remove the side and top panels. Refer to page 7-4, Removing Access Panels.
Forklift Method:

a  Put the forklift tines through the ends of the skid until they touch the component lifting areas.

b  Lift the end until there is sufficient clearance to put an industrial dolly under the skid at the lift point (Figure 4-2).

c  Lower the skid onto the dolly and remove the forklifts.

d  Move the furnace over the market footprint.

e  Position the forklift tines under the furnace lift points (over the skid).

f  Remove the bolts securing the furnace to the skid.

g  Lift the furnace off the skid.

h  Install the leveling feet in the holes that were used to secure the furnace to the skid.

i  Remove the skid and the casters or dollies.

j  Lower the furnace onto the marked footprint.

k  Store or discard the shipping skid.

Overhead Crane Method:

a  With a lifting jack, lift the sides, one at a time, and put the lifting straps in position under the lift points.

<table>
<thead>
<tr>
<th>CAUTION!</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EQUIPMENT DAMAGE!</strong></td>
</tr>
<tr>
<td>Do not jack the entrance or exit ends of the furnace. Damage from concentrated weight will result.</td>
</tr>
<tr>
<td>Do not use the overhead crane without using wooden supports to spread the lift straps; otherwise the furnace may be damaged.</td>
</tr>
</tbody>
</table>

b  Put the wooden supports in position to spread the lifting straps as shown (Figure 4-2).

c  Remove force from the slings. Make sure that the supports do not move.

d  Remove the bolts securing the furnace to the skid.

e  Lift the furnace off the skid.

f  Install the leveling feet in the holes that were used to secure the furnace to the skid.

g  Remove the skid.

h  Position and lower the furnace over the marked footprint.

i  Remove the lifting equipment.

j  Store or discard the shipping skid.
NOTE: The above drawing is for illustration only and may not look exactly like your furnace.

Figure 4-2: Equipment Lifting Points

1 Lifting Equipment  
2 Exit Table (Removed)  
3 Skid  
4 Lifting Points  
5 Entrance Table (Removed)
Assemble Sections

In-Line Diffusion furnaces are shipped in many parts that require assembly by BTU field service personnel. Customers may assemble the furnace sections, in preparation for final installation.

Contact BTU International to prearrange your furnace installation.

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
</table>
| Special Tools:      | • Floor jack  
|                     | • Torque wrench, 80 in.-lb. |
| Related Documents:  | None |

To assemble the furnace:

1. Remove the clamps from the frame assemblies.

2. Level the largest section.

3. Adjust each section so that they touch each other (Figure 4-3). (Look through the process chamber and make sure that you cannot see anything that comes out of the inside walls.)

4. If equipped, make sure that the muffle joint adjustment is aligned at the top, sides, and bottom (no ridges or offsets at the joints).

5. Level each section to the larger section before attaching.

![Figure 4-3: Aligning Sections](image-url)
CAUTION!

**EQUIPMENT DAMAGE!**

If silicone rubber gasket is used, do not overtighten and compress the flange gasket to less than two-thirds of its original thickness. Over tightening can cause damage to the gasket. Do not use more than 70 in.-lb. of torque on the clamp screws or flange bolts.

6 For systems with flange bolts: Sequentially tighten each bolt a little at a time until its split lock washer is flattened (Figure 4-4).

7 If equipped, install the flange clamp assemblies (Figure 4-4). After assemblies are installed, tighten each clamp screw in sequence until all assemblies are tightened evenly.

---

**Figure 4-4:** Join Sections with Clamps

1 Entrance Table 4 Exit Table 7 Clamp
2 Heating Section 5 Process Chamber 8 Flange
3 Cooling Section 6 Heating Section 9 Cooling Section
INSTALLATION CHECKLIST

Use the following installation checklist to make sure that installation is complete before you start the equipment:

- Facility design requirements have been met (site and space)
- Environmental requirements have been met
- Exhaust requirements have been met
- Plumbing requirements have been met
- Electrical requirements have been met
- Equipment is received and checked
- Equipment is moved into place
- Equipment is assembled and level
- Belt has been installed
- All options are installed
- Utilities are connected

After installation is complete, the equipment is ready to start.
SYSTEM STARTUP

**WARNING!**

**READ!**
- Read this manual in its entirety before you install, operate, troubleshoot or maintain the furnace.
- Read a procedure in its entirety before you perform it.
- Always note and take any safety precautions recommended in this manual and other documentation before you perform any procedure; otherwise, severe personal injury or equipment damage may occur.

**QUALIFIED PERSONNEL!**
- Procedures include working with high amperage, high voltage and moving parts.
- Procedures must be performed by fully trained, fully qualified personnel.
- Most procedures require advanced knowledge of electrical, mechanical, and plumbing theories and issues.
- DO NOT PERFORM THE PROCEDURE IF YOU HAVE ANY DOUBTS ABOUT HOW TO ACCOMPLISH THE TASKS INVOLVED. Contact BTU International Customer Service; otherwise, severe personal injury or equipment damage may occur.
- If you do not obey all the safety precautions listed in this manual and any other associated documents, you risk the occurrence of death or serious injury to personnel, equipment and or facility damage, and a cancelled manufacturer’s warranty.

The furnace was fully tested at the BTU factory before being shipped to you. If you operate and maintain the furnace in reference to the procedures listed in this manual, it will provide you with many years of reliable service and product of the highest quality.

If you are familiar with the equipment and know that the equipment and utilities are installed correctly, you can start the furnace yourself. If you prefer factory service personnel to start the furnace, you can request System Startup Service from BTU.
CHAPTER 5
OPERATION

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WARNING!

Obey all safety precautions when you operate and maintain the equipment. Otherwise, personal injury and equipment can result. Only qualified personnel should operate and maintain the equipment.
GENERAL

- This chapter gives instructions to operate the furnace. Read this manual and *WINCON Online Help* before you operate the equipment.
- Your equipment may not include all of the options listed in this chapter.
- For a description of the main control panel, refer to page 3-11, *Operator Control Panel*.

SUMMARIZED CHECKLIST

<table>
<thead>
<tr>
<th>Step</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Calculate the necessary gas flows</td>
</tr>
<tr>
<td>2</td>
<td>Turn on the gas supply to the furnace</td>
</tr>
<tr>
<td>3</td>
<td>Make sure that the atmosphere curtain assemblies are in the correct position</td>
</tr>
<tr>
<td>4</td>
<td>Make sure that the facility exhaust fan is operating</td>
</tr>
<tr>
<td>5</td>
<td>Energize the furnace</td>
</tr>
<tr>
<td>6</td>
<td>Turn on the cooling H₂O supply</td>
</tr>
<tr>
<td>7</td>
<td>Pull out all EMO buttons</td>
</tr>
<tr>
<td>8</td>
<td>Start the computer and <em>WINCON</em> furnace control software</td>
</tr>
<tr>
<td>9</td>
<td>Set up and run a recipe for the furnace controller including temperature, speed, and optional equipment</td>
</tr>
<tr>
<td>11</td>
<td>Set the necessary cover gas flows</td>
</tr>
<tr>
<td>12</td>
<td>Set the flowmeters for gas flow to the atmosphere curtains</td>
</tr>
<tr>
<td>13</td>
<td>Press START/RESET pushbutton (energizes conveyor and heaters)</td>
</tr>
<tr>
<td>15</td>
<td>Energize any optional equipment</td>
</tr>
<tr>
<td>21</td>
<td>When the monitor displays Ready, load product</td>
</tr>
</tbody>
</table>

**After You Run a Profile of the Product**

<table>
<thead>
<tr>
<th>Step</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>If necessary, adjust the left-center-right heaters in <em>WINCON</em></td>
</tr>
<tr>
<td>24</td>
<td>Only if necessary, adjust the gas flows at the flowmeters</td>
</tr>
</tbody>
</table>

**NOTE:** Do not change the atmosphere curtains. This decreases the effectiveness as an atmosphere barrier and increases O₂ levels in the process chamber. Make sure that there is sufficient clearance between the product to keep three curtains minimum in the down position.

CALCULATE COVER GAS FLOW (ALL FURNACES)

Use this procedure to calculate a safe cover gas flow for the process chamber and N₂ purge gas for the plenums inside the atmosphere curtains. Use the results in the start procedure.
## Common Measurements

### Table 5-2: Common Measurements

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>cm</td>
<td>Centimeter, one hundredth of a meter</td>
</tr>
<tr>
<td>cm³</td>
<td>Volume within cube measuring 1 x 1 x 1 cm</td>
</tr>
<tr>
<td>LPM/LPH</td>
<td>Liters per minute/liters per hour; measure of flow</td>
</tr>
</tbody>
</table>

### English Common (or Customary) Measure

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ft</td>
<td>Foot, unit of linear measure equal to 12 in. or 1/3 yd</td>
</tr>
<tr>
<td>ft³</td>
<td>Volume within cube measuring 1 x 1 x 1 foot; equal to 1728 in.³ 1 ft³ = 28.317 liters</td>
</tr>
<tr>
<td>in.</td>
<td>Inch, unit of measure equal to 2.54 cm</td>
</tr>
<tr>
<td>in.³</td>
<td>Volume within cube measuring 1 x 1 x 1 in.</td>
</tr>
<tr>
<td>gpm</td>
<td>Gallons per minute; 1 (U.S.) gallon equals 3.7852 liters; measure of flow</td>
</tr>
</tbody>
</table>

### Calculate the Per-minute Volume of Cover Gas

1. Measure the muffle width, length, and height (including heating and cooling sections, but not the area beneath the atmosphere curtains).
2. Calculate the volume of the process chamber as follows: \( \text{Volume} = \text{Width} \times \text{Length} \times \text{Height} \)
3. Based on the recipe to be run, select the number of atmosphere changes needed per hour to provide sufficient gas flow (30 is typical).
4. Convert cubic feet per hour (or cubic centimeters per hour) to liters per minute (lpm) and adjust flowmeters to process chamber and cooling system.

### English Measure (Example)

**Calculate gas flow for a muffle 15 in. wide, 240 in. long, 8 in. high.**

1. Find volume of muffle: \( 15 \times 240 \times 8 = 28,800 \text{ in.}^3 \).
2. Divide 28,800 in.³ by 1728 (in.³ in one ft³) = 16.66 cubic ft.
3. Convert 16.66 ft³ to liters (1 ft³ holds 28.317 liters) = 472 liters static volume.

**NOTE:** For entrance and exit curtains, the change per hour must be 120.

4. Multiply static volume by gas changes per hour: \( 30 \times 472 = 14,160 \text{ LPH} \).
5. Divide 14,160 LPH by 60 min = 236 LPM.
Metric Measure (Example)

Calculate gas flow for a muffle 38 x 610 x 20.3 cm.

1 Find volume of muffle in cm$^3$: 38 x 610 x 20.3 cm = 470,554 cm$^3$.
2 Divide cm$^3$ by 1000: 470,554/1000 = 471 dm$^3$ static volume.
3 Convert dm$^3$ to liters: 471 dm$^3$ = 471 liters static volume.

NOTE: For entrance and exit curtains, the change per hour must be 120.

4 Multiply static volume by changes/hour: 30 x 471 liters = 14,130 LPH.
5 14,130 LPH / 60 = 235.5 LPM.

Calculate Atmosphere Curtain Flow Rates

1 Calculate the amount of gas that must flow from the plenums:
   a Measure the width, length, and height of the area under the atmosphere curtains at the entrance of the muffle.
   b Calculate the volume under the atmosphere curtains at the entrance as follows: Volume = Width x Length x Height
   c If measured in inches, convert this volume to ft.$^3$ by dividing by 1728 and multiplying by 28.317 to find the number of static liters.
   d If measured in cm, divide cm$^3$ by 1000 to find the number of dm$^3$, which equals the number of static liters.
   e If atmosphere quality is not critical, enter the volume in static liters (lpm). If atmosphere quality is critical, double the static liters.

2 Calculate forming gas flow to the exit atmosphere curtain. Make sure that total purge gas flow to the atmosphere curtains exceeds the total amount of the cover gas flow.

3 Monitor the O$_2$ and dewpoint readings in the process chamber, and adjust the flow to the atmosphere curtains if necessary. Increased O$_2$ or dewpoint indications need more atmosphere curtain flow rates.

4 The furnace is ready to start.

START AND OPERATE

WARNING!

Make sure that all gas input lines are connected to the correct inlets.
**NOTE:** Each furnace is made for specific processes at specific temperature profiles and belt speeds. Because furnace configurations and processes are furnace specific, the settings for gas flows, zone temperatures, and belt speed are process dependent and not given.

1. Make sure all installation procedures are done.
2. Make sure that the atmosphere curtains are in the correct position.
3. Turn on the facility electric power to the equipment.
4. Remove the lockout/tagout. Refer to page 2-10, Lockout / Tagout Procedure.
5. Set the main power disconnect switch to **ON**.
6. Make sure the facility exhaust fan operates correctly. Open each butterfly damper.

**NOTE:** Do not use too much exhaust flow, as it can alter the process atmosphere in the furnace. Set the exhaust flow on high to ensure that exhaust is removed from the exhaust stacks and furnace entrance area. Do not set it so high that a negative pressure is created in the process chamber.

7. Set the exhaust dampers or balance valves according to your process needs.

**NOTE:** The ideal H₂O temperature depends on the necessary profile and furnace operating settings. If the temperature decreases below the minimum, condensation can occur. If the temperature increases above the maximum, sufficient heat might not be removed to cool the product and protect the cooling system.

The H₂O temperature must stay within the limits. The nominal H₂O operating temperature for your furnace is 20°C (68°F). If you are operating the furnace with a H₂O cooler, the minimum operating temperature can be as low as 5°C (40°F). If the H₂O is filtered, close the H₂O filter bypass line.

8. Set the flowmeters for a safe gas flow to the atmosphere curtains.

**NOTE:** Before heatup, purge the furnace using nitrogen at the recommended flow rates for 30 minutes. Purging the furnace, prevents oxidation of the belt from occurring under heated conditions.

9. Turn on the cooling H₂O supply, if applicable.

10. Press **MASTER START**. (The conveyor system and heaters start up when DRIVE and HEAT are set to **ON** and a recipe is enabled.)

11. Set DRIVE and HEAT to **ON**.

12. Start the computer and refer to **WINCON Online Help** for assistance in using WINCON to operate the furnace. Equipment status (Table 5-3) is displayed in the upper left-hand corner of the monitor.

<table>
<thead>
<tr>
<th>Item</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>INIT</td>
<td>Shows when the computer is first energized and establishing a link between the computer and the Intellimax.</td>
</tr>
<tr>
<td>IDLE</td>
<td>Shows when the system is energized without any heater power energized.</td>
</tr>
</tbody>
</table>
For each zone, type a temperature setpoint in your WINCON controller recipe.

Unless told otherwise, use the coefficients in Table 5-4.

Table 5-4: Recommended Initial Temperature Control Coefficients

<table>
<thead>
<tr>
<th>Temperature Range</th>
<th>High</th>
<th>Low</th>
<th>Rate</th>
<th>Reset</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 to 300°C</td>
<td>20</td>
<td>20</td>
<td>2.0</td>
<td>0.05</td>
</tr>
<tr>
<td>300 to 400°C</td>
<td>20</td>
<td>20</td>
<td>1.8</td>
<td>0.10</td>
</tr>
<tr>
<td>400 to 500°C</td>
<td>15</td>
<td>15</td>
<td>1.5</td>
<td>0.10</td>
</tr>
<tr>
<td>500 to 750°C</td>
<td>15</td>
<td>15</td>
<td>1.3</td>
<td>0.15</td>
</tr>
<tr>
<td>750 to 1000°C</td>
<td>15</td>
<td>15</td>
<td>1.0</td>
<td>0.20</td>
</tr>
</tbody>
</table>

For accurate temperature control, adjust these entries as needed. When the operating parameters are programmed in the recipe, they can be run. This process of adjusting temperatures is discussed in PID Temperature Control in WINCON Online Help. If you require additional assistance, contact Customer Service.

NOTE: Temperature ramp parameters are set at the factory, cannot be changed, and are available in WINCON for viewing only. The ramp rate a quartz furnace is intentionally slow, as indicated in Table 5-5.

Table 5-5: Factory Set Temperature Ramping

<table>
<thead>
<tr>
<th>Temperature Ramp Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature °C</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>25 - 200</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>200 - 280</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>280 - 550</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>550 - 600</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>600 - Operating</td>
</tr>
</tbody>
</table>

Run the processing recipe in WINCON.

Change flowrate as follows:

a Examine the flowmeters for the correct flowrates to the entrance and exit curtains.

NOTE: The stack slot shows the position of the damper plate. When the slot is vertical, the valve is open. When the nut is tight, the stack nut forms a gas-tight seal.

b Adjust the exhaust butterfly valve on the exhaust stack.
  • Loosen the nut.
  • Use a screwdriver to set the valve to the correct setting.
• Tighten the nut.

c When you profile product, you can adjust the venturi valves for more or less exhaust gas.

d Examine \( \text{O}_2 \) in the process chamber, and adjust the flow to the atmosphere curtains if necessary. To prevent room air from coming into the furnace, adjust the entrance and exit curtain gas flows to a rate that is slightly higher than your cover gas flow rate.

e After you profile the equipment to calculate the actual temperatures that the product encounters, you can adjust the temperature setpoint for specific heater sets (refer to \textit{WINCON Online Help}). Heater output trim is available by the conveyor belt width):

- 9-in. (0.139 m) belts: no trim
- 14-in. (0.357 m) belts: center and side trim
- 25-in. (0.637 m) belts: left, center, and right trim

18 When WINCON status displays \textbf{READY}, load product on the conveyor. The system begins to process product in reference to the selected recipe. As each product completes processing, it moves onto the exit table for removal or transport to an adjoining piece of equipment.

<table>
<thead>
<tr>
<th>CAUTION!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product that exits the furnace is hot. Use protective gloves to handle product. Keep hands away from moving parts when the power is on.</td>
</tr>
</tbody>
</table>

**NOTE:** All process functions (except gas flows) are controlled by the furnace controller. Zone temperature settings depend on the process recipe being run. The zone temperatures are programmed through the furnace controller, which keeps accurate temperature setpoints through PID temperature control loops (refer to \textit{WINCON Online Help}).

