Vogt Ice LLC

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Tube-Ice

Tube Ice, LLC

1000 W. Ormsby Ave.

Suite #19

Loulsville, KY 40210

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TURBO

Turbo Refrigerating, LLC

P. O. Box 396 (zip 76202)

1815 Shady Oaks Drive

Denton, TX 76205

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TIG ICE

Generator Manual

TURBO

REFRIGERATING COMPANY

TIG ICE GENERATOR MANUAL

R-22 SERVICE DISCLAIMER

This manual (prepared prior to the regulations resulting from the Clean Air Act of 1990) contains recommendations and procedures for service work on refrigeration equipment utilizing refrigerant R-22. The Clean Air Act of 1990 will result in changes to the procedures in this manual for handling refrigerant R-22.

The owner and/or service provider using this manual is responsible for compliance with all local, state, or federal codes and regulations regardless of the procedures or recommendations cited in this manual, which are not intended to supersede or contradict applicable regulations in effect at the time of service.

TURBO®

TIG ICE GENERATOR MANUAL

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FIGURES & TABLES

Read Safety Section before installing or using equipment.

INTRODUCTION

Turbo Refrigerating Company is a supplier of ice making and ice storage equipment. Turbo does not engineer or design ice systems or ice plants.

Information on safety, installation, operation, maintenance, and trouble shooting is contained in this manual. If you have questions concerning any of these phases, contact Turbo Refrigerating Company or one of its distributors to ensure you fully understand the instructions and guidelines.

You must read all of the information carefully and make sure that all personnel involved in the installation and operation have also read and understood the information and safety instructions. This will help avoid injury to personnel and/or damage to the equipment. Both are valuable assets to your operation. **Take the time to protect them.**

Read the manual contents before you start your installation or operation. This will save time by ensuring all the necessary materials and tools are available when the equipment arrives.

History

Turbo Refrigerating Company has been producing equipment for the ice industry since 1960. The ice generators described in this manual are part of a family of products designed specifically to meet the needs of the industrial ice users. The TIG/TIGAR series ice generators were introduced in 1985. Although they are the youngest member of the Turbo family, they are built with the same high quality standards of engineering used to develop the icemakers of the 60's. Many of the latest developments in technology are used to design the TIG/TIGAR series ice generators.

In applications where totally dry uniform ice is not required, the TIG/TIGAR series offers a **low cost alternative.**

Icemakers Versus Ice Generators

There are several basic differences between Turbo icemakers (C-series) and Turbo ice generators (TIG/TIGAR series).

Turbo Icemakers

The traditional Turbo icemaker was designed to meet the needs of the packaged ice industry where dry, sub-cooled, uniform pieces of ice are essential. To meet these requirements, Turbo icemakers make ice on only one side of the plate and warm water is used to harvest (some models are available with hot gas assist). The water to each section is cut-off and a drying cycle is used. Both of the above insure a dry, sub-cooled ice. As the ice separates from the plates, it is metered into a breaker assembly to ensure uniform ice size. The sizing system consists of:

- a rotating breaker bar
- an adjustable sizer bar
- a fixed sizer grate.

The unique sizing adjustment along with ice thickness controls allow the Turbo icemaker to produce a wide variety of ice nugget sizes.

Turbo Ice Generators

The Turbo ice generators were designed to meet the needs of the industrial user requiring ice for its cooling effect rather than for consumption. TIG/TIGAR series units maintain the same operating technology, and sanitation requirements as the icemakers maintain, while eliminating the icemaker features not essential to their applications. In the TIG/TIGAR, the drying cycle and warm water harvest are replaced by a hot gas harvest, and the ice breaker/sizer mechanism is replaced by a auger to break the ice into irregular sizes. As a result, a random shaped piece of fragmented ice is produced at a **lower cost per ton.**

Read Safety Section before installing or using equipment.

Models

All TIG/TIGAR units are provided with:

- stainless steel exterior panels
- control panel with programmable controller
- stainless steel ice slide
- stainless steel evaporator plates
- 230/3/60 or 460/3/60 motor with 115/1/60 controls
- multiple evaporator sections
- open compressors direct-coupled to an open-drip-proof motor
- stainless steel water distribution pan.

All surfaces in contact with the water or ice are either stainless steel, PVC, or hot-dipped galvanized for maximum sanitation and corrosion resistance.

TIG Series Models

SC (Self-Contained)
- Completely self-contained, including refrigerant charge.
- Uses a water-cooled condenser with water regulating valves.
- Optional cooling tower and pump are available.

SCA (Self-Contained Air-Cooled)
- Completely self-contained, including refrigerant charge.
- Uses an air-cooled condenser.
- Head pressure controls provided with the air-cooled condenser.
- Complete unit and condenser is mounted on a common base frame.

SCE (Self-Contained Evaporative-Cooled Condenser)
- Completely self-contained, including refrigerant charge.
- Uses an evaporative-cooled condenser.
- Optional cooling tower and pump are available.
- Head pressure controls provided with the evaporative-cooled condenser.
- Complete unit and condenser is mounted on a common base frame.

SCAR (Self-Contained Air-Cooled Remote)
- Self-contained unit set up for remote air-cooled condenser.
- Air-cooled condenser and head pressure controls can be furnished as options.
- No refrigerant charge.
- Receiver and isolating valves are optional.

SCER (Self-Contained Evaporative Remote)
- Self-contained unit set up for remote evaporative-cooled condenser.
- Evaporative-cooled condenser and head pressure controls can be furnished as options.
- No refrigerant charge.
- Receiver and isolating valves are optional.
- No refrigerant charge.