### NORMAL SHUTDOWN

<table>
<thead>
<tr>
<th>CAUTION!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shut down the furnace with a COOLDOWN or SHUTDOWN recipe.</td>
</tr>
</tbody>
</table>

1 Remove all product from the furnace.

2 Run your cooldown recipe until the furnace is cool (less than 100\(^\circ\)C).

3 Exit WINCON before shutting down power to the computer.

4 Do the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.
EMERGENCY SHUTDOWN

Refer to page 2-13, EMO (Emergency Off).

<table>
<thead>
<tr>
<th>CAUTION!</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO NOT USE THE EMO AS NORMAL SHUTDOWN</td>
</tr>
<tr>
<td>Do not press an EMO except in an emergency. Using the EMO button as the normal shutdown can severely damage your system.</td>
</tr>
</tbody>
</table>

IDLE THE FURNACE

When not processing product, operate in idle mode (decreased temperature, decreased N₂ flow, and decreased belt speed). This saves gas and power and decreases restart time.

- Operate at an idle temperature of 100°C or 200°C below the usual operating setpoint.
- The decreased N₂ flow must be set at the minimum possible flow that is sufficient to prevent room air from entering the furnace.
- Reduce belt speed to a minimum to decrease air intake into the furnace and decrease heat transfer to the cooling section.

SYSTEM ALERTS AND ALARMS

System alarms occur for various reasons. When there is a system alarm, the system sounds an audible alarm that shows operator action is necessary. With the light tower, the red light comes on. Refer to Chapter 6, TROUBLESHOOTING.

NOTE: For a description of the optional light tower, refer to page 3-12, Light Tower.

Alerts

An alert is a visual indication that temperature or pressure is more than the limits. When there is an alert:

- A yellow light on the light tower comes on
- New Alarms message displays on the screen with the blinking ALERT (yellow)
- Process State button shows a yellow box with the word ALERT
- Operator action is necessary. Find the cause of the alert and correct the problem. Do the same as an alarm condition.

Alarm

An alarm is an audible and visual indication of a critical problem. When there is an alarm:

- There is an audible alarm
- The red light on the light tower comes on
- A red ALARM window appears on the monitor screen in a red box
If there is an alarm, do as follows:

1. Select **Acknowledge** in the ALARM window to silence the alarm. The alarm displays until it is cleared. A New Alarm window is displayed (alarm type in red).

2. Location, type, date, and time show as follows:
   - Yellow shows the location and type of alert condition
   - Red shows the location and type of alarm condition
   - Alerts and alarms are listed from latest to earliest

3. Access the Alarm Status window by doing one of the following steps:
   - Click the yellow or red process state buttons (ALERT or ALARM displays).
   - Choose **Status > Alarms**.

4. Locate and correct the condition that caused the alert or alarm.

   **NOTE:** You can not clear an alert or alarm until the problem is corrected.

5. Press the **Clear** button on the alarm screen.

6. If the alarm sounds again, select **Acknowledge Alarms**. For more information, refer to *WINCON Online Help*.

   **NOTE:** Turn the outer ring on the alarm device (on the operator control panel) to set the volume of the alarm.
Respond to Interlock and Alarm Conditions

For interlock alarm conditions and recovery procedures, refer to Table 5-6. Recovery procedures assume that you have first acknowledged an alarm.

Table 5-6: Interlock and Alarm Conditions and Recovery

<table>
<thead>
<tr>
<th>Condition</th>
<th>Subsystem Status</th>
<th>Result</th>
<th>Action</th>
</tr>
</thead>
</table>
| Emergency Stop             | Heaters Off               | All furnace subsystems are de-energized and alarm is shown in NEW ALARM dialog box. | 1. Reset EMO.  
2. Press **RESET/ START** on control panel.  
3. Clear alarm in WINCON.  
4. Restart recipe. |
|                            | Conveyor Off              |                                                                        |                                                                        |
|                            | Computer On               |                                                                        |                                                                        |
|                            |                           |                                                                        |                                                                        |
| Belt Motion                | Heaters On                | Proximity switch senses stopped idler pulley and alarm is shown in NEW ALARM dialog box. | 1. Check shear pin.  
2. Check proximity switch setting to sprocket.  
3. Clear alarm in WINCON. |
|                            | Conveyor On               |                                                                        |                                                                        |
| Belt Speed Deviation       | Heaters On                | Alarm is shown in NEW ALARM dialog box.                                | 1. Check WINCON Deviation setting.  
2. Check belt movement.  
3. Correct as required.  
4. Clear alarm in WINCON. |
|                            | Conveyor On               |                                                                        |                                                                        |
| Temperature Deviation      | Heaters On                | Thermocouples in heating zones send signal to Intellimax indicating temperature is not within the limits, an alarm shows in the NEW ALARM dialog box (refers to heating zone number). | 1. Check temperature Delta between zones.  
2. Check for current, if below setpoint.  
3. Check for no current if above setpoint.  
4. Check Deviation Alarm setpoint.  
5. Reset alarm in WINCON. |
| Alert / Alarm              | Conveyor On               |                                                                        |                                                                        |
| Over-temperature           | Heaters Off               | Thermocouple in heated zone sends signal to the OverTemperature Unit indicating temperature has exceeded setpoints. Alarm shows in the NEW ALARM dialog box. | 1. Examine LEDs in the OTM to find defective heating zone, and correct problem.  
2. Press **RESET/ START** on control panel.  
3. Reset alarm in WINCON.  
4. Restart recipe. |
|                            | Conveyor On               |                                                                        |                                                                        |
| Belt Stretched             | Heaters On                | Switch on bottom of ultrasonic cleaner tank senses belt is touching. Alarm is displayed in NEW ALARM dialog box. | 1. Stop conveyor.  
2. Shorten conveyor belt.  
3. Start conveyor  
4. Clear alarm in WINCON.  
5. Restart recipe and monitor belt tracking. |
|                            | Conveyor On               |                                                                        |                                                                        |
| H₂O Flow Failure           | Heaters Off               | The H₂O flow switch senses low H₂O flow in the outflow pipe. Low H₂O Flow alarm shows in the NEW ALARM dialog box. | 1. Restore H₂O flow.  
2. Clear alarm in WINCON.  
3. Restart recipe. |
|                            | Conveyor On               |                                                                        |                                                                        |
### Recover from an Over-temperature Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Subsystem Status</th>
<th>Result</th>
<th>Action</th>
</tr>
</thead>
</table>
| Low N₂ Pressure or Low Air Pressure | Heaters On Conveyor On            | The pressure switch for Low N₂ or Air has dropped below setlimit (9 psi). Low N₂ / Air Pressure alarm shows in New Alarm dialog box. | 1. Restore gas pressure.  
2. Clear controller alarm in WINCON. |
| Low O₂ Pressure                  | Heaters On Conveyor On            | The pressure switch for Low O₂ has dropped below setlimit (9 psi). Low O₂ Pressure alarm shows in New Alarm dialog box. | 1. Restore gas pressure.  
2. Clear controller alarm in WINCON. |
| Gas Preheaters Flow             | Gas Heaters Off Conveyor On       | Gas flow has dropped below setting on flow switch. Low Flow Burn-out or Firing Section alarm shows in New Alarm dialog box. | 1. Check flow switches below gas panel (gauge needle is to the right).  
2. Adjust flowmeter for Burn-out or Firing section.  
3. Clear alarm. |
2. Check green light on SSR (Refer to schematic in Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS).  
3. Check current using amp meter. |
| Water OverTemperature            | Heaters Off Conveyor On           | Klixon sensor on H₂O drain has exceeded its limits. | 1. Check H₂O flow.  
2. Clear alarm in WINCON.  
3. Restart recipe. |

### To recover from an over-temperature condition:

**NOTE:** The OverTemperature Unit setpoints are preset at the factory (to 25°C (77°F) over WINCON limits) and should not be changed.

Each heated zone is monitored by an OverTemperature thermocouple that is independent from the zone control circuitry.

If any zone is more than the preset safe maximum temperature, the OverTemperature Unit de-energizes all heater power, and sounds an alarm.

The conveyor continues to operate so that you can remove product.

1. Find the OverTemperature Unit. Location varies on each furnace.
2 Remove the applicable access panels. Refer to page 7-4, Removing Access Panels.

3 Find the energized LED on the OverTemperature Unit.
   • The LED indicates the furnace zone that activated the OverTemperature Unit (Figure 5-1).
   • The OverTemperature Unit thermocouple inputs are labeled with the corresponding zone number.
   • Also, refer to Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS for the over-temperature channel/zone assignment.

NOTE: The over-temperature condition must be corrected before you reset the OverTemperature Unit.

4 Find and correct the cause of the over-temperature condition. As each alarm input is found and corrected, the corresponding channel alarm LED is de-energized.

5 On the master control panel, press START/RESET. The OverTemperature Unit is reset and the heaters are energized.

6 Examine equipment operation.

---

Figure 5-1: OverTemperature Unit
OPERATE OPTIONS

Operate the Belt Cleaners
Controls for the ultrasonic belt cleaner are integrated into the software package. Refer to WINCON Online Help for more information.

Operate the Hand Crank [Option]
The conveyor belt stops if a power failure occurs or if the conveyor drive system fails. You can remove product from the furnace as follows:

1. Remove the hand crank from its storage location at the exit end of the furnace, and plug it into the tension pulley drive shaft.
2. Turn the hand crank until all product is removed from the furnace.

WARNING!
If the furnace starts with the hand crank engaged, the crank can turn and cause injury.

3. Remove the hand crank and return it to its storage location.

Operate the O₂ Analyzer [Option]
Refer to Appendix E, VENDOR MANUALS.

Operate the Product Feed Conveyor [Option]
If you have a product feed conveyor at the entrance, observe the following precautions to ensure correct product transfer and prevent misloading:

1. Set the height of the feed conveyor equal to or slightly more than the height of the entrance conveyor belt.

2. Set the feed conveyor speed slightly slower than the conveyor belt speed.
CHAPTER 6
TROUBLESHOOTING

WARNING!

Troubleshooting techniques covered in this chapter require the removal of safety shields and will expose hazardous voltages, temperatures and mechanical hazards.

Obey all safety precautions when you operate and maintain the equipment. Otherwise, personal injury and equipment can result.

Properly dispose of all hazardous waste.

Only qualified personnel should operate and maintain the equipment.

Refer to Chapter 1: INTRODUCTION for the recommended tools.

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Troubleshoot the Atmosphere System ............................................................................................................. 6-7
Troubleshoot the Exhaust System .................................................................................................................... 6-8
Troubleshoot the Furnace Controller System .................................................................................................. 6-8
## TROUBLESHOOT THE FRAME AND PANEL SYSTEM

No Applicable Procedures.

## TROUBLESHOOT THE CONVEYOR SYSTEM

Refer to Table 6-1.

### Table 6-1: Troubleshoot the Conveyor System

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Possible Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyor system runs at erratic speeds</td>
<td>Blocked process chamber or belt edges catching on sides of process chamber</td>
<td>Make sure that there is a 0.9 cm (0.375 in.) gap between the belt edge and the interior of the process chamber. If the belt touches the bricking, there will be a white residue on the belt. Refer to page 7-7, Examine and Adjust Conveyor Belt Tracking.</td>
</tr>
<tr>
<td></td>
<td>Defective drive motor shaft encoder (incorrect position, loose wires, or EMF).</td>
<td>Examine encoder, replace if necessary.</td>
</tr>
<tr>
<td>Incorrect pressure on snub roller</td>
<td>Inspect setscrew or torque limiter.</td>
<td>Increase pressure on snub roller pulley.</td>
</tr>
<tr>
<td>Shear pin assembly or torque limiter assembly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worn drive motor brushes</td>
<td>Examine the motor brushes for wear. If worn, replace the brushes. Refer to page 7-26, Replace Drive Motor Brushes.</td>
<td></td>
</tr>
<tr>
<td>Defective drive motor</td>
<td>Replace motor.</td>
<td></td>
</tr>
<tr>
<td>Loose drive sprocket set screws</td>
<td>Tighten set screws on drive sprocket.</td>
<td></td>
</tr>
<tr>
<td>Defective or incorrectly adjusted drive chain and sprockets</td>
<td>Adjust or replace if necessary. Refer to page 7-23, Examine and Adjust Drive Chain Tension.</td>
<td></td>
</tr>
<tr>
<td>Contamination on belt.</td>
<td>Clean belt.</td>
<td></td>
</tr>
<tr>
<td>Curled belt</td>
<td>Continuous operation of furnace at high temperature (especially with heavy product loads)</td>
<td>1. Periodically turn the belt over. This increases the life of the belt. 2. Replace the belt.</td>
</tr>
<tr>
<td></td>
<td>Belt speed is slow or belt has stopped in a hot furnace</td>
<td>Increase belt speed or avoid stopping the belt in a hot furnace.</td>
</tr>
<tr>
<td>Worn out belt</td>
<td>Replace the belt.</td>
<td></td>
</tr>
<tr>
<td>Conveyor belt drive pulley slips under load</td>
<td>Loosen pressure pulley tension on drive pulley assembly</td>
<td>Adjust the drive pulley tension. Refer to page 7-24, Fill Drive Motor Gearbox with Oil.</td>
</tr>
<tr>
<td>Contamination on belt.</td>
<td>Clean belt.</td>
<td></td>
</tr>
<tr>
<td>Problem</td>
<td>Possible Cause</td>
<td>Possible Solution</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Conveyor system does not move</td>
<td>Conveyor system is blocked</td>
<td>Remove obstruction.</td>
</tr>
<tr>
<td></td>
<td>Loose or broken shear pin (Figure 7-2)</td>
<td>Replace the shear pin.</td>
</tr>
<tr>
<td></td>
<td>Loose drive motor slip clutch in the</td>
<td>1. Find and correct the cause of the conveyor system overload or readjust the torque limiter.</td>
</tr>
<tr>
<td></td>
<td>torque limiter (if equipped with a torque</td>
<td>2. Examine the slip clutch on the drive motor. Adjust or replace, if necessary.</td>
</tr>
<tr>
<td></td>
<td>limiter)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pressed EMO</td>
<td>1. Release the EMO.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Press START/RESET.</td>
</tr>
<tr>
<td></td>
<td>Tripped conveyor system circuit breaker</td>
<td>1. Find and correct the cause of the tripped breaker.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Reset the tripped circuit breaker.</td>
</tr>
<tr>
<td></td>
<td>Worn drive motor brushes</td>
<td>Examine the motor brushes for wear. If worn, replace the brushes. Refer to page 7-26, Replace Drive Motor Brushes.</td>
</tr>
<tr>
<td></td>
<td>Defective drive controller</td>
<td>Replace controller.</td>
</tr>
<tr>
<td></td>
<td>Defective drive motor</td>
<td>Replace motor. Refer to page 8-6, Replace the Drive Motor.</td>
</tr>
<tr>
<td></td>
<td>Examine optical shaft encoder output with a</td>
<td>Replace drive shaft encoder, if defective.</td>
</tr>
<tr>
<td></td>
<td>multimeter (0 to 5 V DC square wave) for a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>defective drive motor shaft encoder</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If product feed conveyor is used, downstream</td>
<td>Clear downstream equipment.</td>
</tr>
<tr>
<td></td>
<td>equipment (SMEMA) is not ready</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conveyor turned off in recipe.</td>
<td>Turn conveyor on in recipe.</td>
</tr>
<tr>
<td></td>
<td>Furnace in manual mode.</td>
<td>Switch to automatic mode.</td>
</tr>
<tr>
<td></td>
<td>Belt motion sensor</td>
<td>Check / set sensor.</td>
</tr>
<tr>
<td></td>
<td>Belt does not track correctly</td>
<td>Examine and adjust the pulleys. Refer to page 7-7, Examine and Adjust Conveyor Belt Tracking.</td>
</tr>
<tr>
<td></td>
<td>Drive pulley or idler pulleys not adjusted</td>
<td>Examine and adjust the pulleys. Refer to page 7-7, Examine and Adjust Conveyor Belt Tracking.</td>
</tr>
<tr>
<td></td>
<td>correctly</td>
<td>Examine and adjust rollers. Refer to page 7-7, Examine and Adjust Conveyor Belt Tracking.</td>
</tr>
<tr>
<td></td>
<td>Return rollers are not adjusted, steering</td>
<td>Examine and adjust pressure on pulley assembly. Refer to page 7-15, Examine and Adjust Pressure Pulley Tension.</td>
</tr>
<tr>
<td></td>
<td>belt to one side</td>
<td>Damaged belt</td>
</tr>
<tr>
<td></td>
<td>Snub roller pressure pulley too strong or</td>
<td>Examine the belt. Adjust or replace as necessary. Refer to page 8-3, Replace the Conveyor Belt.</td>
</tr>
<tr>
<td></td>
<td>pressure not equal on both sides of pulley</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Incorrect conveyor belt splice</td>
<td>Examine the conveyor belt splice.</td>
</tr>
<tr>
<td></td>
<td>Damaged quartz tubes or process chamber</td>
<td>Call BTU International.</td>
</tr>
<tr>
<td>Problem</td>
<td>Possible Cause</td>
<td>Possible Solution</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Noisy or worn drive chain or sprockets    | Misadjusted drive sprockets | 1. Adjust the sprockets and adjust chain tension.  
|                                           |                         | 2. If damaged or worn, replace the chain or sprockets.                             |
|                                           |                         | **Tight or loose drive chain tension**                                                |
|                                           |                        | Adjust the chain tension. Refer to page 7-24, *Fill Drive Motor Gearbox with Oil.* |
|                                           |                         | **Chain requires lubrication**                                                       |
|                                           |                         | Lubricate chain.                                                                    |
|                                           |                         | **Damaged or worn gearbox gears.**                                                   |
|                                           |                         | Replace gearbox.                                                                    |
## TROUBLESHOOT THE TEMPERATURE SYSTEM

Refer to Table 6-2.