TIGAR Series Models

R (RemoteEvaporator)
- Low side evaporator including Turbo suction accumulator/heat exchanger for connection to remote high side equipment.
- No refrigerant charge provided.

AR (Ammonia Remote)
- Ammonia evaporator set up for connection to a remote ammonia recirculation and high side equipment.
- Contains all controls for icemaking and electrical interface with remote refrigeration equipment.
- Ammonia high side and recirculation packages can be furnished as options.
- No charge provided.

Capacities

The TIG series is available in 16, 21, 31, 42, 63, and 80 tons of ice per day models. The TIGAR series is available in 25, 50, 75, and 100 tons of ice per day models. All capacities are based on 60° F make-up water, 0° F evaporator and 95° F condensing temperatures.

Read Safety Section before installing or using equipment.

USDA Approved

All Turbo TIG/TIGAR series ice generators have preliminary USDA approval and are built to meet rugged industrial standards which make them the most reliable in the industry. Each system is designed to provide the safest and simplest operation as well as to minimize maintenance.

Operation

The basic operating sequence of the TIG and TIGAR series units are as follows:

1. Incoming water is fed into a tank located within the unit. A simple, easy to adjust float valve is used for this purpose.
2. The water is pumped from the tank through PVC pipe to a water distribution pan above the plates.
3. As the water leaves the stainless steel distribution pan, it is evenly distributed along the length of each plate.
4. Water leaving the bottom of the plate is collected and returned to the tank for recirculation to the plate.
5. During this sequence, refrigeration is supplied to the plates and ice is built on both outside surfaces of the plates.
6. After a preset time, the refrigeration to a section of plates is removed and hot gas is introduced into the plate. The water continues to run over the plates.
7. As the water and ice separate from the plates, they are collected by the ice slide and converge in a perforated trough.
8. The water drains through the perforated holes in the trough and back into the water tank. Ice is removed from the trough by the integral auger to the unit ice discharge.
9. A dryout section of trough as well as a special ice discharge are used to eliminate virtually all water from the ice.
10. After a pre-set time period, the harvest sequence for this group of plates ends and the section returns to the icemaking mode.
11. The next section of plates goes into harvest.
12. This sequence will repeat as long as the ice generator is operating.

Note:
Ice thickness can be varied from 3/16" to 1/2" by simple control changes.

Sanitary Ice

Turbo makes every effort possible to minimize the potential for contamination of the ice produced on the ice generators (as well as all other products). All water and ice contact areas are either stainless steel, PVC, or hot-dipped galvanized. In addition, the stainless steel water distribution pan is open and easily accessible for cleaning.

The hole pattern in the water distribution pan acts as a secondary screening media for the water on the plates. A strainer is provided in the make-up water line. Turbo strongly urges each user to consult a local water treatment specialist to determine any water treatments that might be beneficial in obtaining the best ice possible.

Controls

Turbo ice generators use the latest controls available for simple, reliable operation. All models are supplied with:

- a programmable controller
- magnetic starters with overload protection (for all motors furnished with the ice generator - extra starters for remote equipment are optional)
- all selector switches required for automatic operation of the system.

All components are mounted in a stainless steel electrical enclosure (NEMA 12). Control panels are UL approved.

Read Safety Section before installing or using equipment.

Ice Delivery

Ice produced by the ice generator is delivered to a common ice discharge opening outside the cabinet of all models. The discharge opening is a standard screw conveyor down spout. Turbo recommends that an inclined transfer screw conveyor or belt conveyor be used to transfer the ice from the ice discharge to its final delivery point. Such arrangements prevent any condensation or water from:

- accidentally dumping into the system
- draining or flowing into the final icing points.

IMPORTANT

All conveyors, transitions, or belts connecting to the ice discharge should ensure that access into the screw conveyor (auger) is eliminated. See Safety Section on page 11.

Optional TIG Features

Although Turbo designs and builds the ice generators to be as flexible as possible, the standard models or features may not meet a particular application. Turbo can design special configurations and offers several optional features.

Optional features include:

- Winterizing kits
  - for low ambient operation.
- Weatherizing kits
  - enclosures for outboard equipment including compressors.
- Bin-O-Matic controls
  - to automatically turn ice generators off when delivery point is full.
- Voltage and frequency
  - special voltages and frequencies are available.
- Open belt driven compressor
  - belt drive is available
  - TEFC and explosion proof motors are available.
- Complete pneumatic systems to convey ice
  - blower, rotary airlocks, and two or three position diverter valves may be purchased separately.
- Cooling towers and cooling tower pumps
  - available for all SC models
  - with head pressure controls for SC models.
- Air-cooled condenser
  - with head pressure controls for SCAR models.
- Evaporative condenser
  - with head pressure controls for SCER models.
- Stainless steel auger and discharge trough.

If you have an application or a need that is not discussed here, contact the sales department of Turbo Refrigerating Company or a Turbo distributor to discuss your needs:

Turbo Refrigerating Company
P.O. Box 396
Denton, Texas 76202
1-817-387-4301
Telex:
682 9266 Turbo UW
FAX # 817-382-0364

Read Safety Section before installing or using equipment.

Associated Turbo Equipment

Turbo Block Press

Turbo offers another feature to make it possible to get your money's worth out of your ice production. Instead of throwing away the snow produced by the breaker bar, screw conveyors or other handling devices, install a Turbo block press. The Turbo block press converts the snow into a ten or fifty-five pound block of ice.

Introduced in 1977, the Turbo block press is a completely automatic hydraulic powered unit capable of producing from 120 to an excess of 400 ten pound blocks per hour.
The Turbo block press is available with a block bagger attachment which again means:

- less handling
- a better product
- higher profits for the ice person.