**Table 6-2: Troubleshoot the Temperature System**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Possible Solution</th>
</tr>
</thead>
</table>
| Product processing quality is decreased      | A temperature profile problem that causes incorrect product heating          | 1. Make sure that all zones and controlled heating sections are at their setpoint temperatures, recheck the profile temperature setpoints, and then re-enter your settings to achieve a new profile. Refer to the WINCON Operation Manual.  
2. Examine the trim power settings and the belt speed calibration in the recipe. |
| Incorrect PID settings in recipe             |                                                                                | 1. If a zone of the furnace is not at setpoint temperature, examine the controller PID settings. Typically if the temperature is oscillating around the setpoint, you can adjust the PID settings to dampen oscillation.  
2. If the oscillating cannot be dampened, call your service representative. |
| Incorrect gas flow to the atmosphere curtains|                                                                                | 1. Make sure curtains are down.  
2. Examine flow of gas to atmosphere curtain plenums.                           |
| Defective thermocouple                       |                                                                                | 1. Do a temperature profile. Refer to page 7-7, Perform a Temperature Profile.  
2. Replace the thermocouple.                                                             |
| Defective heater                             |                                                                                | 1. Measure current to each heater.  
2. No current indicates a failed heater or SSR. Refer to page 8-18, Replace an SSR. For heater replacement, call BTU Customer Service. |
| Defective SSR                                |                                                                                | 1. Measure current to each heater.  
2. No current indicates a failed heater or SSR.                                          |
| Excessive exhaust flow that stirs process atmosphere |                                                | Examine the exhaust flow.                                                        |
| Process chamber leak                         |                                                                                | 1. Perform a leak test.  
2. Examine plumbing line gaskets and replace if necessary.                           |
<p>| Incorrect belt speed                         | Refer to page 6-2, Troubleshoot the Conveyor System.                           |                                                                                  |
| Incorrect recipe                             |                                                                                | Check to be sure the correct recipe is running.                                   |</p>
<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Possible Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Products exiting the furnace are too hot</td>
<td>Cooler not working</td>
<td>Examine cooling H₂O flow.</td>
</tr>
<tr>
<td>Conveyer belt running too fast</td>
<td></td>
<td>1. Make sure that belt speed is within the set speed range.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Decrease the belt speed.</td>
</tr>
<tr>
<td>Conveyer belt overloaded</td>
<td></td>
<td>1. Decrease product load on the belt.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Examine maximum load per square meter.</td>
</tr>
<tr>
<td>Replacement belt may be too heavy</td>
<td></td>
<td>Make sure the belt is correct belt for your furnace.</td>
</tr>
<tr>
<td>Controller temperature indication is 1850°C</td>
<td>Broken or open circuit thermocouple connection</td>
<td>1. Examine for open circuit thermocouple connections or open thermocouple.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Repair or replace as necessary.</td>
</tr>
<tr>
<td>Over-temperature condition</td>
<td>High temperature deviation alarm or</td>
<td>1. Refer to page 5-11, Recover from an Over-temperature Condition.</td>
</tr>
<tr>
<td></td>
<td>Over-temperature condition in a zone de-energize</td>
<td>2. Examine the setpoint value of the high temperature deviation alarm.</td>
</tr>
<tr>
<td></td>
<td>heater power</td>
<td></td>
</tr>
<tr>
<td>Thermocouple failure</td>
<td>Replace thermocouple.</td>
<td></td>
</tr>
<tr>
<td>Defective or short-circuited SSR</td>
<td>Examine the SSR. Replace if necessary.</td>
<td></td>
</tr>
<tr>
<td>Intellimax controller failure</td>
<td>Replace Intellimax controller. Refer to page 8-13, Replace Intellimax Controller.</td>
<td></td>
</tr>
<tr>
<td>Loss of heater power</td>
<td>Over-temperature condition de-energized all heater power</td>
<td>Refer to page 5-11, Recover from an Over-temperature Condition.</td>
</tr>
<tr>
<td>Defective heater contactor</td>
<td>Replace the heater contactor</td>
<td></td>
</tr>
<tr>
<td>The furnace controller is in an idle mode (heat contactor is off)</td>
<td>Examine the status box in the top line of the monitor. Refer to WINCON Online Help.</td>
<td></td>
</tr>
<tr>
<td>Defective SSR</td>
<td>1. Examine the SSR with an ohmmeter.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Replace if necessary.</td>
<td></td>
</tr>
<tr>
<td>Tripped power circuit breaker.</td>
<td>Examine the circuit breaker, fuses, interlocks and EMOs.</td>
<td></td>
</tr>
<tr>
<td>Loss of heater power to one zone</td>
<td>Defective or open thermocouple circuit:</td>
<td>Replace the thermocouple. Refer to page 8-42, Replace Bottom Heaters.</td>
</tr>
<tr>
<td></td>
<td>controller reads 1850°C</td>
<td></td>
</tr>
<tr>
<td>A failure in the heater control or power circuit (may include a</td>
<td>Examine voltage at the breaker and on each SSR</td>
<td>Refer to Appendix A, DRAWINGS, SPECIFICATIONS &amp; OPTIONS.</td>
</tr>
<tr>
<td></td>
<td>terminal (terminals 3 and 4 are control terminals). Refer to Appendix A, DRAWINGS, SPECIFICATIONS &amp; OPTIONS.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Examine voltage at the breaker and on each SSR terminal (terminals 3 and 4 are control terminals). Refer to Appendix A, DRAWINGS, SPECIFICATIONS &amp; OPTIONS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If there is voltage but not current, there is an open heater.</td>
</tr>
<tr>
<td>Defective heater caused by break in heater coils</td>
<td>Examine for heater failure with a clip-on ammeter (For the required heater current, refer to Appendix A, DRAWINGS, SPECIFICATIONS &amp; OPTIONS).</td>
<td></td>
</tr>
</tbody>
</table>
**TROUBLESHOOT THE ATMOSPHERE SYSTEM**

Refer to Table 6-3.

Table 6-3: Troubleshoot the Atmosphere System

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Possible Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature of one zone must be set lower than an adjacent zone to</td>
<td>Defective heater thermocouple</td>
<td>Replace the thermocouple. Refer to page 8-42, Replace Bottom Heaters.</td>
</tr>
<tr>
<td>maintain the profile</td>
<td>Heat barrier is not lowered</td>
<td>Lower the correct heat barrier(s).</td>
</tr>
<tr>
<td>Low gas flow volume</td>
<td>Low gas inlet pressure</td>
<td>Examine gas inlet pressure regulator setting or air/gas supply pressure to the furnace.</td>
</tr>
<tr>
<td></td>
<td>Blocked gas inlet</td>
<td>Make sure that gas inlet line is not blocked.</td>
</tr>
<tr>
<td>High dewpoint reading on hygrometer</td>
<td>Excessive room drafts around vicinity of furnace</td>
<td>1. Examine room air conditioner blower ducts, and exhaust fans.</td>
</tr>
<tr>
<td></td>
<td>entrance and exit ends</td>
<td>2. Prevent them from blowing directly at the furnace entrance or exit ends.</td>
</tr>
<tr>
<td></td>
<td>Gas plumbing system leak</td>
<td>Make sure that plumbing connections are satisfactory.</td>
</tr>
<tr>
<td></td>
<td>Incorrectly installed atmosphere curtains</td>
<td>Make sure the curtains are hanging perpendicular to the belt.</td>
</tr>
<tr>
<td></td>
<td>Excessive gas flow rate to the atmosphere curtains</td>
<td>Adjust the venturi and curtain flowmeters to prevent pulling ambient air into the process chamber.</td>
</tr>
<tr>
<td></td>
<td>or venturi-controlled exhaust stacks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plenum module assembly gasket leaks</td>
<td>1. Examine or tighten the clamp screws on plenum module assembly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Examine condition of gasket, replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>Process chamber muffle leak</td>
<td>Examine for leaks around the muffle, gaskets, and plumbing fittings.</td>
</tr>
<tr>
<td></td>
<td>Defective air solenoid</td>
<td>Disconnect pressurized air supply to furnace to make sure that solenoid or make sure that the valve is not defective.</td>
</tr>
<tr>
<td></td>
<td>High dewpoint in gas supply (especially when</td>
<td>Make sure that gas or air supply has a humidity level at least 10 percent lower than the necessary dewpoint.</td>
</tr>
<tr>
<td></td>
<td>operating in a N₂ atmosphere)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Incorrect hygrometer indication</td>
<td>Calibrate the hygrometer in reference to its reference manual.</td>
</tr>
</tbody>
</table>
TROUBLESHOOT THE EXHAUST SYSTEM

Refer to Table 6-4.

Table 6-4: Troubleshoot the Exhaust System

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Possible Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce process quality</td>
<td>Excessive venturi exhaust stack flow which causes damage to the process atmosphere</td>
<td>Examine the exhaust flow rate and exhaust dampers</td>
</tr>
<tr>
<td>Furnace exhaust effluents are collecting in the room</td>
<td>Incorrect furnace exhaust flow. Exhaust blower may not be operating or duct is blocked</td>
<td>Examine and adjust the furnace exhaust system and/or exhaust dampers.</td>
</tr>
<tr>
<td></td>
<td>Exhaust flow dampers may be closed or not sufficiently opened</td>
<td>Open the dampers to let exhaust flow remove effluents.</td>
</tr>
</tbody>
</table>

TROUBLESHOOT THE FURNACE CONTROLLER SYSTEM

For information about WINCON, refer to the WINCON Online Help.

For problems related to the computer, refer to the applicable vendor manual.
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<td>Examine and Adjust Drive Chain Tension</td>
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</tr>
</tbody>
</table>
OBSERVING SAFETY PRECAUTIONS

Make sure you are familiar with all the hazards, general safety related procedures, and safety labels for the furnace (refer to Chapter 2: SAFETY). If you have any doubt about a procedure, contact BTU International Customer Service.

WARNING!

READ!

- Read this manual in its entirety before you install, operate, troubleshoot or maintain the furnace.
- Read a procedure in its entirety before you perform it.
- Always note and take any safety precautions recommended in this manual and other documentation before you perform any procedure; otherwise, severe personal injury or equipment damage may occur.
- If your company utilizes a lockout/tagout policy, lock the main power disconnect switch in the OFF (0) position to prevent unauthorized use. Refer to page 2-10, Lockout / Tagout Procedure for a proper lockout/tagout procedure.

QUALIFIED PERSONNEL!

- Procedures include working with high amperage, high voltage, high temperatures, compressed gas, moving parts, and refractory ceramic fiber insulation (RCF).
- Procedures must be performed by fully trained, fully qualified personnel.
- Most procedures require advanced knowledge of electrical, mechanical, and plumbing theories and issues.
- DO NOT PERFORM THE PROCEDURE IF YOU HAVE ANY DOUBTS ABOUT HOW TO ACCOMPLISH THE TASKS INVOLVED. Contact BTU International Customer Service; otherwise, severe personal injury or equipment damage may occur.
- If you do not obey all the safety precautions listed in this manual and any other associated documents, you risk the occurrence of death or serious injury to personnel and a cancelled manufacturer's warranty.

Main Power Disconnect Switch [OPTION]

If your company utilizes a lockout/tagout policy, you can lock the main power disconnect switch in the OFF position to prevent unauthorized use.

Lockout/Tagout Procedure

Set the main power disconnect switch to the OFF (0) position. Afterward, pull out the tab on the switch handle and insert a padlock to lock the switch in the OFF (0) position. If your furnace has an optional UPS, it is disabled when the main power disconnect switch is set to the OFF (0) position.

Replacing the Main Power Disconnect Switch

When replacing the main power disconnect switch, always use a switch of a equal or greater power rating. For example, If the power rating of the power disconnect switch is 100,000 AIC, the replacement switch must have a minimum rating of 100,000 AIC.
Electrical Hazards

All procedures that could expose you to an electrical hazard include a electrical danger symbol.

**DANGER!**

**HIGH-VOLTAGE ELECTRICITY!**

Electrical maintenance on this furnace often involves working with high-voltage electricity. Only qualified personnel should perform electrical maintenance procedures. Do not touch the high-voltage connections when working with this equipment or serious injury or death may occur.

Identifying the Level of Electrical Hazard in Maintenance Tasks

The level of electrical hazard for each maintenance task is identified by Type numbers 1 through 5 at the beginning of each maintenance procedure that involves electrical work.

<table>
<thead>
<tr>
<th>Item</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>Equipment is fully de-energized (electrically cold).</td>
</tr>
<tr>
<td>Type 2</td>
<td>Equipment is energized. Live circuits are covered or insulated.</td>
</tr>
<tr>
<td>Type 3</td>
<td>Equipment is energized. Live circuits are exposed and accidental contact is possible. Potential exposures are less than 30 volts RMS, 42.2 volts peak, 240 volt-amps, and 20 Joules.</td>
</tr>
<tr>
<td>Type 4</td>
<td>Equipment is energized. Live circuits are exposed and accidental contact is possible. Voltage potentials are greater than 30 volts RMS, 42.2 volts peak, 240 volt-amps, and 20 Joules, or radio frequency (rf) is present.</td>
</tr>
<tr>
<td>Type 5</td>
<td>Equipment is energized and measurements and adjustment requires physical entry into the equipment, or equipment configuration will not allow the use of clamp-on probes.</td>
</tr>
</tbody>
</table>

Chemical Hazards

Processes and maintenance procedures used in this furnace may include exposure to hazardous materials. All procedures that could expose you to a dangerous chemical hazard include a chemical danger symbol. Some types of optional oxygen analyzers may contain a hazardous electrolyte fluid. Recommended cleaning solvents, lubricants, adhesives and other chemicals are listed in this chapter (refer to page 7-4, Required Tools and Consumable Items). Potentially hazardous items include a Material Safety Data Sheet (MSDS) located in Appendix C: MATERIAL SAFETY DATA SHEETS. When using and disposing of general cleaning solutions, chemicals and associated application materials such as rags, wipes and brushes, refer to the appropriate MSDS warning sheet. Also refer to all local, state and federal regulations for disposal of these item. For other general purpose chemicals and process materials not specifically identified in this manual, it is the end user's responsibility to provide MSDS information regarding use and disposal.

When using cleaning solvents or other vaporous chemicals, always provide adequate ventilation and appropriate safety equipment. Make sure the equipment surface is cool before applying any solvent or cleaning fluid.
Ceramic Fiber Insulation Hazard
This furnace contains Refractory Ceramic Fiber (RCF) in the insulation around the heated zones. Under normal operating conditions, exposure to RCF should not occur. However, when performing furnace maintenance procedures that expose this insulation, take care to avoid inhaling the fibers. Use protective dust mask, clothing and gloves (refer to Appendix C: MATERIAL SAFETY DATA SHEETS).

REQUIRED TOOLS AND CONSUMABLE ITEMS
The following is a list of tools and equipment required to perform the maintenance procedures contained in this chapter:

Table 7-2: Required Tools and Consumable Items

<table>
<thead>
<tr>
<th>Required Tools</th>
<th>Consumable Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Ammeter, clip-on</td>
<td>• Cleaning solution (90 percent water / 10 percent Isopropyl alcohol)</td>
</tr>
<tr>
<td>• Brush, soft-bristle</td>
<td>• Adhesive, high-temperature RTV gasket or sealant</td>
</tr>
<tr>
<td>• Brush, stainless-steel wire</td>
<td>• Lubricating grease (EP-1)</td>
</tr>
<tr>
<td>• Grease gun</td>
<td>• Oil, gear</td>
</tr>
<tr>
<td>• Hammer</td>
<td>• Oil, gear and chain lubricating</td>
</tr>
<tr>
<td>• Multimeter, digital or analog (must be true RMS)</td>
<td>• Thread adhesive (Loctite No. 222 or equivalent)</td>
</tr>
<tr>
<td>• Needle-nose pliers</td>
<td>• Thread dope, nickel anti-seize pipe</td>
</tr>
<tr>
<td>• Screwdriver set</td>
<td>• Thread tape (Teflon®)</td>
</tr>
<tr>
<td>• Torque wrench, 0–50 in.-lb.</td>
<td>• Water, distilled or purified (do not use de-ionized)</td>
</tr>
<tr>
<td>• Torque wrench, 0–50 ft.-lb.</td>
<td>• Wipes, lint-free</td>
</tr>
<tr>
<td>• Wrench set, Allen</td>
<td>• Vacuum cleaner with HEPA-rated filter bag</td>
</tr>
<tr>
<td>• Wrench set, SAE and metric</td>
<td></td>
</tr>
<tr>
<td>• Identification labels</td>
<td></td>
</tr>
</tbody>
</table>

REMOVING ACCESS PANELS
All access panels and doors include a type of latch to prevent inadvertent entry. If your furnace includes an optional interlock safety package, the furnace is de-energized to prevent furnace operation if any access panel is removed.

To remove exit table side panels:
The side access panels on the exit table include quarter-turn latching screws; these screws must be turned with a screwdriver to unlatch them. After unlatching the quarter-turn latching screws, the panel can be removed by lifting it slightly and pulling it off.

1. Using a screwdriver, loosen the quarter-turn latch screws.
2. Remove the access panel by lifting it straight up, and then away, from the furnace.

To remove the process chamber side and top panels:
The top and side access panels to the processing area of the furnace are held in place with a nut and small panel bracket. After the nut and bracket are removed, the top cover panels can be removed, and the side access panels can be removed by lifting them slightly and then pulling them off.
1. Using a wrench, remove the nut that attaches the bracket.

2. Remove the bracket.

3. Remove the access panel by lifting it straight up, and then away, from the furnace.

**To remove the entrance and exit table tops:**

The entrance and exit table tops are secured in place with bolts and nuts. To remove these panels, you may have to remove the side access panels to get access to the nuts. It may be necessary to remove these top panels when performing some drive system maintenance.

1. Using a wrench, remove the nuts that attach the table top.

2. Remove the table top by lifting it straight up, and then away, from the furnace.

---

**Figure 7-1:** Entrance / Exit Table Tops and Access Panels

---
# PREVENTIVE MAINTENANCE SCHEDULE

Table 7-3: Preventive Maintenance Schedule

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Frequency</th>
<th>As Required</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time Req’d (hr)</td>
<td>Weekly</td>
<td>Monthly</td>
</tr>
<tr>
<td>Perform a temperature profile</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examine and adjust conveyor belt tracking</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean external surfaces</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examine conveyor system</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean conveyor system</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examine and shorten conveyor belt</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Align entrance and exit pulleys</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test furnace interlocks</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintain the O2 analyzer</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examine and adjust pressure pulley tension</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examine and adjust drive chain tension</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fill drive motor with oil</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lubricate the drive chain and the drive chain sprockets</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verify and calibrate conveyor speed</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibrate conveyor belt motion</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lubricate idler pulley bearings</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace drive motor brushes</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verify Intellimax calibration</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Empty exhaust traps</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test exhaust</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean ultrasonic belt cleaner tank</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace the air/gas filters</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test heater current</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset a circuit breaker</td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
WEEKLY PREVENTATIVE MAINTENANCE

Perform the following preventative maintenance procedures every week:

Perform a Temperature Profile

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>WINCON Online Help</td>
</tr>
</tbody>
</table>

If your equipment is used to process a variety of products, establish a profiling schedule so that each process can be examined periodically. Refer to WINCON Online Help.