Rugged industrial construction and stainless steel in all areas of ice contact make the Turbo block press the most reliable on the market.

Turbo Ice Rake

Turbo offers the only proven automatic ice storage and delivery system (from 20 to 300 ton capacities).

There are two basic sizes in the hydraulic version as well as two larger versions known as "automatic ice rakes". The smaller hydraulic models range in capacity from 20 to 75 tons while the larger automatic ice rakes range from 100 to 300 tons of ice storage.

All Turbo ice storage systems are USDA approved. Each system is designed to make the loading and unloading of the ice storage system as safe and simple as possible. Turbo ice rakes are self-leveling and self-unloading.

Typical Applications

- produce (broccoli, carrots, etc.)
  - top icing in the field or in the processing area
  - units can be trailer mounted
- concrete icing
- ingredient icing (as in bakeries)
- fish icing
- poultry icing
- chemical and dye processes
- emergency cooling loads
- ice slurries
- catering trucks
- salad bars or display ice
- food processing.

Customer Service

The Turbo service department provides assistance for all customer needs. Turbo conducts training schools at the factory and various locations throughout the world. For information, contact the service department at Turbo Refrigerating Company.

The model and serial number of your Turbo equipment is located on the nameplate attached to the electrical control panel. Please refer to the model and serial number when making inquiries about the equipment. This will enable our personnel to handle your questions quickly and accurately.

High Values

Turbo highly values its friends and customers in the industry. Please remember to:

T hink safely - act safely.
U nderstand operating procedures and dangers of the equipment.
R emember to think before you act.
B efore you act, understand the consequences of your actions.
O bserve equipment warnings and labels.

Read Safety Section before installing or using equipment.

TERMS & CONDITIONS

Turbo Refrigerating Co. (the "Company") agrees to sell the Equipment described herein upon the following terms and conditions of sale which, accordingly, supersede any of Buyer's additional or inconsistent terms and conditions of purchase.

1. TERMS AND PRICES

(a) All orders are to be accompanied by a twenty percent (20%) down payment or an acceptable irrevocable letter of credit confirmed on a U.S. Bank acceptable to Turbo. No orders are to be entered without payment or L/C in hand.

(b) All orders are subject to the approval of the Company's home office. Unless otherwise stated, standard terms of payment are thirty (30) days net from the earlier of date of shipment or readiness of the Equipment for shipment. If partial shipments are made, payment shall become due and payable to the partial shipment.

(c) In addition to the purchase price, Buyer shall pay any excise, sales, privilege, use or any other taxes, Local, State or Federal, which the Company may be required to pay arising from the sale or delivery of the Equipment or the use thereof. Prepaid freight, if applicable, will be added to the purchase price and invoiced separately. Where price includes transportation or other shipping charges, any increases in transportation rates or other shipping charges from date of quotation or purchase order shall be for the account of and paid by Buyer.

(d) Contract prices are subject to adjustment to the Company's prices in effect at time of shipment unless otherwise specified in a separate Price Adjustment Policy attached to the proposal or other contract document of the Company.

(e) If Buyer requests changes in the Equipment or delays progress of the manufacture or shipment of the Equipment, the contract price shall be adjusted to reflect increases in selling price caused thereby.

2. SHIPMENT

Shipment is F.O.B. Company's plant or place of manufacture, unless otherwise specified. Risk of loss shall pass to Buyer upon delivery to transporting carrier.

3. DELIVERY

(a) The Company will endeavor to make shipment of orders as scheduled. However, all shipment dates are approximate only, and the Company reserves the right to readjust shipment schedules.

(b) Under no circumstances will the Company be responsible or incur any liability for costs or damages of any nature (whether general, consequential, as a penalty or liquidated damages or otherwise) arising out of or owing to (i) any delays in delivery or (ii) failure to make delivery at agreed or specified times due to circumstances beyond its reasonable control.

(c) If shipment is delayed or suspended by Buyer, Buyer shall pay (i) Company's invoice for the Equipment as per payment terms, (ii) Company's handling and storage charges then in effect, and (iii) demurrage charges if loaded on rail cars.

4. LIMITED WARRANTY; WARRANTY ADJUSTMENT; EXCLUSIONS; LIMITATION OF LIABILITY

(a) LIMITED WARRANTY
The Company warrants that at the time of shipment the Equipment manufactured by it shall be merchantable, free from defects in material and workmanship and shall possess the characteristics represented in writing by the Company. The Company's warranty is conditioned upon the Equipment being properly installed and maintained and operated within the Equipment's capacity under normal load conditions with competent supervised operators and, if the Equipment uses water, with proper water conditioning. Equipment, accessories and other parts and components not manufactured by the

Company are warranted only to the extent of and by the original manufacturer's warranty to the Company, in no event shall such other manufacturer's warranty create any more extensive warranty obligations of the Company to the Buyer than the Company's warranty covering Equipment manufactured by the Company.

(b) EXCLUSIONS FROM WARRANTY

(i) THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, ORAL OR EXPRESS OR IMPLIED, INCLUDING ANY WARRANTIES THAT EXTEND BEYOND THE DESCRIPTION OF THE EQUIPMENT. THERE ARE NO EXPRESS WARRANTIES OTHER THAN THOSE CONTAINED IN THIS PARAGRAPH 4 AND TO THE EXTENT PERMITTED BY LAW THERE ARE NO IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE. THE PROVISIONS OF THIS PARAGRAPH 4 AS TO DURATION, WARRANTY ADJUSTMENT AND LIMITATION OF LIABILITY SHALL BE THE SAME FOR BOTH IMPLIED WARRANTIES (IF ANY) AND EXPRESS WARRANTIES.

(ii) The Company's warranty is solely as stated in (a) above and does not apply or extend, for example, to expendable items, ordinary wear and tear, altered units; units repaired by persons not expressly approved by the Company, materials not of the Company's manufacture, or damage caused by accident, the elements, abuse, misuse, temporary heat, over-loading, or by erosive or corrosive substances or by the alien presence of oil, grease, scale, deposits or other contaminants in the Equipment.

(c) WARRANTY ADJUSTMENT

Buyer must make claim of any breach of any warranty by written notice to the Company's home office within thirty (30) days of the discovery of any defect. The Company agrees at its option to repair or replace, BUT NOT INSTALL, F.O.B. Company's plant, any part or parts of the Equipment which within twelve (12) months from the date of initial operation but no more than eighteen (18) months from date of shipment shall prove to the Company's satisfaction (including return to the Company's plant, transportation prepaid, for inspection, if required by the Company) to be defective within the above Warranty. Any warranty adjustments made by the Company shall not extend the initial warranty period set forth above. The warranty period for replacements made by the Company shall terminate upon the termination of the initial warranty period set forth above. Expenses incurred by Buyer in replacing or repairing or returning the Equipment or any part or parts will not be reimbursed by the Company.

(d) SPARE AND REPLACEMENT PARTS WARRANTY ADJUSTMENT

The Company sells spare and replacement parts. This subparagraph (d) is the Warranty Adjustment for such parts. Buyer must make claim of any breach of any spare or replacement parts warranty by written notice to the Company's home office within thirty (30) days of the discovery of any alleged defect for all such parts manufactured by the Company. The Company agrees at its option to repair or replace, BUT NOT INSTALL, F.O.B. Company's plant, any part or parts of material it manufactures which, within one (1) year from the date of shipment shall prove to the Company's satisfactory (including return to the Company's plant, transportation prepaid, for inspection, if required by the Company) to be defective within this Parts Warranty. The Warranty and warranty period for spare and replacement parts not manufactured by the Company (purchased by the Company, from third party suppliers) shall be limited to the Warranty and Warranty Adjustment extended to the Company by the original manufacturer of such parts, in no event shall such other manufacturer's warranty create any more extensive warranty obligation of the Company to the Buyer for such parts than the Company's Warranty Adjustment covering parts manufactured by the Company as set forth in this subparagraph (d). Expenses incurred by the Buyer in replacing, repairing, or returning the spare or replacements parts will not be reimbursed by the Company.

(e) LIMITATION OF LIABILITY

The above Warranty Adjust-

ment sets forth Buyer's exclusive remedy and the extent of the Company's liability for breach of implied (if any) and express warranties, representations, instructions or defects from any cause in connection with the sale or use of the Equipment. THE COMPANY SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR FOR LOSS, DAMAGE OR EXPENSE, DIRECTLY OR INDIRECTLY ARISING FROM THE USE OF THE EQUIPMENT OR FROM ANY OTHER CAUSE WHETHER BASED ON WARRANTY (EXPRESS OR IMPLIED) OR TORT OR CONTRACT, and regardless of any advices or recommendations that may have been rendered concerning the purchase, installation or use of the Equipment.

5. PATENTS

(a) PATENT INDEMNITY AND CONDITIONS

The Company agrees at its own expense to defend and hold Buyer harmless in the event of any suits instituted against Buyer for an alleged infringement of any claim of any United States Patent covering solely to the structure of the Equipment as originally manufactured by the Company per the Company's specifications, and without modification by the Buyer, provided buyer shall (i) have given the Company immediate notice in writing of any such claim or institution or threat of such suit, and (ii) have permitted the Company to defend or settle the same, and have given all needed information assistance and authority to enable the Company to do so. Buyer shall defend and indemnify the Company against all expenses, costs and loss by reason of any real or alleged infringement by the Company's incorporating a design or modification requested by Buyer.

(b) LIMITATION OF LIABILITY

The Company's total liability hereunder is expressly limited to an amount no greater than the sales price of the Equipment and may be satisfied by the Company's refunding to Buyer, at the Company's option, the sales price of the Equipment in the event the Company elects to defend any such suit and the structure of the said Equipment is held to infringe any such United States Patent and if the Buyer's use thereof is enjoined, the Company shall, at its expense and at its option (i) obtain for the Buyer the right to continue using the Equipment, or (ii) supply non-infringing Equipment for installation by Buyer, or (iii) modify the Equipment so that it becomes non-infringing, or (iv) refund the then market value of the Equipment.

6. PRIOR USE

If damage to the Equipment or other property or injury to persons is caused by use or operation of the Equipment prior to being placed in initial operation ("Start up") by the Company where start up is included in the purchase price, then Buyer shall indemnify and hold the Company harmless from all liability, costs and expenses for all such damage or injury.

7. EQUIPMENT CHANGES

The Company may, but shall not be obligated to, incorporate in the Equipment any changes in specifications, design, material, construction, arrangement, or components.

8. SECURITY INTEREST; INSURANCE

(a) To secure payment of the purchase price, Buyer agrees that the Company shall retain a security interest in the Equipment until Buyer shall have paid in cash the full purchase price when due, interest at the highest lawful contract rate until so paid and the costs of collection, including reasonable attorney's fees. The Equipment shall at times be considered and remain personal property and Buyer shall perform all acts necessary to assure and perfect retention of the Company's security interest against the rights or interests of third persons. In the event Buyer defaults in payment of any part of the purchase price when due, or fails to comply with any and all provisions of this contract, the Company shall have the remedies available under the Uniform Commercial Code.