Examine and Adjust Conveyor Belt Tracking

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
</table>
| Special Tools:      | • Measuring tape  
                     | • Rubber gloves   
                     | • Protective clothing |
| Related Documents:  | None   |

To examine conveyor belt tracking:

1. Remove applicable access panels. Refer to page 7-4, Removing Access Panels.

2. Make sure the furnace frame is level and adjusted.

3. Make sure both the process chamber and the hearth line are aligned, straight, and cleared of obstructions.
   - With a tape measure, examine and make sure that the process chamber and hearth line are centered with the frame.
   - Make sure the hearth line is clean and is not damaged.

4. Make sure the entrance and exit tables are aligned with the hearth line.

5. Make sure both idler pulley (entrance) and drive pulley (exit) are perpendicular to the direction of belt travel. Belt travel must be centered between the belt guides and process chamber walls as it passes through the furnace.
   - There are two sets of conveyor belt guides, one set is located on top of the entrance table and the other set is located on top of the exit table. Belt tracking should be adjusted so that the conveyor belt is centered as it travels through both sets of guides.
   - The belt guides are adjusted at the factory and require no further adjustments.

6. Make sure the belt is unobstructed as it passes through the under-frame and drive:
   - Belt is centered and not touching sides.
• Return rollers are not damaged. Rollers are used under the furnace to return the belt to the entrance table. Rollers must be perpendicular to the direction of belt travel. If not, the belt travels in the direction the roller is positioned.
• The belt catenary is in the correct position and does not touch the bottom of the frame, or the bottom or sides of the ultrasonic belt cleaner.

NOTE: The length of the catenary is important to the life of the belt, rollers, and belt cleaner. Do not let the belt touch the furnace frame or the belt cleaner tank. Belt length increases when it becomes hot and shortens as it cools.

7 Make sure the drive is adjusted correctly.

CAUTION!

Do not adjust pressure pulley position with different spring compressions. If the belt slips, increase both sides half a turn and examine again. Because the belt is always being heated and cooled, it is very soft. Too much spring compression causes the loops to flatten and can cause the belt to increase in length or to become deformed.

Be sure to adjust the compression springs under full furnace load. Spring tension should be adjusted to the minimum that does not allow the conveyor belt to slip.

• At the exit end, examine the compression springs to make sure they are adjusted the same on both sides. Refer to Figure 7-2. The pressure pulley must be tight against the drive pulley to pull the loaded belt correctly.
• Make sure all fasteners are tight.
• Make sure the drive chain is not loose and is adjusted correctly.

CAUTION!

Do not apply too much tension to the compression spring assemblies. Too much tension can cause damage to the belt and the drive and pressure roller. Springs should be adjusted to the minimum that does not allow the conveyor belt to slip.

Adjust the belt tracking as follows:
1 Operate the drive slowly until the furnace drive is in usual operation.

NOTE: Do not load the belt or operate the heaters.

2 Operate the drive at full speed.

NOTE: Tracking is dependent upon setup to the point that if the setup is correct then the tracking is correct. When the unit needs an adjustment, shut off the drive, do the adjustment and restart the drive to examine. It is not uncommon to return to the setup instruction on occasion to make adjustments and then proceed.
Adjust tracking at exit table. The tracking adjustment, located in the exit table, moves one side of the drive pulley forward or backward. This is the only adjustment needed at the exit table.

a  Shut off the drive.
b Loosen the mounting bracket nuts (11) and adjust the two belt tracking adjustment nuts (17). See Figure 7-2.
   • Move the adjustable mounting bracket to the rear to move the belt to the adjustment side.
   • Or, move the adjustable mounting bracket forward to move the belt away from the adjustment side.

   c Start the drive and observe tracking at the exit end of the furnace.
      • Observation must be at the exit end of the furnace.
      • Observation of the belt at the entrance table is not related to what happens at the exit end.

4 Adjust tracking at the entrance table. Belt tracking at the entrance is dependent on the perpendicularly of the return rollers (Figure 7-2) to the line of belt travel.
   a Shut off the drive.
   b Return rollers are mounted on a 90 to 120 cm (3 to 4 ft.) tray, which is attached by clamps. Install or remove shims from under the clamps to center the tray within the furnace frame. This adjusts the rollers relative to the belt and sends the belt in the correct direction.
   c Start the drive and observe tracking at the entrance end.

5 The adjustment is complete when:
   a When the drive operates for several hours without incident, set the furnace to operating temperature and load product.
   b Monitor belt tracking for the first few hours of operation.
   c Make necessary adjustments. However, there must be sufficient time to observe the results of any adjustment before processing product with the furnace.
Backup WINCON Files

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>None</td>
</tr>
<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>WINCON Online Help</td>
</tr>
</tbody>
</table>

Backing up WINCON system files will protect both your process related data and equipment configuration data. BTU recommend you backup your data on a weekly basis or when you make system changes to WINCON such as recipe, security, scheduler, data set or system event changes etc.

**NOTE:** Configuration (.CFG) files contain critical information necessary to operate the equipment. Do not edit these files outside of WINCON, or the equipment will become inoperable.

Each configuration is unique and should never be used on other equipment.

Shut down WINCON before copying these files.

WINCON files are located in C:\Wincon folder. Backup the following WINCON files weekly.

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>*.rcp</td>
<td>All files ending in .rcp</td>
<td>WCDCDB.MDB</td>
<td>Data Collections Database</td>
</tr>
<tr>
<td>ICMO1888.CFG</td>
<td>Intellimax Calibration data; each ICM file is unique (ICMxxxxxx.CFG).</td>
<td>WINCON.ODB</td>
<td>Data Set and Event details</td>
</tr>
<tr>
<td>SCHEDULE.CFG</td>
<td>Recipe scheduling details</td>
<td>monitor.wmf</td>
<td>Monitor Graphic background</td>
</tr>
<tr>
<td>monitor.INI</td>
<td>Defines Monitor Graphic layout</td>
<td>WCSDB.MDB</td>
<td>Operator Security records and Access Levels</td>
</tr>
<tr>
<td>RECIPE.ACT</td>
<td>Active Recipe information</td>
<td>SYSTEM.cfg</td>
<td>Equipment specific configuration</td>
</tr>
</tbody>
</table>

WINCON files are located in C:\Wincon folder. Backup the following WINCON files weekly.
MONTHLY PREVENTATIVE MAINTENANCE

Perform the following preventative maintenance procedures every month:

Examine Conveyor System

Refer to Table 7-4.

### Table 7-4: Inspect Conveyor System

<table>
<thead>
<tr>
<th>Item</th>
<th>Problem</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance and exit pulleys</td>
<td>Not level</td>
<td>Refer to page 7-19, Align Entrance and Exit Pulleys.</td>
</tr>
<tr>
<td>Belt pins</td>
<td>Not joined correctly</td>
<td>Replace the belt pins.</td>
</tr>
<tr>
<td>Rollers</td>
<td>Not level and/or perpendicular to belt line, and flanges have damage</td>
<td>Adjust and/or replace the rollers and/or flanges.</td>
</tr>
<tr>
<td>Belt catenary</td>
<td>Belt touches furnace or ultrasonic belt cleaner</td>
<td>Shorten the conveyor belt. Refer to page 7-17, Clean Conveyor System.</td>
</tr>
</tbody>
</table>

**NOTE:** Examine the oil level in the drive motor must periodically. Examine the level more often if you think that there is a leak.

| Gear reducer                | Low oil level                                                          | Add oil. Refer to page 7-24, Fill Drive Motor Gearbox with Oil.       |

**NOTE:** The rate of wear in the drive motor brushes is related to the motor speed and amount of load. If the brushes are below the limits, the motor commutator could be damaged.

| Drive motor brushes         | Wear to 5 mm (0.20 in.) or less.                                       | Replace the drive motor brushes. Refer to page 7-26, Replace Drive Motor Brushes. |

**NOTE:** Operate the conveyor system at an average speed for a few minutes or until the belt has completed at least three or four full cycles.

Conveyor belt

- Not tracking correctly (during the cycle, the belt edge may move away from the reference point on the drum).
  - Make sure that there is a 0.9 cm (0.375 in.) gap between the belt edge and the interior of the process chamber. If the belt touches the brickwork, there will be a white residue on the belt. If there is a belt tracking problem, refer to page 7-7, Examine and Adjust Conveyor Belt Tracking.

- Defective weave in the belt that can interfere with correct belt travel.
  - Stop the belt and correct the problem. If the belt is damaged near one of the ends, remove that portion of the belt and replace it with some of the surplus belt shipped with the furnace. If there is a belt tracking problem, refer to page 7-7, Examine and Adjust Conveyor Belt Tracking.

- Twists or has too much side-to-side movement
  - Stop the belt and correct the problem. If there is a belt tracking problem, refer to page 7-7, Examine and Adjust Conveyor Belt Tracking.

- Touches an item that prevents smooth operation (belt does not need to be centered through the vestibules, as long as there is clearance between the belt and vestibule walls)
  - Stop the belt and correct the problem. If there is a belt tracking problem, refer page 7-7, Examine and Adjust Conveyor Belt Tracking.

- Not tracking correctly, defective belt, touches other parts of the furnace
  - Adjust the belt tracking. Refer to page 7-7, Examine and Adjust Conveyor Belt Tracking. Make sure that there is 0.9 cm (0.375 in.) between belt edge and muffle wall.
Examine and Shorten the Conveyor Belt

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Conveyor belt</td>
</tr>
<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>None</td>
</tr>
</tbody>
</table>

All conveyor belts stretch after a period of extended use. The length can change with temperature. If the belt touches the bottom of the furnace (or the bottom of the ultrasonic belt cleaner) it must be shortened.

To shorten the conveyor belt:

**DANGER!**

ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

**WARNING!**

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

2. Let the furnace fully cool.

3. Remove applicable access panels. Refer to page 7-4, Removing Access Panels.

**NOTE:** Do not remove the belt from the furnace.

4. Stand at the furnace entrance.

5. Make a new belt connection splice by cutting the weld at the ends and removing the splice pin. Pull it out from the side with the bead attached. Keep the splice. Refer to Figure 7-3.

6. When you cut the belt, leave sufficient belt for a catenary. (The belt must not touch the bottom of the furnace (or the bottom of the ultrasonic belt cleaner.)

7. With wire cutters, remove the necessary amount of belt length.
   a. Cut the belt near the weld bead at the edge of the belt.
   b. Cut off the weld bead on one side.
   c. Leave the weld bead on the other side to match the belt splice.
8 Overlap and join the two ends of the belt using the splice.
   a  Make sure that one joined spiral is left-hand and that the other is right-hand.
   b  Insert the splice from the end without the bead.
   c  Make sure that you join a left-hand spiral to a RH spiral.
   d  If you join a left-hand and a left-hand spiral, the belt can walk from side to side.

9 Examine the conveyor belt and splice. Make sure the belt does not touch anything except the return rollers.

10 If maintenance is complete, remove the lockout/tagout. Refer to page 2-10, Lockout / Tagout Procedure.

11 Operate the belt slowly. Make sure that the belt is tracking correctly.

12 Catenary length is important to the life of the belt, rollers, and belt cleaner. Do not let the belt touch the furnace frame or drag on the belt cleaner vessel. Remember that the belt increases in length when it is hot from the process chamber. Refer to Figure 7-3.

Figure 7-3: Conveyor Belt (Shows Splice and Direction of Travel)
Examine and Adjust Pressure Pulley Tension

There are two possible drive assembly adjustments: pressure pulley tension and alignment. If the conveyor belt tracks incorrectly at the exit end of the furnace, readjust the position of the drive roller shaft that is on the opposite side of the furnace from the drive motor. The only adjustment necessary on the drive roller assembly is the two nuts on the fixed mounting bracket of the roller tension assembly (Figure 7-4). Changing the drive roller’s shaft alignment may change the spring tension on the pressure roller; therefore, check the pressure roller tension.

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Tools:</td>
<td></td>
</tr>
<tr>
<td>- Ruler or tape measure</td>
<td></td>
</tr>
<tr>
<td>- Open end wrenches</td>
<td></td>
</tr>
<tr>
<td>Related Documents:</td>
<td>None</td>
</tr>
</tbody>
</table>

![Figure 7-4: Drive Tension Assembly](Viewed from Opposite the Drive Side)

**To check and adjust the pressure roller tension:**

**CAUTION!**

Avoid applying excessive pressure pulley tension. Overtightening the spring tension does not help conveyor belt alignment and can damage the belt. The compression springs on both sides of the furnace should have equal tension.

Normally, it is not necessary to change the spring tension because it has been preset for the proper tension at the factory. If the pressure pulley tension is too loose, the belt will slip under load, and the compression springs should be equally tightened.

1. Run the conveyor belt through two or three complete cycles to let it stabilize.
Perform the lockout / tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

Remove the side panels from the exit table. Refer to page 7-4, Removing Access Panels.

Measure and compare the width of the tension spring on both sides of the furnace, which is the distance between the two washers on the tension spring (Figure 7-4).

Tighten the pressure pulley tension springs equally on both sides of the furnace as follows:

a. Unlock the two tension locknuts on each side.

b. Tighten the two tension locknuts equally on each side only a little more than necessary to prevent the belt from slipping under a heavy load.

If the springs are not equal width, adjust the tension lock nuts until the springs are equal length.

Lock the locknuts together.

Remove the lockout / tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.

Turn on the power to the furnace, and run the conveyor belt through two or three complete cycles to let it stabilize.

Check the conveyor belt alignment at the exit end, and if necessary, adjust the drive roller. Refer to page 7-19, Align Entrance and Exit Pulleys.

If the alignment is OK, close and latch the access panels. Refer to page 7-4, Removing Access Panels.

Examine equipment operation.
Clean External Surfaces

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
</table>
| Special Tools:      | • Vacuum  
                      • Lint-free wipes  
                      • Soapy water  
                      • Rubber gloves  
                      • Protective clothing |
| Related Documents: | None |

**CAUTION!**
Contamination collects on the equipment when it is shipped. Contamination can get into the equipment and cause damage or an electrical problem. Do not use compressed air to remove contamination.

To clean the external surfaces:
1. With a vacuum cleaner, clean the external surfaces.
2. With lint-free wipes and soapy water, clean the external surfaces.

Clean Conveyor System

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>None</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Vacuum  
                      • 10% isopropyl alcohol/90% H₂O  
                      • Rubber gloves  
                      • Protective clothing |
| Related Documents:  | Lockout / Tagout Procedure (page 2-10) |

To clean the conveyor system:

**DANGER!**
**ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!**

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.
2 Let the furnace fully cool.
3 Remove applicable access panels. Refer to page 7-4, Removing Access Panels.
4 With a vacuum cleaner, clean the belt, the belt rollers, and the drive shafts.
5 With lint free wipes and a cleaning solution (10% isopropyl alcohol / 90% water), clean the belt, the belt rollers, the drive shafts (including the polished drive shafts that the bearings move on).
6 Dispose of hazardous materials. Refer to page 2-14, Disposal of Equipment.
7 Install the access panels. Refer to page 7-4, Removing Access Panels.
8 If maintenance is complete, remove the lockout/tagout. Refer to page 2-10, Lockout / Tagout Procedure.
9 Examine equipment operation.

**WARNING!**

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

---

**Figure 7-5:** Conveyor System Locator (Typical)
Align Entrance and Exit Pulleys

Procedure Category: | Type 1
Parts Referenced: | None
Special Tools: | • Rubber gloves  
              • Protective clothing
Related Documents: | Lockout / Tagout Procedure (page 2-10)

NOTE: Adjustment is set by the alignment of the entrance to exit pulleys, which are factory-set. Refer to Figure 7-6. Belt and pulley condition affects belt tracking.

To align the entrance and exit pulleys:

**DANGER!**

ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

**WARNING!**

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

2. Let the furnace fully cool.
3. Remove the access panels on the entrance and exit tables.
4. Measure the distance from the edge of the entrance pulley to the edge of the exit pulley on the both sides of the pulley. All dimensions must be equal. Refer to Figure 7-6.
5. Adjust the belt guides at the entrance end, if necessary.
   • The belt guides are set at the factory and normally require no adjustment.
   • The conveyor belt should be centered between both the entrance and exit belt guides and should not touch the walls of the process chamber.
6. Adjust the drive pulley assembly at the exit end.
7. Install access panels. Refer to page 7-4, Removing Access Panels.
8. If maintenance is complete, remove the lockout/tagout. Refer to page 2-10, Lockout / Tagout Procedure.
**Test Furnace Interlocks**

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>None</td>
</tr>
<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>None</td>
</tr>
</tbody>
</table>

For safety purposes periodically test all the interlocks in the system to make sure they operate correctly.

**To test furnace interlocks:**

When the system is in operation (gas, heaters, exhaust blowers, and other options all energized), test all the interlocked devices for correct operation. Refer to **Appendix A: DRAWINGS, SPECIFICATIONS & OPTIONS**.
QUARTERLY PREVENTATIVE MAINTENANCE

Perform the following preventative maintenance procedures every three months:

Examine and Lubricate the Drive Chain and the Drive Chain Sprockets

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
</table>
| Special Tools:      | • Cleaning solution (10% isopropyl alcohol / 90% H₂O)  
|                     | • Soft, bristle brush  
|                     | • General purpose gear / chain lubricating oil  
|                     | • Rubber gloves  
|                     | • Protective clothing |
| Related Documents:  | WINCON Online Help |

To lubricate the drive chain and drive chain sprockets (Figure 7-7):

DANGER!

ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

WARNING!

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

2. Let the furnace fully cool.

3. Remove applicable access panels at the exit end of the furnace.

4. Examine the drive chain and drive chain sprockets.
   a. Make sure the chain and sprockets are aligned correctly with one another.
   b. Make sure the set screws that attach the sprockets are tight.
   c. If necessary, using an Allen wrench, loosen the set screws that attach the sprockets; align the chain and sprockets with one another; then tighten the set screws.

5. Using lint-free wipes and a cleaning solution (10% isopropyl alcohol / 90% water), clean the drive chain and associated sprockets. Remove old lubricant and accumulated debris from the chain and associated sprockets.

6. Using a soft-bristle brush, apply lubricant to the drive chains and associated sprockets. Apply lubricant to all sides of the chains.
7 Install the access panel covers.