(b) So long as the purchase price is unpaid, Buyer at its

cost shall obtain insurance against loss or damage from all external causes, naming the Company as an insured, in an amount and form sufficient to protect the Company's interest in the Equipment.

9. CANCELLATION

Buyer cannot cancel orders placed with the Company, except with the Company's express written consent and upon terms and payment to the Company indemnifying the Company against loss, including but not limited to expenses incurred and commitments made by the Company.

10. LOSS, DAMAGE OR DELAY

The Company shall not be liable for loss, damage or delay resulting from causes beyond its reasonable control or caused by strikes or labor difficulties, lockouts, acts or omissions of any governmental authority or the Buyer, insurection or riot, war, fires, floods, Acts of God, breakdown of essential machinery, accidents, priorities or embargoes, car and material shortages, delays in transportations or inability to obtain labor, materials or parts from usual sources. In the event of any delay from such sources, performance will be postponed by such length of time as may be reasonably necessary to compensate for the delay. In the event performance by the Company of this agreement cannot be accomplished by the Company due to any action of governmental agencies, or any laws, rules or regulations of the United States Government, the Company (at its option) may cancel this agreement without liability. In no event shall the Company be liable for any loss or damage of any kind, including consequential or special damages of any nature.

11. WORK BY OTHERS: ACCESSORY AND SAFETY DEVICES

The Company, being only a supplier of the Equipment, shall have no responsibility for labor or work of any nature relating to the installation or operation or use of the Equipment, all of which shall be performed by Buyer or others. It is the responsibility of Buyer to furnish such accessory and safety devices as may be desired by it and/or required by law or OSHA standards respecting Buyer's use of the Equipment. Buyer shall be responsible for ascertaining that the Equipment is installed and operated in accordance with all code requirements and other applicable laws, rules, regulations and ordinances.

12. COMPLETE AGREEMENT

THE COMPLETE AGREEMENT BETWEEN THE COMPANY AND BUYER IS CONTAINED HEREIN AND NO ADDITIONAL OR DIFFERENT TERM OR CONDITION STATED BY BUYER SHALL BE BINDING UNLESS AGREED TO BY THE COMPANY IN WRITING. No course of prior dealings and no usage of the trade shall be relevant to supplement or explain any terms used in this Agreement. This Agreement may be modified only by a writing signed by both the Company and Buyer and shall be governed by the Uniform Commercial Code as enacted the State of Texas. The failure of the Company to insist upon strict performance of any of the terms and conditions stated herein shall not be considered a continuing waiver of any such term or condition or any of the Company's rights.

WARNING! Read this section first. Failure to carefully follow these instructions could result in permanent injury or loss of life.

SAFETY

Here are some safety points to keep in mind when creating an efficient yet safe working environment.

Safety Definitions

Statements or labels in this manual or on the product preceded by the following words are of special significance:

Warning
Indicates severe personal injury or death will result if instructions are not followed.

Caution
Indicates a strong possibility of severe personal injury or death if instructions are not followed.

Important
Means hazards or unsafe practices which could cause minor personal injury or product or property damage.

Note
Gives helpful information.

Machinery is Dangerous

Machinery can hurt you if you are not careful. Use caution during assembly and operation of equipment.

ALWAYS:

- Read the entire manual first.
- Use common sense and be careful.
- Have enough manpower.
- Have the proper tools.
- Follow directions and illustrations.
- Check to see that all equipment meets applicable installation codes for your area.
- Have sufficient safety warnings on all equipment.

EMERGENCY STOP BUTTON

Note:
Warning labels attached to the control panel, screw trough extension, belt pulley guard, and access panels should be followed. They are shown in Figure 2-1, Figure 2-2, Figure 2-3, and Figure 2-4.

If all labels are not attached and visible or labels start to become illegible, contact Turbo Refrigerating Company immediately.

Turbo Refrigerating Company
P.O. Box 396
Denton, Texas 76202
1-817-387-4301
Telex:
682 9266 Turbo UW
FAX # 817-382-0364

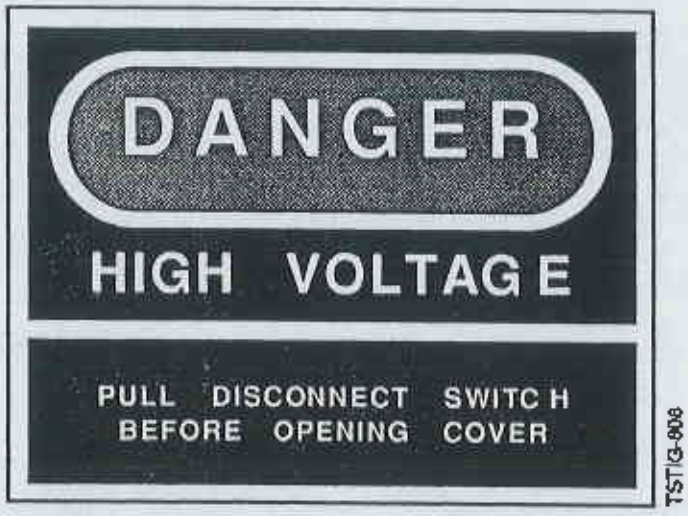


Figure 2-1 Warning Labels on the Control Panel

WARNING! Read this section first. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Involve Your People

Before operating equipment, have the people involved in the operating or maintenance of the equipment meet to discuss the dangers and safety aspects of the TIG.