8 Dispose of hazardous materials. Refer to page 2-14, Disposal of Equipment.

9 If maintenance is complete, remove the lockout/tagout. Refer to page 2-10, Lockout / Tagout Procedure.

10 Examine equipment operation.

**Figure 7-7**: Lubricate the Drive Chain and Drive Chain Sprockets
Examine and Adjust Drive Chain Tension

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>None</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Tape measure  
                     • Straight edge  
                     • Rubber gloves  
                     • Protective clothing |
| Related Documents:  | Lockout / Tagout Procedure (page 2-10) |

**NOTE:** Adjustment is set by the alignment of the entrance to exit pulleys, which are factory-set. Refer to Figure 7-6. Belt and pulley condition affects belt tracking.

To adjust the drive chain tension:

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

2. Let the furnace fully cool.

3. Remove applicable access panels. Refer to page 7-4, Removing Access Panels.

4. Examine the drive chain for signs of wear.
   a. Look for loose chain links. Tighten loose chain links.
   b. Look for worn chain links, especially where the sprockets engage the chain links. Replace worn chain links or the entire chain. Refer to page 8-5, Replace the Drive Motor Chain.

5. Put a straightedge across the chain sprockets and make sure that the drive chain sprockets are aligned. If the sprockets are not aligned, make the correct sprocket adjustments before you adjust the chain tension.

6. Examine the tension of the drive chains. There must be 6 mm (0.25 in.) of slack.
   a. If chain tension and adjustment are correct, no adjustment is necessary.
b If the chain tension is incorrect, adjust it as follows:
   • Loosen the motor/gear reducer mounting screws.
   • Keep the sprockets adjusted.
   • Move the gear reducer until the chain tension and adjustment is correct.
   • Slightly tighten the gear reducer mounting screws.
   • Put the gear reducer in position so that drive chain tension and adjustment are correct. Hold it in position while you tighten the mounting screws.

7 Remove the lockout/tagout. Refer to page 2-10, Lockout / Tagout Procedure.

8 Energize and operate the conveyor system.
   a The drive system must operate correctly.
      • If chain tension is too loose, the chain jumps
      • If chain tension is too tight, the chain clicks or makes straining noises
   b Adjust the chain tension if necessary.

9 Install the access panels. Refer to page 7-4, Removing Access Panels.

10 Examine equipment operation.

---

**Fill Drive Motor Gearbox with Oil**

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
</table>
| Parts Referenced:   | • 4111 Metalicoil (Hodson Corporation) (gear reducer/motor combination integrated in the same housing)  
                      • Mobil 600W Extra Hecia Super  
                      • AGN4A-47 Oil (Motor/worm gear reducer combination, separate housings)  
                      • No. 8 Oil (Motor/worm gear reducer combination, separate housings) |
| Special Tools:      | • General purpose gear/chain lubricant  
                      • Rubber gloves  
                      • Protective clothing |
| Related Documents:  | WINCON Online Help |

To fill the drive motor with oil:

**DANGER!**

ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1 Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.
2 Let the furnace fully cool.
3 Remove applicable access panels at the exit end of the furnace.
4 Remove the fill plug (Figure 7-8).
5 Fill the drive motor to the fill line with the recommended gear oil.
6 Install the fill plug.
7 Install the access panel covers.
8 Dispose of hazardous materials. Refer to page 2-14, Disposal of Equipment.
9 If maintenance is complete, remove the lockout/tagout. Refer to page 2-10, Lockout / Tagout Procedure.
10 Examine equipment operation.

WARNING!
Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

Figure 7-8: Fill the Drive Motor with Oil
SEMI-ANNUAL PREVENTATIVE MAINTENANCE

Perform the following preventative maintenance procedures every six months:

Replace Drive Motor Brushes

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Motor Brush (Refer to Appendix B: RECOMMENDED SPARE PARTS.)</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Rubber gloves  
                     • Protective clothing |
| Related Documents:  | Lockout / Tagout Procedure (page 2-10) |

To replace the drive motor brushes:

**DANGER!**

ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

**WARNING!**

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

2. Let the furnace fully cool.

3. Remove applicable access panels. Refer to page 7-4, Removing Access Panels.

4. Remove one motor brush at a time from the motor. Record the position so that you can install it into the same position. Refer to Figure 7-9.

5. Examine the brush wear line.
   
   a. If the brush is in good condition, install the brush in the same position as when it was before it was removed.
   
   b. If the brush is worn (wear to 5 mm (0.20 in.) or less), install a new brush. The orientation of the new brush is not important. It will put itself in the correct position.

6. Examine equipment operation.

7. Dispose of hazardous materials. Refer to page 2-14, Disposal of Equipment.
To lubricate the idler pulley bearings:

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>None</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Cleaning solution (10% isopropyl alcohol / 90% H₂O)  
                      • Lint-free wipes  
                      • Grease gun  
                      • Lubricating grease (EP-1)  
                      • Rubber gloves  
                      • Protective clothing |
| Related Documents:  | Lockout / Tagout Procedure (page 2-10) |

**DANGER!**

ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1 Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.
2 Let the furnace fully cool.

3 Remove the access panels from the entrance table to gain access to the idler pulley bearings. The idler pulley bearings are located at both ends of the pulley shaft.

4 Using lint-free wipes and a cleaning solution (10% isopropyl alcohol / 90% water), clean the idler pulley bearings and the grease fittings on the pillow blocks.

5 Using a grease gun and general purpose lubricating grease, apply enough lubricant to each grease fittings until lubricant seeps out along the bearing block.

6 Using lint-free wipes, remove all excess lubricant from the bearing block grease fitting and bearing block. This prevents dirt accumulation.

7 Install the access panel covers.

8 Dispose of hazardous materials. Refer to page 2-14, Disposal of Equipment.

9 If maintenance is complete, remove the lockout/tagout. Refer to page 2-10, Lockout / Tagout Procedure.

10 Examine equipment operation.

---

**WARNING!**

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

---

**Figure 7-10:** Lubricate the Idler Pulley Bearings (Entrance Table)
ANNUAL PREVENTATIVE MAINTENANCE

Perform the following preventative maintenance procedures yearly

Verify Intellimax Calibration

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
</table>
| Special Tools:      | • Calibrated thermocouple simulator  
                     • Wiring harness for all Intellimax channels using copper wire  
                     • Calibrated digital voltmeter to measure the voltage at Intellimax/harness terminal block  
                     • The original Intellimax calibration values (located in Appendix D of the BTU System Manual for your furnace) |
| Related Documents: | WINCON Online Help |

Periodically test and verify the Intellimax calibration through WINCON. Refer to Intellimax Calibration in WINCON Online Help for procedures.

For electrical component layout, refer to Appendix A: DRAWINGS, SPECIFICATIONS & OPTIONS.

Clean the Exhaust Ducts

After a long period of extended use, the exhaust ducts may accumulate a coating of residue process materials and dust. Cleaning the exhaust ducts may require disassembling or replacing the sections. If it is impractical to clean the ducts, replace them.

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
</table>
| Special Tools:      | • Rags, wipes, brushes or other suitable application materials  
                     • Methanol (methyl alcohol), ethanol (denatured alcohol), or isopropyl alcohol  
                     • Strong commercial detergent cleaner or furnace cleaner (for removing greasy, oily, or carbonaceous soils or resins from furnace parts)  
                     • Methanol (methyl alcohol), or ethanol (denatured alcohol), or isopropyl alcohol (for cleaning resin from the furnace components)  
                     • Rubber gloves and protective clothing |
| Related Documents: | Lockout / Tagout Procedure (page 2-10) |
To clean the exhaust ducts:

1. Turn off all power to the furnace and allow it to cool. (See flash point of any solvents to be used in the MSDS sheets for the solvent.)

2. Disassemble the duct sections and place them in a well ventilated area to be cleaned.

3. Using rags or other application materials dampened with cleaning solvent, clean the interior of the ducts.

4. Dispose of cleaning solutions, chemicals and associated application materials such as rags, wipes and brushes. Refer to the appropriate MSDS warning sheet. Also refer to all local, state, and federal regulations for disposal of these items.

5. Reassemble the exhaust ducts.

6. Test and readjust the exhaust flow to your furnace needs (see page 7-32, Test Exhaust).

Empty Exhaust Traps

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>None</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Rubber gloves  
|                     | • Protective clothing |
| Related Documents:  | Lockout / Tagout Procedure (page 2-10) |

The In-Line Diffusion furnace is equipped with an exhaust trap below each exhaust stack. The exhaust traps collect contaminants from the exhaust as it is expelled from the furnace. Venturis on the stacks assist in directing the gas flow up and out of the furnace gas stacks into the facility ducts.
To clean the exhaust traps:

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

2. Let the furnace fully cool.

3. Remove the exhaust traps from the furnace. Each exhaust stack is held in place by a clamp.

4. Empty the trap. Dispose of the contents in a responsible manner, according to local and state laws for the disposal of hazardous material.

5. With lint-free wipes soaked in water, clean the interior of the traps.

6. Install the exhaust traps onto the furnace.

7. If maintenance is complete, remove the lockout/tagout. Refer to page 2-10, Lockout / Tagout Procedure.

---

**DANGER!**

**ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!**

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

---

**WARNING!**

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.
8 Test and adjust the exhaust flow as necessary.

To test the exhaust:

Using a manometer, check that the exhaust system is drawing properly to expel effluents. Refer to the Installation Drawing, located in Appendix A: DRAWINGS, SPECIFICATIONS & OPTIONS, for the estimated effluent flow expected with this furnace.
AS REQUIRED MAINTENANCE

Perform the following preventative maintenance procedures as required.

Clean Ultrasonic Belt Cleaner Tank

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>None</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Rubber gloves  
|                     | • Protective clothing |
| Related Documents:  | None   |

The ultrasonic belt cleaner (USBC) is used to clean irregular surfaces of the conveyor belt. The USBC uses sound to agitate a tank of water, which rinses deposits from the belt. Periodically clean the tank by flushing the system a few times.

To clean the ultrasonic belt tank [Option]:

1. Let the furnace fully cool.

2. Remove applicable access panels. Refer to page 7-4, Removing Access Panels.

3. Flush the ultrasonic belt cleaner tank a few times:
   a. Turn on the ultrasonic belt cleaner. The tank fills.
   b. Turn off the ultrasonic belt cleaner. The tank drains.

![Figure 7-12: Ultrasonic Belt Cleaner Tank Location](image)
Reset a Circuit Breaker

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>None</td>
</tr>
<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>None</td>
</tr>
</tbody>
</table>

To reset a circuit breaker:

1. Remove applicable access panels. Refer to page 7-4, Removing Access Panels.
2. Find the cause of the fault. Do the necessary repairs.
3. Reset the tripped circuit breaker as follows:
   a. For button-type circuit breakers, press in the button.
   b. For switch-type circuit breakers, set the circuit breaker to the OFF position and then to the ON position.
4. Start the furnace. Refer to page 3-7, paragraph 3.5, Start and Operate.
5. Examine equipment operation.

Verify and Calibrate Conveyor Speed

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Tools:</td>
<td>Ruler</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>WINCON Online Help</td>
</tr>
<tr>
<td>Exit Criteria:</td>
<td>The speed of the conveyor belt is calibrated.</td>
</tr>
</tbody>
</table>

The conveyor is calibrated at the factory before shipment. Verification and calibration (if required) should be performed after any work on the drive system or as part of a periodic maintenance check.

To verify the conveyor speed, you will need to time an object as it travels over a specific distance and compare the results to the belt speed in WINCON.

To verify conveyor speed:

1. Set the belt speed in the WINCON main screen (Monitor Graphic).
2. Determine measurement length. Refer to Figure 7-13.
3 Place an object that will not melt on the conveyor belt.

4 Using a stop watch, measure the time required for the object to travel the measured distance.

5 Calculate the results in inches or mm / minute and compare the results with the conveyor speed in WINCON.

To calibrate the conveyor belt speed:

**NOTE:** Note that during calibration the system will be in Setup Mode. This calibration procedure uses the *Conveyor Configuration* page in WINCON (Config >System > Conveyor Speed).
1. Open the Conveyor Configuration page (Config > System > Conveyor Speed) in WINCON (Figure 7-14).

2. Enter 50 as the percentage of speed in the Power field. This provides a set stable power output to the controller for calibration.

3. Click on the STOP button to stop the conveyor.

**CAUTION!**

**EQUIPMENT DAMAGE!**

To prevent damage to the conveyor, avoid leaving the conveyor stopped for more than a few minutes if the equipment is hot.

4. Place product (or something that will not melt) on the conveyor.

5. Click on the START button to get the conveyor moving.

6. Allow the conveyor to run the maximum measurable distance then click on the STOP button to stop the conveyor.

7. Measure the exact distance the conveyor traveled and enter this value in the Distance field, you must enter the distance in the length units that are displayed. e.g., in the example above the length units are Inches, so we would enter the distance traveled in Inches.

8. Click Calculate to calculate the Pulses per Unit. The value may change.

9. Click the Save button, to save and store the new calibration number. If the Save button is not visible, select Button Bar from the Window pull-down menu.

10. Click the AUTOMATIC button to return to normal operation.

11. Close the Conveyor Configuration page.

**Calibrate Conveyor Belt Motion**

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Tools:</td>
<td>Tape Measure</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>WINCON Online Help</td>
</tr>
<tr>
<td>Exit Criteria:</td>
<td>Drive Pulses Per Motion Pulse and Drive Pulse Tolerance counts are updated with the new calibration numbers.</td>
</tr>
</tbody>
</table>

The Conveyor Motion is calibrated at the factory before shipment. The following procedure should be performed after any work on the drive system, any changes to the conveyor speed configuration setup, or as part of a periodic maintenance check. For a complete theory of operation, refer to WINCON Online Help.
To Calibrate the Conveyor Motion:

1. The Conveyor Speed must be calibrated first, and should be set to the fastest speed before proceeding with the Conveyor Motion calibration. The conveyor speed should not be adjusted during calibration. Refer to page 7-34, Verify and Calibrate Conveyor Speed.

**NOTE:** During calibration or if calibration fails, the system will be in Setup Mode. The Setup Status Dialog displays the calibration state as either “Calibrating” or as “Not Calibrated” if calibration fails.

This calibration procedure uses the Conveyor Motion Configuration page in WINCON (Config > System > Conveyor Motion). System Administrator or Factory Service level access is required to modify this page.

2. Open the Conveyor Motion Configuration page (Config>System> Conveyor Motion) in WINCON (Figure 7-15).

3. Verify you are getting Drive Pulses Per Motion Pulse, both current and previous. If the current count is not changing then the conveyor in either not on or has a problem and this needs to be resolved before calibrating. If the previous count is not changing then there is a problem with the conveyor motion signal and this needs to be resolved before calibrating. Refer to WINCON Online Help if either of these conditions occur.

4. Make sure the Calibration Cycle Count is correct, typically set to the number of teeth on the sprocket.

5. Click the Calibrate Button. The calibration state changes to calibrating.

6. After the Calibration cycle count completes the system is calibrated, the Drive Pulses Per Motion Pulse and Drive Pulse Tolerance counts are updated with the new calibration numbers.
7 Click **Save** to save the new settings. If the Save button is not visible, select **Button Bar** from the **Window** pull-down menu.

8 Verify that **Calibrated** appears in the **Calibrated State** field on the **Conveyor Motion Configuration** page.

9 Close the **Conveyor Motion Configuration** page.

### Replace the Air / Gas Filters

The In-Line Diffusion furnace does not have any internal air / gas filters. BTU International strongly recommends installing a pressure regulator and filter in all gas / air supply lines before connection to the furnace. To maintain the filters, periodically replace the filter elements. Refer to page 4-5, **CDA and Nitrogen Requirements**.

### Calibrate the O₂ Analyzer with Calibrated Gas [Option]

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>None</td>
</tr>
<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>None</td>
</tr>
</tbody>
</table>

**NOTE:** One calibration gas cylinder is needed to set the span. To examine the span or to adjust the span, use a calibration gas with an O₂ content between 10 and 90 percent of the range on a single range instrument, or between 10 and 90 percent of the middle range on a multi-range instrument. Use a gas similar to the sample gas that has an O₂ content that approximates either the expected O₂ limit of level to be monitored.

To calibrate the O₂ analyzer:

1 Operate the O₂ analyzer for at least eight hours to make sure that there will be a stable reading.

2 Select a certified cylinder of appropriate background gas in which the O₂ content has been accurately determined. Use a thoroughly purged regulator on the cylinder.

3 Energize the O₂ analyzer. Set a flow rate of 2.0 scfh.

4 Monitor the response of the O₂ analyzer to the certified gas until you get a stable reading. Use a recorder to make sure that the sensor has reached an equilibrium point.

5 If necessary, reset the SPAN dial until the analyzer reading corresponds to the O₂ level listed for the certified gas cylinder. Record the SPAN dial reading.

6 For more information, refer to the O₂ analyzer manual in **Appendix E: VENDOR MANUALS**.
# Test Heater Current

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
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</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
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<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>None</td>
</tr>
</tbody>
</table>

To test the heater current:

**NOTE:** All heater wiring is labeled. Refer to Appendix A: DRAWINGS, SPECIFICATIONS & OPTIONS for the Heater Data Sheet and corresponding electrical drawings.

1. Remove the applicable access panels. Refer to page 7-4, Removing Access Panels.
2. On the Master Control Panel, set HEAT ON/OFF to **ON**.
3. Wait until the heaters are fully energized.
4. Attach an ammeter to a heater wire.
5. Compare the ammeter indication with the current ratings on the Heater Data Sheet in Appendix A: DRAWINGS, SPECIFICATIONS & OPTIONS for that heater.
6. Repeat 4 and 5 on all heater wiring. Refer to Figure 7-16.

**Figure 7-16:** Test Heater Current

1. Heater wires (attach ammeter along each wire)
2. Thermocouple housing
# CHAPTER 8
## COMPONENT REPLACEMENT

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## WARNING!

### READ!
- Read this manual in its entirety before you install, operate, troubleshoot or maintain the furnace.
- Read a procedure in its entirety before you perform it.
- Always note and take any safety precautions recommended in this manual and other documentation before you perform any procedure; otherwise, severe personal injury or equipment damage may occur.

Refer to [Chapter 1, INTRODUCTION](#) for the recommended tools.

### QUALIFIED PERSONNEL!
- Procedures include working with high amperage, high voltage and moving parts.
- Procedures must be performed by fully trained, fully qualified personnel.
- Most procedures require advanced knowledge of electrical, mechanical, and plumbing theories and issues.
- **DO NOT PERFORM THE PROCEDURE IF YOU HAVE ANY DOUBTS ABOUT HOW TO ACCOMPLISH THE TASKS INVOLVED.** Contact BTU International Customer Service; otherwise, severe personal injury or equipment damage may occur.
- If you do not obey all the safety precautions listed in this manual and any other associated documents, you risk the occurrence of death or serious injury to personnel and a cancelled manufacturer's warranty.
CONVEYOR SYSTEM

Replace the Conveyor Belt

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Tools:</td>
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<tr>
<td>Parts Referenced:</td>
<td>Replacement belt (Refer to Appendix B, RECOMMENDED SPARE PARTS.)</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>Lockout/Tagout Procedure (page 2-10)</td>
</tr>
</tbody>
</table>

To replace the conveyor belt:

**DANGER!**

ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

2. Disassemble the connector clip and master link from the drive chain (Figure 8-4), and remove the chain.

3. Remove the entrance and exit curtains.

**NOTE:** When replacing the conveyor belt, two people are required.

4. Place the rolled up belt at the entrance end of the furnace and orient.

5. Cut the old belt and securely attach the leading edge of the new belt to the old belt.

6. Carefully pull the belt through the furnace from the exit end, while an assistant unrolls and guides the belt into the furnace (Figure 8-1).
7 When the belt has been pulled through the furnace chamber, continue pulling the belt through the drive system, until the belt path is complete, as shown in Figure 8-2. Be sure the catenary weight is positioned approximately 3-in. above the frame.

A catenary is an unsupported length of conveyor belt that forms a sagging loop. The purpose of the catenary loop is to absorb belt length variations due to thermal expansion and load changes. In the In-Line Diffusion furnace, a weight is installed in the catenary for belt tracking. The belt catenary hangs inside the ultrasonic cleaner at the exit end of the furnace.

8 Splice the belt, as shown in Figure 8-3.

9 Install the drive chain.

10 Install the entrance and exit curtains.

11 If maintenance is complete, remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.

12 Examine equipment operation:

   a  Operate the belt slowly.

   b  Make sure the belt tracks correctly.
Replace the Drive Motor Chain

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Drive Chain (Refer to Appendix B, RECOMMENDED SPARE PARTS.)</td>
</tr>
<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>None</td>
</tr>
</tbody>
</table>

To remove the drive motor chain:

1. Remove access panels from the exit table. Refer to page 7-4, Removing Access Panels.
2. Disassemble the connector clip and master link from the drive chain (Figure 8-4), and remove the chain.

![Figure 8-4: Connector Clip](image)

To install the drive motor chain:

1. Position the replacement chain over the drive pulley and drive motor sprockets.
2. Connect the two ends together using a master link and connector clip.
3. Examine chain tension and adjust as required. Refer to page 7-23, Examine and Adjust Drive Chain Tension.
4. Install access panels. Refer to page 7-4, Removing Access Panels.
5. Operate the drive motor and examine equipment operation.
Replace the Drive Motor

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Drive Motor</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Wrench  
                       • Rubber gloves  
                       • Protective clothing |
| Related Documents:  | Lockout / Tagout Procedure (page 2-10) |

To remove the drive motor:

**DANGER!**

**ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!**

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

**WARNING!**

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

2. Let the furnace fully cool.
3. Remove access panels from the exit table. Refer to page 7-4, Removing Access Panels.
4. Remove the connector clip and master link from the motor drive chain (Figure 8-4).
5. Remove the chain.
6. Disconnect the wires from the motor.
7. Remove the mounting bolts that secure the motor to the exit table frame (Figure 8-5).
8. Remove the motor.
9. Disassemble and remove the drive sprocket assembly from the motor shaft.
NOTE: The new drive motor has an optical encoder that is factory adjusted. Additional adjustments are not necessary.

To install the replacement motor:

1. Install the sprocket assembly onto the replacement motor’s drive shaft.
2. Place the replacement motor in position and install the mounting bolts.
3. Install the drive chain. Refer to page 8-5, Replace the Drive Motor Chain.
4. Connect the drive motor and optical encoder wires.
5. Examine the sprocket/chain adjustment and adjust if necessary. Refer to page 7-23, Examine and Adjust Drive Chain Tension.
6. Fill the motor with oil. Refer to page 7-24, Fill Drive Motor Gearbox with Oil.
7. Remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.
8. Operate the drive motor and examine the direction of travel. If the direction is not correct:
   a. Examine the installation for defective wire connections and correct as required.
   b. Operate the drive motor and examine equipment operation.
9. Install the access panels. Refer to page 7-4, Removing Access Panels.
Replace the Drive Motor Optical Encoder

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Drive Motor Optical Encoder</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Rubber gloves  
|                     | • Protective clothing |
| Related Documents:  | Lockout / Tagout Procedure (page 2-10) |

To remove the drive motor optical encoder:

**DANGER!**

ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

**WARNING!**

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

2. Let the furnace fully cool.

1. Remove access panels from the exit table. Refer to page 7-4, Removing Access Panels.

2. Disconnect the optical encoder wiring connector.

3. Refer to manufacturer instructions (Appendix E, VENDOR MANUALS) and remove the encoder. Do not remove the extension shaft from the motor unless it is damaged.

To install the drive motor optical encoder:

1. Refer to manufacturer instructions (Appendix E, VENDOR MANUALS) and install the encoder. Install a new extension shaft if the current shaft is damaged.

2. Reconnect the optical encoder wiring connector.

3. Install the access panels. Refer to page 7-4, Removing Access Panels.

4. If maintenance is complete, remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.

5. Examine equipment operation.

6. Calibrate the belt speed. Refer to WINCON Online Help.
Replace the Drive Motor Shear Pin

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Shear pin (spare shear pins are in an envelope by the drive motor)</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Thread adhesive (removable grade)  
                      • Pliers  
                      • Drift pin punch  
                      • Light-weight hammer  
                      • Rubber gloves  
                      • Protective clothing |
| Related Documents:  | None |

NOTE: Use the correct shear pin. Usually, the shear pin block has four different sized holes and two set screws.

To remove the drive motor shear pin:

1. Remove access panels from the exit table. Refer to page 7-4, Removing Access Panels.
2. Find the cause of the belt overload and correct it. Refer to page 6-2, Troubleshoot the Conveyor System.
3. Remove the drive motor chain.
   a. Remove the connector clip.
   b. Remove the master link.
4. Using pliers or a drift pin punch and light-weight hammer, remove shear pin from the pin block and sprocket. Refer to Figure 8-6.

To install the drive motor shear pin:

1. Push the drive sprocket against the shaft collar.
2. Examine the adjustment. If the chain and sprocket are not aligned:
   a. Loosen the shaft collar set screws.
   b. Reposition the sprocket and collar.
   c. Tighten the shaft collar set screws. Use removable grade thread adhesive.
3 Push the shear pin block against the sprocket:
   a Make sure the key stock is properly installed in the keyway.
   b Tighten the shear pin block setscrews.
   c Make sure the drive sprocket rotates freely on the drive shaft with the shear pin removed.

4 Turn the sprocket until the correct shear pin hole is aligned with the shear pin hole in the block.

5 Tap in the new shear pin using a light-weight hammer. Make sure that it is tight.

6 Install the drive chain on the sprockets.

7 Install the access panels. Refer to page 7-4, Removing Access Panels.

8 Examine equipment operation.

9 Refer to Figure 8-6.
Replace Drive Return Rollers

<table>
<thead>
<tr>
<th>Procedure Category:</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Roller</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Rubber gloves  
|                     | • Protective clothing |
| Related Documents:  | Lockout / Tagout Procedure (page 2-10) |

To remove a drive return roller:

**DANGER!**

ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

**WARNING!**

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

2. Let the furnace fully cool.

3. Remove applicable access panels. Refer to page 7-4, Removing Access Panels.

4. Record the mounting hole in which the defective roller (Figure 8-7) is installed.

![Figure 8-7: Return Roller (Top View)](CONV1031)

1 Slot 2 Drive Return Roller 3 Pins (One end is spring-loaded. Press in to release.)
5 Press the spring-loaded end to release it from the furnace frame and remove the roller.

To install a drive return roller:
1 Insert the new roller and press the spring-loaded end into the same hole from which it was removed.
2 Install the access panels. Refer to page 7-4, Removing Access Panels.
3 If maintenance is complete, remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.
4 Examine equipment operation.

**ELECTRICAL AND CONTROL SYSTEM**

**Replace the Belt Speed Module**

<table>
<thead>
<tr>
<th>Procedure Category:</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
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</tr>
<tr>
<td>Special Tools:</td>
<td>• Rubber gloves</td>
</tr>
<tr>
<td></td>
<td>• Protective clothing</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>Lockout / Tagout Procedure (page 2-10)</td>
</tr>
</tbody>
</table>

**NOTE:** If you replace the belt speed module, you must replace a circuit board module in the electric cabinet.

To remove the belt speed module:

**DANGER!**

**ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!**
Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you! Perform the lockout / tagout procedure before continuing with this procedure.

1 Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

**WARNING!**

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

2 Let the furnace fully cool.
3 Remove applicable access panels. Refer to page 7-4, Removing Access Panels.
4 Record the wire connections to the belt speed module.
5 Disconnect the wires from the belt speed module.
6 Remove the screws.
7 Remove the belt speed module.

To install the belt speed module:
1 Set the potentiometers and switches of the new belt speed module to the same settings as the old belt speed module.
2 Install the new belt speed module.
3 Install the screws.
4 Connect the wires.
5 Install the tie down clips.
6 Install the access panels. Refer to page 7-4, Removing Access Panels.
7 If maintenance is complete, remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.
8 Examine conveyor operation at maximum and minimum speeds.

Replace Intellimax Controller

<table>
<thead>
<tr>
<th>Procedure Category:</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Intellimax board</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Labels  
                      • Rubber gloves  
                      • Protective clothing |
| Related Documents:  | WINCON Online Help  
                      Lockout / Tagout Procedure (page 2-10) |

**NOTE:** Only fully trained and qualified personnel shall be authorized to replace an Intellimax. If you have any questions or issues, call BTU International Customer Service.

The **Intellimax Installation Wizard** automatically configures any applicable Intellimax controller board to the furnace in which it is installed. After you have installed a new Intellimax, the Installation Wizard starts automatically, and does the following:

- Checks channel compatibility
- Checks Intellimax input and output (I/O) capability
- Verifies software compatibility
- Updates software (if available)
- Verifies and stores gain and offset data
The Installation Wizard also guides you through a read-only memory (ROM) image update when a software update is available, and if invalid calibration is detected.

To remove the Intellimax Controller:

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.
2. Remove the applicable access panels to gain access to the electrical panel.
3. Label and disconnect all connectors on the existing Intellimax. Be careful when disconnecting the connectors! Do not pull on the wires! Pulling on the wires will damage them.
4. Disconnect the Ethernet cable from the Intellimax. The Ethernet cable is located on the left-hand side of the Intellimax.
5. Using a screwdriver, loosen, but do not remove, the screws that attach the Intellimax to the electrical panel.
6. Carefully remove the Intellimax from the furnace. Lift the Intellimax up and then away from the electrical panel.

To install the Intellimax Controller:

1. Install the Intellimax in the furnace. Lower the Intellimax onto the four screws on the electrical panel.
2. Using a screwdriver, tighten the screws that attach the Intellimax.
3. Connect the connectors onto the Intellimax. Be careful when connecting the connectors! Do not use excessive force on the connectors! Excessive force will damage the connector pins.
4. Connect the Ethernet cable to the Intellimax.
5. Install all access panels.
6. Remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure. After WINCON starts, the Intellimax Wizard locates the new Intellimax control module.
7. Sign on to WINCON. After signing on, the Intellimax Wizard checks channel configuration to ensure the new Intellimax will operate properly with your furnace (e.g., the Wizard verifies that the newly installed Intellimax has the correct number of channels, 16, 32, or 48). Then the Wizard checks I/O capability and WINCON compatibility, which includes the following:
   - Checking user privileges...
• Checking channel configuration...
• Checking Intellimax software versions...

8 If there is a matching ROM image available, the ROM image will update automatically. If there is no matching ROM image available, the Wizard will provide you with options to either browse for an ROM image file, to use the most compatible available image, or use the existing image on the Intellimax (if compatible).

• Recording physical characteristics...
• Recording software version information...
• Recording calibration information...
• Set System...

9 Click Run WINCON.

NOTE: After the Intellimax has restarted, any latching circuits will need to be manually reset, i.e., the START/RESET push button.

10 On the operator control panel, press and hold the START/RESET push button for 5 seconds.

11 Examine equipment operation.
Replace the Light Tower

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Light Tower</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Rubber gloves  
                     | • Protective clothing |
| Related Documents:  | None |

To remove the light tower:

**NOTE:** If this is the first installation of the light tower, refer to the INSTALLATION DRAWING in Appendix A for the location of the light tower.

1. Remove the applicable access panels. Refer to page 7-4, Removing Access Panels.
2. Disconnect the light tower electrical connector under the top panel.
3. Loosen and remove the four nuts, washers, and screws from the light tower bottom.
4. Remove the light tower by sliding the electrical wires and connector up through the opening in the panel.

To install the light tower:

**NOTE:** The light tower is removed for shipment. The gasket is attached to the light tower.

1. Install the light tower by threading the electrical connector and wires through the panel opening. Be sure the gasket is installed.
2. Secure the light tower using the four screws, washers, and nuts.
3. Connect the light tower electrical connector.
4. Install the access panels. Refer to page 7-4, Removing Access Panels.
5. If maintenance is complete, remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.
6. Examine equipment operation.
Replace a Light Tower Bulb

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>Lockout/Tagout Procedure (page 2-10)</td>
</tr>
</tbody>
</table>

The light tower contains bayonet based lamps that are located behind the colored lenses. In order to reach one of the lower lamps, you must first remove the lenses that are above the desired lens.

To replace a light tower bulb:

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.
2. Loosen the screw on the top cover plate of the light tower, then remove the cover plate.
3. Depending on which lamp you need to replace, remove the lenses until you have accessed the desired lamp.
4. Remove the existing lamp by pushing in and turning it counterclockwise.
5. Insert the new replacement lamp by pushing it in and turning it clockwise.
6. Replace all of the lenses in the proper order.
7. Replace the cover plate and install the screw securing the cover plate on the top of the light tower.
8. Remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.
9. Examine equipment operation.
Replace the Computer

The computer is located inside the exit table.

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Computer</td>
</tr>
<tr>
<td>Special Tools:</td>
<td>• Rubber gloves</td>
</tr>
<tr>
<td></td>
<td>• Protective clothing</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>WINCON Online Help</td>
</tr>
</tbody>
</table>

To remove the computer:
1. Remove access panels from the exit table. Refer to page 7-4, Removing Access Panels.
2. De-energize the computer.
3. Label the connectors.
4. Disconnect the cables.

To install the computer:
1. Place the new computer in position inside the exit table.
2. Connect the cables.
3. Energize the computer.
4. Reinstall WINCON using the back-up disk located inside the front cover of the user manual.
5. For information on installing and connecting the computer or to configure the controller, refer to WINCON Online Help.
6. Examine equipment operation.

Replace an SSR

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>• SSR</td>
</tr>
<tr>
<td></td>
<td>• Thermal Pad, Insulated</td>
</tr>
<tr>
<td>Special Tools:</td>
<td>• Rubber gloves</td>
</tr>
<tr>
<td></td>
<td>• Protective clothing</td>
</tr>
</tbody>
</table>
To remove the SSR:

**DANGER!**

**ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!**

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

**WARNING!**

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

2. Let the furnace fully cool.
3. Remove applicable access panels. Refer to page 2-11, Lockout / Tagout Removal Procedure.
4. Remove the plastic cover.
5. Label and disconnect the wire connections to the SSR.
6. Remove the SSR mounting screws (Figure 8-8).
7. Remove the SSR.

![Figure 8-8: Replace an SSR](image)
To install the SSR:

1. Install the new thermal pad.
2. Install the SSR.
3. Install the SSR mounting screws.
4. Connect the wire connections to the SSR.
5. Install the plastic cover.
6. Install the access panels. Refer to page 7-4, Removing Access Panels.
7. If maintenance is complete, remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.
8. Examine equipment operation.
9. Refer to Figure 8-8.

Replace the UPS [Option]

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>UPS</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Rubber gloves  
                      | • Protective clothing |
| Related Documents:  | Lockout / Tagout Procedure (page 2-10) |

To remove the UPS:

**DANGER!**

**ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!**

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

**WARNING!**

Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.

2. Let the furnace fully cool.
3. Remove applicable access panels. Refer to page 7-4, Removing Access Panels.
4 Label and disconnect the electrical connections.
5 Remove the old UPS.

To install the UPS:
6 Put the new UPS into position. Make sure that there is sufficient clearance for airflow.
7 Connect the male and female power plugs.
8 Make sure that ENABLE OUTPUT is on. Refer to Appendix E, VENDOR MANUALS.
9 Re-install the access panels.
10 If maintenance is complete, remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.
11 Charge the UPS for 24 hours before you operate the furnace. If the lamp blinks when energized, the battery is charging.
12 Examine equipment operation.

Replace the Belt Speed Module

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Tools:</td>
<td>None</td>
</tr>
</tbody>
</table>
| Related Documents:  | • Applicable manufacturer's data sheet  
|                     | • Lockout / Tagout Procedure (page 2-10) |

The belt speed module is located in the electrical compartment.

To remove the belt speed module:

DANGER!

ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!

Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

Perform the lockout / tagout procedure before continuing with this procedure.

1 Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.
2 Remove the applicable access panel to gain access to the belt speed module.
3 Using a screwdriver, remove the mounting screws that secure the protective cover.
4 Remove the connectors from the module.
5 Using a screwdriver, remove the mounting screws that attach the belt speed module.
6 Remove the existing belt speed module.
To install the belt speed module:

1. Make sure the potentiometers and switches of the new belt speed module match those of the existing module. If necessary, adjust the potentiometers of the new module (refer to the manufacturer's data sheet).