- Warn them of the danger of miscommunication.
- Turn electricity off and **lock it out** when working on the TIG.
- Have a person trained and qualified in the operation of the equipment on duty to ensure that the electricity stays **locked out** to protect the personnel working on the equipment.

Figure 2-2 Warning Labels on the Screw Trough Extension

WARNINGS

- The TIG is an automatic machine. When in operation, any and all motors may start without warning. Some motors may start even if the master control switch is in the "OFF" position. Never attempt to service the TIG unless all electrical power is disconnected and **locked out.**
- The ice discharge opening has a warning label (refer to Figure 2-3). Field installation must ensure that a cover or guard (not supplied by Turbo) is in place on the ice discharge opening before operating to prevent entry into the screw conveyor.

Figure 2-3 Warning Labels on the Access Panels

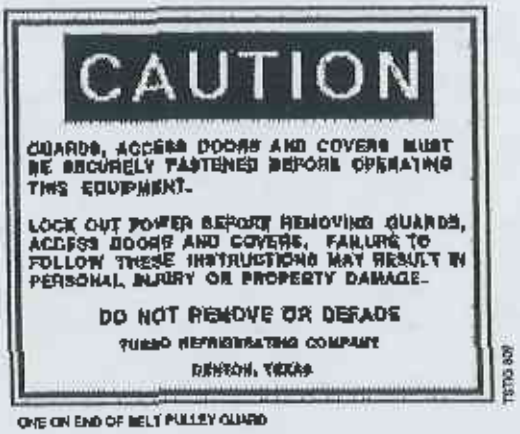
WARNING! Read this section first. Failure to carefully follow these instructions could result in permanent injury or loss of life.

- Pull disconnect and lock out all electrical service before removing any guards, access panels, and/or covers.
- Never operate the unit without all guards, access panels, and covers in place and securely fastened.
- If leaks in the refrigerant piping require soldering or welding, be sure refrigerant is bled off and the system is open before attempting to repair. Protect eyes with the proper eye protection.
- When changing oil in the compressor, make sure the pressure is bled off before opening the system.
- Always wear eye protection when cleaning the system.
- Do not expose insulation (polyurethane) to open flame. If ignited, it will give off highly toxic fumes. Leave the area and notify qualified personnel.
- Use only recommended ice machine cleaners. Follow instructions and warnings supplied by the manufacturer of the cleaning agents.
- Never open the control panel without disconnecting and **locking out** electrical service. All electrical work should be performed by a qualified electrician.
- When servicing the TIG, Turbo recommends that at least two (2) people be present at all times.
- Although Turbo Refrigerating Company does not supply conveying equipment beyond the ice discharge opening, any conveyors used in association with the operation of Turbo equipment must be sufficiently guarded to prevent injury.

Notes:

1. Conveyor manufacturer's instructions and warnings are on pages 15–16.
2. Per the OSHA Hazard Communication Standard, material safety data sheets for refrigerant and refrigerant oils are on pages 17–23.

TWO ON END OF BELT PULLEY GUARD



ONE ON END OF BELT PULLEY GUARD

Figure 2-4 Warning Labels on the Screw Conveyor Belt Pulley Guard

WARNING! Read this section first. Failure to carefully follow these instructions could result in permanent injury or loss of life.

- If an outside contractor is required to install or service your TIG, require him to furnish you with a certificate of insurance before performing any work on your equipment. Turbo also recommends that the person hiring a contractor to perform work be satisfied with their experience and competence.

Keyed Control Switch *

A keyed switch is provided to control the TIG operations (on and off). To lock out the TIG controls:

1. Pull disconnect and **lock out** all electrical service.
2. Turn key selector switch (provided) to the "OFF" position.
3. Take key out and keep in your possession.

* On some early models (prior to mid 1988), a keyed switch was not provided. Follow step #1.

Emergency Stop Button

A push/pull mushroom head emergency switch is on the control panel door for emergency cut-off of the control circuit power. Refer to Figure 2-1. *This button is not to be used for service or lock out.* **This is an emergency button only.**

If you have questions, *call Turbo Refrigerating* Company at:

1-817-387-4301.

WARNING! Read this section first. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Conveyor Manufacturer's Instructions and Warnings

Turbo Refrigerating Company does not install conveyors, consequently it is the responsibility of the contractor, installer, owner, and user to install, maintain, and operate the conveyor, components, and assemblies in such a manner as to comply with the Williams-Steiger Occupational Safety and Health Act and with all state and local laws and ordinances and the American National Standard Institute (ANSI) safety code.

In order to avoid an unsafe or hazardous condition, the assemblies or parts must be installed and operated in accordance with the following minimum provisions.

1. Conveyors shall not be operated unless all covers and/or guards for the conveyor and drive unit are in place. If the conveyor is to be opened for inspection, cleaning, maintenance, or observation, the electric power to the motor driving the conveyor must be **locked out** in such a manner that the conveyor cannot be restarted by anyone (however remote from the area) until conveyor cover or guards and drive guards have been properly replaced.

2. If the conveyor must have an open housing as a condition of its use and application, the entire conveyor is then to be guarded by a railing or fence in accordance with ANSI standard B20.1-1976, with special attention given to section 6.12.

3. Feed openings for shovel, front loaders or other manual or mechanical equipment shall be constructed in such a way that the conveyor opening is covered by a grating. If the nature of the material is such that a grating cannot be used, then the exposed section of the conveyor is to be guarded by a railing or fence and there shall be a warning sign posted.

4. Do not attempt any maintenance or repairs of the conveyor until power has been **locked out.**

5. Always operate conveyor in accordance with these instructions and those contained on the caution labels affixed to the equipment.

6. Do not place hands or feet in the conveyor.

7. Never walk on conveyor covers, grating, or guards.

8. Do not use conveyor for any purpose other than that for which it was intended.

9. Do not poke or prod material into the conveyor with a bar or stick inserted through the openings.

10. Keep area around conveyor drive and control station free of debris and obstacles.

11. Always regulate the feeding of material into the unit at a uniform and continuous rate.

12. Do not attempt to clear a jammed conveyor until power has been **locked out.**

13. Do not attempt field modification of conveyor or components.

Turbo Refrigerating Company insists that disconnecting and locking out the power to the motor driving the unit provides the only real protection against injury. Other devices should not be used as a substitute for **locking out** the power prior to removing guards or covers. We caution that use of secondary devices may cause employees to develop a false sense of security and fail to **lock out** power before removing covers or guards. This could result in a serious injury should the secondary device fail or malfunction.

There are many kinds of electrical devices for interlocking of conveyors and conveyor systems such that if one conveyor in a system or process is stopped, other equipment feeding it, or following it can also be automatically stopped.

Electrical controls, machinery guards, railings, walkways, arrangement of installation, training of personnel, etc. are

WARNING! Read this section first. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Material Safety Data Sheet for Freon

A. General Information

TRADE NAME (COMMON NAME, SYNONYM):
Refrigerant 22, Freon 22, Genetron 22, Fluorocarbon 22, CFC-22, R-22

CAS NO.: 75-45-6
DOT NO.: UN 1018

CHEMICAL NAME: Chlorodifluoromethane or monochlorodifluoromethane

FORMULA: $CHClF_2$

MANUFACTURER'S ADDRESS: (MAILING)

Racon Inc.
P.O. Box 198
Wichita, KS 67201

(LOCATION)

Racon Inc.
6040 S. Ridge Road
Wichita, KS 67215

CONTACT:
Vice President of Manufacturing
(316) 524-3245 or
(800) 835-2916

ISSUE DATE: 11/18/85
REVISED DATE:

For Emergency Medical Information: Call Collect (415) 821-5338 (24 hrs.)

B. First Aid Measures

Inhalation --- Vapor contact --- primary route of exposure. If inhaled, remove to fresh air. Keep warm and at rest. If breathing is difficult (labored), give oxygen. If not breathing, give artificial respiration and check for pulse. If no pulse, start CPR (cardiopulmonary resuscitation). **Do Not** give stimulants (adrenaline, epinephrine or hand-held asthma aerosols). Call 911 (if available) and a physician. Keep patient at rest for 24 hours after overexposure. No long-term effects are expected.

Eyes and/or Skin --- Vapor contact --- flush with fresh water for at least 20 minutes.
Liquid contact --- flush exposed area with lukewarm water or otherwise warm skin slowly. Frostbite is probable. Treat accordingly. Call a physician.

Ingestion --- Liquid --- not probable --- if ingested however, keep patient calm, if conscious, and get to a physician immediately --- frostbite is probable, indicated by necrosis of lips and tongue (contacted tissue), blanching of skin, pain and tenderness. Warm skin slowly.

WARNING! Read this section first. Failure to carefully follow these instructions could result in permanent injury or loss of life.

C. Hazards Information

TOXICITY AND HEALTH

EXPOSURE LIMITS: TLV 1000ppm(vol) (8 hr. TWA) STEL 1250ppm(vol)

ACUTE EXPOSURE EFFECTS:

Inhalation --- CFC-22 is relatively non-toxic following acute exposure. Although no long-term comprehensive studies have specifically investigated acute overexposure of humans to CFC-22, experience indicates the cardiovascular and respiratory systems are the primary systems affected. Abuse (intentional inhalation) has caused death. Human exposure to high concentrations (e.g. 20%) may cause confusion, lung (respiratory) irritation, tremors and perhaps coma, but these effects are generally short lived and reversible without late aftereffects when removed to fresh air. LC_{50} values for rats and mice range from 277,000 to 390,000ppm(vol) over varying time periods of 15 minutes to 2 hours. High atmospheric concentrations of CFC-22 produce stimulation and then depression and finally asphyxiation.

Ingestion --- not probable, at atmospheric pressure, liquid CFC-22 boils at -41.4° F (-40.8° C). Freezing and severe frostbite of contacted tissue will result.

Skin --- contact of vapor CFC-22 with skin or eyes should not cause injury. Contact of liquid CFC-22 will result in freezing and frostbite of contacted tissue.

Note: Human Poisoning Potential --- Sniffing of fluorocarbon propellants for their intoxicating effects has produced over 100 deaths. Fluorocarbons exhibit very toxic properties (asphyxiation, cardiac arrhythmia) when sniffed; however, because of variations in response, it is difficult to predict which symptoms will be exhibited following exposure. It is possible that individuals with heart or respiratory disorders may prove especially susceptible.

SUBCHRONIC/CHRONIC EXPOSURE EFFECTS:

Overexposure by inhalation of various animals to 46,000ppm(vol) --- 50,000ppm(vol) of CFC-22 for 8 days to 10 months caused alterations in body weight and physiological endurance, and affected the lungs, central nervous system (CNS), heart, liver, kidneys and spleen. No information was found concerning effects on humans.

CARDIAC STUDIES:

CFC-22 inhaled at concentrations of 50,000ppm and above has been shown in tests on dogs to sensitize the heart to exogenous (outside the body) adrenaline, resulting in serious and sometimes fatal irregular heart beats (cardiac arrhythmias).