2. Put the new module into position.

3. Using a screwdriver, install the mounting screws that attach the module.

4. Install the connectors to the module. Secure the connectors with tie wraps.

5. Replace and secure the protective cover.

6. Install the access panels.

7. Remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.

8. Examine equipment operation. Operate the conveyor at minimum and maximum speeds.
ATMOSPHERE SYSTEM

Replace an Atmosphere Curtain

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>atmosphere curtain</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Rubber gloves  
                     | • Protective clothing |
| Related Documents:  | None |

Atmosphere curtain assemblies located at the entrance and exit ends of the furnace allow product to pass through while keeping the outside atmosphere from entering the furnace. Curtain assemblies are custom cut and assembled to ensure a minimum of atmosphere transfer.

Each assembly consists of a metal frame and hanging rows of sheet metal curtains. Individual rows contain four sections of sheet metal. This enables individual curtains to remain closed in product lanes not being used.

Occasionally, sections of sheet metal can become damaged during profiling. If an individual curtain is bent or damaged, it can be individually replaced.

To remove an individual atmosphere curtain:

1. Pull out the curtain assembly by the handle.
2. Examine the individual sheet metal curtains for damage.
3. Remove a damaged curtain by removing the cotter pins that secure the sheet metal curtain to the frame.

To install an individual atmosphere curtain:

1. Place the replacement curtain in position.
2. Install new cotter pins.
3. Install the curtain assembly.
4. Examine equipment operation.
Replace a Gas Dispersion Tube

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Gas Dispersion Tube</td>
</tr>
</tbody>
</table>
| Special Tools:      | • China marker  
|                     | • Rubber gloves  
|                     | • Protective clothing |
| Related Documents:  | None |

To remove a gas dispersion tube:

1. Turn off the gas supply at the source.
2. Remove applicable access panels. Refer to page 7-4, Removing Access Panels.
3. Disconnect the elbow (1) and the adapter (2).
4. Remove the fiber insulation (3) assembly.
5. Mark the edges of the dispersion tube (5) in line with the slotted openings with a china marker.
6. Refer to Figure 8-10.

![Figure 8-10: Gas Dispersion Tube](image)

To install a gas dispersion tube:

1. Use the china marks as a guide and insert the tube into the process chamber with the slotted openings at a 45 degree angle to the belt. (On tubes with only one set of slotted openings, put the openings to face the entrance.)
2. Connect the tube to the adapter assembly and the elbow fittings.
3. Install the access panels. Refer to page 7-4, Removing Access Panels.
4 Turn on the gas supply.
5 Examine equipment operation.
6 Refer to Figure 8-10.

Replace a Flowmeter

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Flowmeter</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Rubber gloves  
                       • Protective clothing |
| Related Documents:  | None |

CAUTION!

Make sure that all gas lines have labels so that you can connect them correctly to the facility hookup.

Flowmeters are factory tested. If you purchase a flowmeter from another source, make sure that you do a leak test on it.

To remove a flowmeter (Figure 8-11):

1 Turn off the gas supply at the source.
2 Remove applicable access panels. Refer to page 7-4, Removing Access Panels.
3 Bleed the gas from the line.
4 Record the flow rate setting of the old flowmeter.

Figure 8-11: Flowmeter Plumbing
5 Remove the label from the flowmeter. Keep the old label.
6 Disconnect the flowmeter plumbing.
7 Remove the nuts securing the flowmeter to the panel.
8 Remove the flowmeter.

To install a flowmeter:
1 Position the flowmeter.
2 Connect and tighten the nuts securing the flowmeter to the panel.
3 Connect and tighten the plumbing fittings.
4 Install the label on the new flowmeter.
5 Install the access panels. Refer to page 7-4, Removing Access Panels.
6 Set the flowmeter to the recorded flow rates.
7 Do a leak test of the flowmeter fittings.
8 Turn on the gas supply.
9 Examine equipment operation.
HEATING SYSTEM

Replace Top Heaters

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Set of replacement heaters</td>
</tr>
<tr>
<td></td>
<td>RTC gasket</td>
</tr>
<tr>
<td>Special Tools:</td>
<td>• Input/Heater Power Wiring Diagram (refer to Appendix A, DRAWINGS, SPECIFICATIONS &amp; OPTIONS)</td>
</tr>
<tr>
<td></td>
<td>• Putty knife</td>
</tr>
<tr>
<td></td>
<td>• Eight .5-in. OD x 10-in copper pipes</td>
</tr>
<tr>
<td></td>
<td>• Four 10-in. blocks</td>
</tr>
<tr>
<td></td>
<td>• Labels</td>
</tr>
<tr>
<td></td>
<td>• Rubber gloves</td>
</tr>
<tr>
<td></td>
<td>• Protective clothing</td>
</tr>
<tr>
<td>Related Documents:</td>
<td>Lockout / Tagout Procedure (page 2-10)</td>
</tr>
<tr>
<td></td>
<td>Replace Gasket Procedure (page 8-48)</td>
</tr>
</tbody>
</table>

Top heaters are replaced as sets—Left and Right. Use this procedure to replace a set of top heaters.

**NOTE:** The furnace frame includes welded cross members. Every other zone is under a welded cross member. In order to remove a faulty heater under a cross member, an adjacent set of heaters must be removed. This creates the clearance required to lower the faulty heater under the cross member for removal.

To remove a set of top heaters:

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

   **DANGER!**

   ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!

   Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!

   Perform the lockout / tagout procedure before continuing with this procedure.

2. Let the furnace fully cool.

   **WARNING!**

   Make sure that the equipment is cool before you do maintenance. You will be burned if you touch hot equipment.
3 Remove the side and top access panels necessary to access the zone containing the faulty heater. If the zone is under a cross member, the top heaters in an adjacent zone must also be removed to give access to the faulty heater. Refer to page 7-4, Removing Access Panels.

**NOTE:** If replacing a heater in a zone under an exhaust assembly, disassemble the exhaust venturi and condensation trap plumbing connections, and remove the exhaust pipe/trap assembly before removing the process chamber top panel. Refer to Figure 8-12.

4 Disassemble electrical connections to heater leads extending through process chamber top cover(s). Refer to figure Figure 8-13.

   a Record and label electrical connections before disconnecting.
   b Slide sleeve covering electrical connection back.
   c Loosen and remove split nut and electrical wire from heater lead.
   d Remove mica washer.
   e Remove Viton fitting cover, inner seal, and rubber grommet.
Disassemble electrical connections to thermocouple(s) extending through side of process chamber and remove thermocouple. Refer to Figure 8-14.

- Record and label electrical connections before disconnecting.
- Disconnect wires from terminal block.
- Remove thermocouple by turning counterclockwise.

**NOTE:** The thermocouple is covered in quartz; take care not to drop it.

If removing heaters in a zone under an exhaust, remove the exhaust assembly (Figure 8-15):

- Disassemble the remaining plumbing connections to the exhaust assembly.
b Disassemble electrical connections to exhaust heater leads (4) and exhaust thermocouple. Record and label electrical connections before disconnecting.

c Disassemble electrical ground connection.

d Disassemble connections to exhaust plenum.

e Remove corner bolts (4) securing assembly to furnace frame.

f Lift exhaust assembly up and off the furnace.

**NOTE:** The exhaust assembly is heavy. If possible, lift the assembly using a crane.

---

If zone is equipped with a preheater, disconnect the plumbing connections and remove preheater. Refer to Figure 8-16.

---

**Figure 8-15:** Exhaust Electrical Connections

**Figure 8-16:** Preheater Connections
If zone is equipped with a dispersion tube, remove the dispersion tube (Figure 8-17):

a Disconnect the plumbing to the fitting.
b Disconnect the fitting holding the tube.

c Carefully slide the tube out.

NOTE: The dispersion tube is made of quartz; take care not to drop it.

Remove applicable process chamber top cover(s):

a Remove brackets securing process chamber cover.
   • Seam brackets secure top covers to welded frame cross members. Remove five nuts / washers and remove bracket(s).
   • Side brackets secure top covers to process chamber frame (Figure 8-18). Loosen bolts and remove brackets.
b Break the seal by running a putty knife around the complete perimeter between the gasket and the furnace (Figure 8-19).

c Lift the cover up and off the furnace frame from the 4 corners (requires four people).
d Inspect gasket. If gasket is damaged, replace gasket. Refer to page 8-48, Replace a Silicone Gasket.
10 Remove the ceramic spacer from each heater lead. Refer to “B” in Figure 8-20.

11 Heaters NOT under a frame cross member are removed with the insulation in place.
   • If replacing a heater NOT under a cross member, use this step to remove the top heaters.
   • If replacing a heater UNDER a cross member, use this step to remove the top heaters in the
     adjacent zone to gain access to the faulty heater. Cross members are part of the welded frame and
     are not removable.

   a Inspect the insulation. If the insulation extends under the furnace frame’s cross member or an
     adjacent support bracket, fold back the insulation if possible, or cut the installation
     approximately one to two inches from the cross member or bracket. The dotted line in Figure
     8-20 represents the proper position to cut the insulation.

   NOTE: There are two layers of insulation. Cut the insulation so that when replaced, the top layer
   (Duraback) overlaps the seam in the lower layer (Durablanket), and the lower layer overlaps the
   seam created by the heaters.

   b Heaters are suspended over the process chamber by two heater support brackets. Remove the
   end bolts (4) that secure the support brackets (2) to the frame. Refer to “A” in Figure 8-20.
**WARNING!**

Do not loosen or remove the inner nuts (4) on each bracket, or the heaters may fall onto and break the quartz plates below.

---

**Figure 8-20:** Support Bracket Bolts and Insulation Cut Location

- Being careful not to tilt the heaters into the quartz below, lift the heater assembly out of the furnace by lifting the heater support brackets at both ends (two people required). Refer to Figure 8-21.
12 If you have removed heaters in the adjacent zone in order to access the faulty heater, set the heater assembly aside and skip this step. If the heater assembly contains the faulty heater, place the heater assembly on a flat surface and disassemble it:

a Remove the nuts (4) and washers (4) securing each support bracket (2) to the heaters and remove the brackets.

b Taking note of order of installation, remove the two layers of insulation.

**NOTE:** Note the order of installation of each piece of insulation and do not intermingle the top layer (Duraback) with the bottom layer (Durablanket). They are two different types of insulation. When disassembling the oven, lay the pieces aside in the order they are removed.

c Remove the old heaters and place the replacement heaters in position.

**NOTE:** Heaters are labeled left and right. Be sure to replace each heater with the correct replacement.

d Install the two layers of insulation using the order and orientation previously used with the original heaters.

e Install the support brackets (2) over the threaded rods and secure each bracket with the nuts (4) and washers (4).

f To reinstall the heater assembly, refer to page 8-39.

13 Remove the quartz plates (2) from the adjacent zone (Figure 8-22).
14 Remove the quartz plates (2) from under the faulty heater:

   a  Slide the first quartz plate from under the faulty heater into the adjacent zone and lift out. Refer to (Figure 8-23).

   b  Slide the second quartz plate from under the faulty heater into the adjacent zone and lift out.

15 Place support blocks under the heaters. If the heaters are not temporarily supported, they will fall onto and break the quartz tubes and plates below the belt. Refer to Figure 8-24.
a Measure the distance between the bottom of the heaters and the belt.
b Cut temporary supports (4) to the measured height.
c Place the supports under the heaters toward the center of the furnace.

![Figure 8-24: Temporary Heater Supports (support brackets & insulation removed for clarity)](image)

16 The set of heaters are suspended over the process chamber by two heater support brackets. Remove the support brackets (Figure 8-25):

a Remove the end bolts (4) that secure the support brackets (2) to the frame.
b Remove the nuts (4) and washers (4) securing each support bracket (2) to the heaters and remove the brackets.

17 Remove the two layers of insulation.

**NOTE:** Note the order of installation of each piece of insulation and do not intermingle the top layer (Duraback) with the bottom layer (Durablanket). They are two different types of insulation. When disassembling the oven, lay the pieces aside in the order they are removed.

18 If the heaters are not under an exhaust port, skip this step. If removing heaters in a zone under an exhaust (Figure 8-25):

a Remove small brick from top of each end of exhaust plenum.
b Remove .5-in M-Board from top of exhaust plenum.
c Remove exhaust plenum.
d Remove .25-in. M-Board (protects heater leads from shorting against exhaust plenum).
19 Remove heaters (Figure 8-26).

   a Remove cast-fiber side block from adjacent zone. Refer to “A” in Figure 8-26.

   b Remove cast-fiber side block from under heater (requires two people). Refer to “B” in Figure 8-26.
      • Lift and hold first heater above process chamber.
      • Remove temporary support blocks.
      • Slide cast-fiber side block from under heater into adjacent zone.
      • Remove cast-fiber side block from process chamber.

   c Carefully tilt the heater under the welded cross member, and remove it from the process chamber. Refer to “C” in Figure 8-26.

   d Remove the second heater:
      • Lift and hold second heater above process chamber.
      • Remove temporary support blocks.
NOTE: It is not necessary to remove the opposite cast-fiber side block.

- Carefully tilt the heater and remove it from under the welded cross member. Refer to “C” in Figure 8-26.

**Figure 8-26:** Heater Removal Under Cross Member
To install replacement top heaters:

1 Before installing replacement heaters, follow the above procedure to remove the faulty heater(s). If the faulty heater is under a cross member, the top heaters in an adjacent zone must also be removed to give the necessary clearance for installation.

**NOTE:** Heaters are labeled left and right. Be sure to replace each heater with the correct replacement.

2 Complete this step to install top heaters in a zone UNDER a welded cross member. Refer to Figure 8-26. If the heaters are not under a welded cross member, skip this step.

   a Position the first replacement heater:
      • Place one cast-fiber side block against the furnace side wall.
      • Tilt the replacement heater under the cross member and hold it over the process chamber.
      • Have a second person place two temporary support blocks, on the belt, towards the center of the furnace.
      • Lower the heater so it rests on the side wall and the temporary support blocks.

   b Position the second replacement heater:
      • Tilt the second replacement heater under the cross member and hold it over the process chamber.
      • Have a second person place the cast-fiber side block against the side wall and two temporary support blocks towards the center of the furnace.
      • Lower the second heater so it rests on the side wall and the temporary support blocks.

   c Install two layers of insulation over the replacement heaters using the order and orientation previously used with the original heaters.

   **NOTE:** Do not intermingle the top layer (Duraback) with the bottom layer (Durablanket). They are two different types of insulation. Be sure that all seams are overlapping.

   d Install the heater support brackets (2) over the threaded heater rods and secure each bracket with the nuts (4) and washers (4).

   **NOTE:** Ensure the tops of both heaters are aligned and level.

   e Remove the temporary support blocks from under the heaters.

   f Secure the heater support brackets (2) to the furnace frame using the end bolts (4).

   g Install the quartz plates (2) under the replacement heaters:
      • If necessary, reinstall the cast-fiber side blocks in the adjacent zone.
      • Using the adjacent zone for access, lower a quartz plate onto the cast-fiber side blocks in the adjacent zone, and slide the plate under the replacement heaters.
      • Repeat the procedure with the second quartz plate (Figure 8-23).

3 Complete this step to reinstall top heaters that were removed in an adjacent zone for clearance, or to install replacement heaters in a zone NOT under a welded cross member.

   a If necessary, reinstall the cast-fiber side blocks against both furnace side walls.

   b Carefully rest both quartz plates on the cast-fiber side blocks.
c Being careful not to tilt the heaters into the quartz below, lower the heater assembly into the furnace by holding the heater support brackets at both ends (two people required). Refer to Figure 8-21.

d Secure the brackets (2) to the furnace frame using the end bolts (4). Refer to Figure 8-20.

e If necessary, adjust each heater’s height:

NOTE: Adjusting heater height is only required if the heater assembly was disassembled for heater replacement. If the heater assembly was removed to provide clearance for adjacent heaters, height adjustment is not required.

- Each heater is supported by two brackets. Loosen the two nuts closest to the furnace frame (“A” Figure 8-27) and lower the first heater until it rests on the cast-fiber side block. Tighten nuts.
- Pull back the insulation and loosen the two nuts closest to the center of the furnace (“B” Figure 8-27) and lower the heater until the top is flush with the top of the adjacent heater. Tighten the nuts.
- Repeat the procedure with the second heater.
- Reposition the insulation. Be sure that all seams are overlapping.

4 If replacing heaters under an exhaust assembly, reinstall the exhaust plenum and insulation (Figure 8-25):

a Install .25-in. M-Board over heaters (protects heater leads from shorting against exhaust plenum).

b Install exhaust plenum.

c Install .5-in M-Board over exhaust plenum.

d Install small brick on top of each end of exhaust plenum.

5 Install process chamber top covers:

a Cut eight (8) pieces of .5-in x 10-inch copper pipe.

b Place a pipe over each heater lead to help align the leads with the cover.

c Cut and position a 10-inch high block (4) at each corner of the cover opening.
a  Using 4 people, lower cover onto corner blocks.

b  Align the viton fittings in the cover with the copper pipes over the leads.

c  Remove the four blocks and lower the cover into position over the furnace frame.

d  Remove copper pipes.

e  Secure cover to furnace frame using top and side (Figure 8-18) cover brackets.

6  If the heaters are not under an exhaust assembly, skip this step. If installing heaters in a zone under an exhaust assembly:

a  Lower exhaust assembly into position.

NOTE: The exhaust assembly is heavy. If possible, lift the assembly using a crane.

b  Secure the exhaust assembly to process chamber frame with the corner bolts (4).

c  Secure the following connections:
   • exhaust plenum couplings
   • electrical ground
   • electrical connections to exhaust heater leads (4) and exhaust thermocouple (Figure 8-15).

7  If the zone included a preheater, install the preheater (Figure 8-16).

8  Connect electrical connections to heater leads extending through the top cover (Figure 8-13).

a  Insert a 3-inch ceramic spacer over each heater lead. The spacer protects the lead from shorting against the Viton fitting.

b  Install packing around the lead to keep it centered.

c  Insert the rubber grommet and seal.

d  Install the Viton fitting cover and place a mica washer over the heater lead.

e  Install the split nut and secure the electrical wire to the heater lead.

f  Slide sleeve over electrical connection.

9  Install zone thermocouple in process chamber side cover and reconnect electrical connections to the thermocouple. Refer to Figure 8-14.

10 If the zone was equipped with a dispersion tube, install the dispersion tube and reconnect the plumbing. Refer to Figure 8-17.

11 Install top and side access panels. Refer to page 7-4, Removing Access Panels.

12 If exhaust assembly was removed, reinstall exhaust venturi and condensation traps (Figure 8-12).

13 If maintenance is complete, remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.

14 Examine equipment operation.
Replace Bottom Heaters

Bottom heaters are replaced as sets--- Left and Right. Use this procedure to replace a set of bottom heaters.

**NOTE:** The top heaters in a zone must be removed to give access to bottom heaters.

To remove a set of bottom heaters:

1. Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.

2. Let the furnace fully cool.

3. Remove the side and top access panels necessary to access the zone containing the faulty heater.

4. Remove the top heaters in the zone containing the faulty heater. Refer to page 8-27, Replace Top Heaters.

5. Disassemble electrical connections to heater leads extending through process chamber side covers: Figure 8-13.
   
   a. Record and label electrical connections before disconnecting.

---

**Procedure Category:** Type 1

**Parts Referenced:**
- Set of replacement heaters
- RTC gasket

**Special Tools:**
- Input/Heater Power Wiring Diagram (refer to Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS)
- Putty knife
- Labels
- Rubber gloves
- Protective clothing

**Related Documents:**
- Lockout / Tagout Procedure (page 2-10)
- Replace Gasket Procedure (page 8-48)
b Slide sleeve covering electrical connection back.

c Loosen and remove split nut and electrical wire from heater lead.

d Remove mica washer.

e Remove Viton fitting cover, inner seal, and rubber grommet.

6 Remove applicable process chamber side cover(s):

a Loosen bolts and remove brackets securing process chamber side cover.

b Break the seal by running a putty knife around the complete perimeter between the gasket and the furnace (Figure 8-29).

NOTE: The gasket is attached to the cover with RTV adhesive. The gasket can be reused if not damaged. Run the putty knife along the edge of the furnace case. Do not insert the knife between the gasket and the cover.

c Pry the cover off the furnace frame.

d Inspect gasket. If gasket is damaged, replace gasket. Refer to page 8-48, Replace a Silicone Gasket.

Figure 8-28: Bottom Heater Electrical Connections

Figure 8-29: Breaking Seal on Side Cover
Remove bottom heaters:

A 1-in. K FAC-19
B .5-in. M-Board
C Side Block
D Bottom Side Block
E Quartz Plates
F Bottom Heater

Figure 8-30: Remove Bottom Heaters

7 Remove bottom heaters:
a Remove .5-in. K-FAC insulation. Refer to “A” in Figure 8-30.
b Remove 1-in. M-Board insulation. Refer to “B” in Figure 8-30.
c Remove cast-fiber side block. Refer to “C” in Figure 8-30.

NOTE: Be careful not to drop the quartz onto the heaters when removing the bottom side block.

d Remove bottom cast-fiber side block. Refer to “D” in Figure 8-30.
e Carefully support the quartz plates as you slide them out of the process chamber. Refer to “E” in Figure 8-30. Try not to slide them against the top of the heaters.
f Slide out and remove first heater. Refer to “F” in Figure 8-30.
g Slide the second heater over toward the opening by pushing on the heater leads from the other side of the furnace.
h Remove the second heater.

To install replacement bottom heaters:

NOTE: Heaters are labeled left and right. Be sure to replace each heater with the correct replacement.

1 Slide the first replacement heater into the process chamber.
a Push the heater into the process chamber until the heater leads protrude through the process chamber far wall.
b From the other side of the furnace, pull the heater into position by the heater leads.

2 Slide the second replacement heater into the process chamber. Refer to “F” in Figure 8-30.

3 Carefully slide the quartz plates into position.

Normally, each quartz plate is supported by bottom side blocks and along one edge by .25-in. M-Board. Because only one bottom side block is currently installed, each quartz plate must be carefully supported to prevent it from scraping across the top of the heaters as it is installed.

4 Install the bottom cast-fiber side block. Refer to “D” in Figure 8-30.

5 Install the cast-fiber side block. Refer to “C” in Figure 8-30.

6 Install 1-in. M-Board insulation. Refer to “B” in Figure 8-30.

7 Install .5-in. K-FAC insulation. Refer to “A” in Figure 8-30.

8 Install the process chamber side cover.

9 Connect electrical connections to heater leads extending through the side covers (Figure 8-28).

10 Reinstall the top heaters. Refer to page 8-39, To install replacement top heaters:

11 If maintenance is complete, remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.

12 Examine equipment operation.
Replace a Thermocouple

<table>
<thead>
<tr>
<th>Procedure Category:</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts Referenced:</td>
<td>Thermocouple</td>
</tr>
</tbody>
</table>
| Special Tools:      | • Teflon thread tape  
                      | • Nickel anti-seize pipe thread dope (for threaded thermocouples)  
                      | • Labels  
                      | • Rubber gloves  
                      | • Protective clothing |
| Related Documents:  | None |

**WARNING!**

Use a protective dust mask, clothing, and gloves when you do maintenance that causes exposure to insulation (for example, around the process chamber).

Make sure that the thermocouples are set above product clearance height.

To remove a thermocouple:

1. Remove applicable access panels. Refer to page 7-4, Removing Access Panels.
2. Record and label the wire connections of the defective thermocouple.
3. Disconnect the thermocouple wires from the terminal block (Figure 8-31).
4. Remove the thermocouple by turning threaded thermocouples, or remove the screws from the thermocouple brackets and remove the thermocouple. Keep the bracket parts.

To install a thermocouple:

1. Remove the cover from the new thermocouple.
2. Install the tube end of the thermocouple in the correct channel in the process chamber. The channel and thermocouple are marked with matching numbers.
3. Tighten the thermocouple:
   • For threaded thermocouples, wrap anti-seize tape around the threads. Hand-tighten each thermocouple into the receiving coupling on the process chamber wall. Carefully tighten the thermocouple to keep the gas integrity of the threaded seal.
   • For thermocouples using brackets, install the screws (supplied) in the thermocouple brackets and tighten. The springs must be lightly compressed and the thermocouple tube must press lightly against the muffle.
4. Connect the thermocouple wires to the correct terminals on the terminal block. Refer to Table 8-1.
5. Calibrate the thermocouple analog inputs. Refer to WINCON Online Help.
6. Install the access panels. Refer to page 7-4, Removing Access Panels.
7. Do a temperature profile. Refer to page 7-7, Perform a Temperature Profile.

8. Examine equipment operation.

Table 8-1: Terminal Connections

<table>
<thead>
<tr>
<th>Wires</th>
<th>To</th>
<th>Terminal Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Intellimax</td>
<td>Match the color of the input thermocouple wire to the color of the output wires (yellow = positive, red = negative). Wire name: Annn-WC</td>
</tr>
<tr>
<td>Overtemperature</td>
<td>OTM</td>
<td>Match the color of the input thermocouple wire to the color of the output wires: yellow is positive, red is negative. Wire name: C080n</td>
</tr>
<tr>
<td>Binding post</td>
<td>GND</td>
<td>Connect GND wire to the terminal of the Control negative (Red) wire.</td>
</tr>
</tbody>
</table>

**COOLING SYSTEM**

No Applicable Procedures.
MUFFLE SYSTEM

Replace a Silicone Gasket

Procedure Category: Type 1
Parts Referenced: Gasket
Special Tools: • RTV silicone adhesive  
• Lint-free wipes  
• Notched spreader  
• Cleaning solution
Related Documents: Lockout / Tagout Procedure (page 2-10)

WARNING!
QUALIFIED PERSONNEL!
• This is a general procedure for replacing silicone gaskets. Replacing a silicone gasket may require disassembling sections of the furnace. Do not perform the procedure if you have any doubts about how to accomplish the tasks involved.
• DO NOT PERFORM THE PROCEDURE IF YOU HAVE ANY DOUBTS ABOUT HOW TO ACCOMPLISH THE TASKS INVOLVED. Contact BTU Customer Service; otherwise, severe personal injury or equipment damage may occur.

To remove a silicone gasket:

DANGER!
ELECTRICAL HAZARD! PERFORM THE LOCKOUT / TAGOUT PROCEDURE!
Do not continue with this procedure if the furnace or any accompanying equipment is energized; otherwise, high-voltage electrical current may electrocute you!
Perform the lockout / tagout procedure before continuing with this procedure.

1 Perform the lockout/tagout procedure. Refer to page 2-10, Lockout / Tagout Procedure.
2 Remove applicable access panels. Refer to page 7-4, Removing Access Panels.
3 Disassemble applicable sections of the furnace.

CAUTION!
EQUIPMENT DAMAGE!
When using a tool like a putty knife to remove gaskets and adhesive residue, make sure not to scratch the gasket mating surface; otherwise, the damaged surface may negatively affect gasket performance by preventing the gasket from forming a proper seal.

Always use caution when using tools to remove gaskets and adhesive residue.
4 With a putty knife, remove the gasket and adhesive.

<table>
<thead>
<tr>
<th>CAUTION!</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMBUSTIBLE SUBSTANCE!</strong></td>
</tr>
<tr>
<td>Some procedures in this manual recommend a cleaning solution of 10 percent isopropyl alcohol/90 percent water. Isopropyl alcohol is explosive in a non-diluted state (flash point: 14°C (57°F)).</td>
</tr>
<tr>
<td>• Refer to the applicable MSDS of any cleaning solution you may use.</td>
</tr>
<tr>
<td>• Do not make a cleaning solution on or near the furnace.</td>
</tr>
<tr>
<td>• Do not use any cleaning solution on a furnace in operation.</td>
</tr>
<tr>
<td>• Make sure there is sufficient ventilation when using cleaning solutions to clean the furnace and its components.</td>
</tr>
<tr>
<td>• Before using any cleaning solutions, make sure the surface to be cleaned is cool to the touch.</td>
</tr>
</tbody>
</table>

5 With lint-free wipes and a cleaning solution, clean the gasket mating surface.

**To install a silicone gasket:**

1 Using a knife, cut four pieces of silicone gasket using butt joints. Refer to Figure 8-32.

2 Apply a 7-mm (0.25-in.) bead of RTV adhesive along the center of the gasket-mounting area.

3 Using a notched spreader, spread the adhesive evenly throughout the gasket-mounting area.

4 Install the gasket onto the gasket-mounting area.

5 Using only your hands, press the gasket down firmly.

6 Apply adhesive onto the seams located in each corner of the gasket.

7 Using a lint-free wipe dampened with water, smooth the adhesive evenly over the seams.

8 Let the adhesive dry for 24 hours.

9 Reassemble the furnace sections.
Examine the separation joint:

1. Examine hearth level (where the belt rides between the sections). Make sure that it is not out of level by more than 1 mm (0.04 in.).
2. If the hearth level exceeds the specifications, adjust the joint. Refer to Figure 8-33.

**Figure 8-32:** Example of a Silicone Gasket with Butt Joints

**Figure 8-33:** Separation Joint
3 Install the access panels. Refer to page 7-4, Removing Access Panels.

4 If maintenance is complete, remove the lockout/tagout. Refer to page 2-11, Lockout / Tagout Removal Procedure.

5 Examine equipment operation.
APPENDIX A
DRAWINGS, SPECIFICATIONS & OPTIONS

INTRODUCTION

NOTE: This is not a full description of BTU or industry drawing methods.

- OEM drawings are available on the CD-ROM. Use Adobe Acrobat Reader® to read the online drawings.
- For a list of abbreviations that are used in the drawings, refer to page 1-5, Symbols, Abbreviations & Terms.
- For drawings / schematics, refer to inserts.

NOTE: Refer to the power input schematic for the main circuit breaker AIC rating.

ENGINEERING DIAGRAM AND EQUIPMENT IDENTIFICATION

A list and corresponding drawings are at the end of this appendix.

Electrical Diagram Lines and Line Codes

Electrical diagrams have alpha-numeric codes on the left-hand margin (for example, A010).

- The codes are groups of letters and numbers that start with A000 and increase by ten (for example, A010, A020, A030).
- The letter refers to specific equipment components. For an explanation, refer to Table A-1.
- The three-digit number identifies a line of the diagram.
- Wire codes relate to the line code. For each additional wire that is used for a given line, the code is increased by one (for example, A010, A011, A012).

Power circuit diagrams are drawn with vertical power lines on the left-hand side of the diagram. Branch circuits extend horizontally from these vertical lines to the right-hand side, return or neutral. Refer to Figure A-1.

Vertical lines represent the source of control power. All control devices are shown between them. Switch and relay contacts are shown next to the right-hand vertical line. Pilot lights, relay coils, etc. are between them and the right-hand vertical line. Refer to Figure A-1.

Circuits that connect to other diagrams are referenced by a line number and name at the connection points (for example, A140 on one drawing can connect to A150 on another drawing). Electrical lines that start at other electrical diagrams are marked by type of voltage (VAC or VDC). There may be a description of the origin of the source voltage below the voltage type. Refer to Figure A-1.
Electrical cabinet parts are identified by their names on the electrical diagrams. Refer to Figure A-1. For example:
A130 of A130-CB is the diagram line number location of the part.
A131-TB is the terminal block below A130-CB, a circuit breaker on line A130 of the electrical diagram.

Electrical Wire Identification

Electrical wire size and insulation type and color are shown at the source voltage connection. Ground wires are green/yellow No. 14 AWG unless specified differently. Ground wires do not usually have color or size labels.

Refer to Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS for the electrical requirements. For electrical wire identification, refer to Table A-1.

Table A-1: Electrical Wire Identification

<table>
<thead>
<tr>
<th>Wire Color</th>
<th>Color Abbreviation</th>
<th>Circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>BK</td>
<td>Line, load, and control circuits at line voltage</td>
</tr>
<tr>
<td>Blue</td>
<td>BU</td>
<td>DC control circuits</td>
</tr>
<tr>
<td>Gray</td>
<td>GR</td>
<td>Grounded circuit conductor for UPS control circuits</td>
</tr>
<tr>
<td>Green/Yellow</td>
<td>GN/YL</td>
<td>Equipment grounding conductor</td>
</tr>
<tr>
<td>Red</td>
<td>RD</td>
<td>AC control circuits at less than line voltage</td>
</tr>
<tr>
<td>White</td>
<td>WT</td>
<td>Grounded circuit conductor (neutral)</td>
</tr>
<tr>
<td>White/Blue</td>
<td>WT/BU</td>
<td>DC common</td>
</tr>
<tr>
<td>Yellow</td>
<td>YL</td>
<td>Interlock control circuits supplied from an external power source or UPS</td>
</tr>
</tbody>
</table>

**NOTE:** Exceptions are as follows:

- Multi-conductor cables are an exception to the above standard color codes.
- Neutral wires are light blue for equipment shipped to Europe (European Community).
- Customer-specified color codes are used as required.
Figure A-1. Electrical Schematic (Example)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Source Voltage</td>
</tr>
<tr>
<td>2</td>
<td>Reference From</td>
</tr>
<tr>
<td>3</td>
<td>Power Line</td>
</tr>
<tr>
<td>4</td>
<td>Electrical Wire Identification</td>
</tr>
<tr>
<td>5</td>
<td>Line Numbering</td>
</tr>
<tr>
<td>6</td>
<td>Reference To</td>
</tr>
</tbody>
</table>
Plumbing Identification

Color-coded tape identifies the plumbing. If there is more than one pipe at a location, a number shows the matching flowmeter, entrance-to-exit.

Refer to Appendix A, DRAWINGS, SPECIFICATIONS & OPTIONS for the plumbing requirements. For plumbing identification, refer to Table A-2.

<table>
<thead>
<tr>
<th>Plumbing Color</th>
<th>Fluid/Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>Carbon Dioxide</td>
</tr>
<tr>
<td>Black/Green</td>
<td>Carbon Monoxide</td>
</tr>
<tr>
<td>Blue</td>
<td>Water Feed (Inlet)</td>
</tr>
<tr>
<td>Brown</td>
<td>Freon</td>
</tr>
<tr>
<td>Gray</td>
<td>Exothermic</td>
</tr>
<tr>
<td>Green</td>
<td>Air (optional)</td>
</tr>
<tr>
<td>Orange</td>
<td>Oxygen</td>
</tr>
<tr>
<td>Orange/Green</td>
<td>Argon</td>
</tr>
<tr>
<td>Purple</td>
<td>Natural Gas (City)</td>
</tr>
<tr>
<td>Red</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Red</td>
<td>Dissociated Ammonia</td>
</tr>
<tr>
<td>Red/Green</td>
<td>Endothermic</td>
</tr>
<tr>
<td>Red/Yellow</td>
<td>Forming Gas</td>
</tr>
<tr>
<td>White</td>
<td>Water Drain (outlet)</td>
</tr>
<tr>
<td>Yellow</td>
<td>Nitrogen</td>
</tr>
</tbody>
</table>

Specifications

Refer to BTU Specification.

Options

Refer to BTU Production Order.
APPENDIX B
RECOMMENDED SPARE PARTS

NOTE: If necessary, contact BTU Technical Support to get the correct part number.

INTRODUCTION

Parts may become defective after use. It is recommended that you obtain advance parts that are likely to wear out. For recommended spare parts, refer to inserts.

If you need technical assistance or have questions about the warranty, contact BTU. Have your furnace manuals and serial number available.

ORDERING SPARE PARTS OR WARRANTY PARTS

To order spare parts or warranty parts:

1 Place the order with the BTU Parts Sales Department.
   • Include the serial number (1) and model number (2). Refer to Figure B-1.

2 If you order warranty parts, you must return the defective part to BTU.

Figure B-1: Equipment Label (Typical)
<table>
<thead>
<tr>
<th>Item:</th>
<th>Fill In:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Name</td>
<td></td>
</tr>
<tr>
<td>Shipping Address</td>
<td></td>
</tr>
<tr>
<td>Billing Address (Non-Warranty Parts)</td>
<td></td>
</tr>
<tr>
<td>Warranty Part? Yes / No (Circle Applicable)</td>
<td></td>
</tr>
<tr>
<td>Preferred Shipment Method</td>
<td></td>
</tr>
<tr>
<td>Purchase Order Number</td>
<td></td>
</tr>
<tr>
<td>Company Contact</td>
<td></td>
</tr>
<tr>
<td>Contact Telephone Number</td>
<td></td>
</tr>
<tr>
<td>MRA Number</td>
<td></td>
</tr>
<tr>
<td>furnace Serial Number</td>
<td></td>
</tr>
<tr>
<td>Part Numbers and Name</td>
<td></td>
</tr>
<tr>
<td>Detailed Description of the Problem</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C
MATERIAL SAFETY DATA SHEETS

Refer to inserts.
APPENDIX D

CALIBRATION SHEETS

Refer to inserts.
APPENDIX E

VENDOR MANUALS

Refer to inserts.