CARCINOGENIC POTENTIAL:

A lifetime inhalation study on rats and mice was performed by ICI, Ltd, (UK). The results from this test showed no effects on either rats or mice up to 10,000ppm(vol). At 50,000ppm (vol), CFC-22 was weakly carcinogenic to the oldest male rats (exhibiting a low incidence of fibrosarcoma in the salivary gland). The significance of this finding is questionable. No abnormal incidence was found in mice of either sex or in female rats at 50,000ppm(vol). No other findings of biological significance were made.

TERATOGENIC POTENTIAL:

Teratogenic studies on rats and rabbits showed an increased incidence of absence of eyes in rat fetuses at exposure levels of 50,000ppm. (CFC-22 exposure occurred from the 6th to 15th day of pregnancy). There was no effect on rabbits or their offspring at this level. There was no evidence of other overt fetal abnormalities.

WARNING! Read this section first. Failure to carefully follow these instructions could result in permanent injury or loss of life.

FIRE AND EXPLOSION

Nonflammable and nonexplosive. One documented incident has been reported where an explosion occurred during the weld repair of a compressor shell which apparently contained a 50:50 mixture of air and CFC-22. At high temperatures (1170° F, 632° C) under favorable laboratory conditions, CFC-22 is capable of forming weakly combustible mixtures with air. Formation of combustible mixtures, under practical conditions, even at higher temperatures, is extremely unlikely and the fire hazards of CFC-22 are very small.

D. Precautions/Procedures

Do not breathe vapors. Avoid contact with eyes, skin and clothing. Wear protective clothing including goggles and cloth-lined rubber gloves. Not for food, drug or cosmetic use.

Store and use with adequate ventilation. Never use in a closed or confined space. Local exhaust may be necessary to reduce concentrations below TLV (1,000ppm). Store in cool place (<120° F).

When fighting fire near or involving this product, use self-contained breathing apparatus. If CFC-22 contacts open flames or extremely hot metal surfaces, it may decompose to form HF, HCl and traces of carbonyl halides (i.e., phosgene).

In the event of a spill or leak, keep upwind. Ventilate enclosed spaces until gas is dispersed. Do not smoke or operate internal combustion engines in immediate vicinity.

CFC-22 is shipped and stored as a liquefied, compressed gas under pressure.

E. Personal Protective Equipment

Respiratory protection is not needed if concentrations are controlled. If concentrations exceed TLV (1,000ppm), use an approved respirator for organic vapors. In very high concentrations, self-contained breathing equipment should be used.

Protective clothing should minimize exposed skin and include goggles, a full face shield if splashing is possible, and cloth-lined rubber gloves.

F. Physical Data

CFC-22 is a gas at normal conditions of 77° F (25° C) and 1 atm.
Molecular weight 86.5
Boiling Point (1 atm) -41.4° F (-40.8° C)
Vapor pressure @ 77° F (25° C) is 136.7 psig
Vapor density is 2.76 lb/ft^3 @ 77° F
Specific gravity of vapor (air = 1) 3.08 @ 1 atm and 77° F
Specific gravity of liquid (water = 1) 1.20 @ 77° F
% volatile @ 77° F and 1 atm 100% (vol)
Solubility in water (% wt) 3 gm/l
Soluble in acetone, ethanol and chloroform
Appearance --- colorless liquid and vapor
Odor --- very slight ethereal odor to odorless

WARNING! Read this section first. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Section III. Fire and Explosion Data

Special Fire Fighting Procedures: Wear self-contained breathing apparatus. Water spray is an unsuitable extinguishing agent.

Unusual Fire and Explosion Hazards: None

Flash Point (Method Used): ASTM D-92 >300° F (>150° C)

Flammable Limits %: NA

Extinguishing Agents:

[X]	Dry Chemical	[X]	CO_2
[ ]	Waterspray	[X]	Foam
[X]	Waterfog	[X]	Sand/Earth
[ ]	Other _____		

Section IV. Health Hazard Data

Permissable Concentrations (air): 5 mg/m^3 mineral oil mist (OSHA).

Effects of Overexpose: Prolonged contact may cause minor skin irritation.

Toxicological Properties: NDA

Emergency First Aid Procedures:

Eyes:	Flush with large amounts of water for at least 15 minutes. If redness or irritation persists, contact a physician.
Skin contact:	Wash with soap and water. Wash clothing before reuse.
Inhalation:	None normally required.
If Swallowed:	Call a physician.

Section V. Special Protection Information

Ventilation Type Required (Local, Mechanical, Special): NA

Respiratory Protection (Specify Type): NA

Protective Gloves: Oil resistant rubber

Eye Protection: Chemical splash goggles

Other Protective Equipment: Rubber apron

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Section VI. Handling of Spills or Leaks

Procedures for Clean-up:

Stop leak, dike up large spills. Use inert absorbent material such as earth, sand, or vermiculite for clean-up.

Waste Disposal:

Dispose of in accordance with Local, State, and Federal government regulations.

Section VII. Special Precautions

Precautions to be Taken in Handling and Storage:

Avoid exposure to heat and flame. Protect against eye and skin contact. Wash thoroughly after handling.

Section VIII. Transportation Data

Unregulated by D.O.T. [X] Regulated by D.O.T. [ ]

Transportation Emergency Information: CHEM TREC 1-800-424-9300

U.S. D.O.T. Proper Shipping Name: NA U.S. D.O.T. Hazard Class: NA

I.D. Number: NA

RQ: NA Label(s) Required: NA

Freight Classification: Petroleum Oil NOIBN

Special Transportation Notes: NA

Section IX. Comments

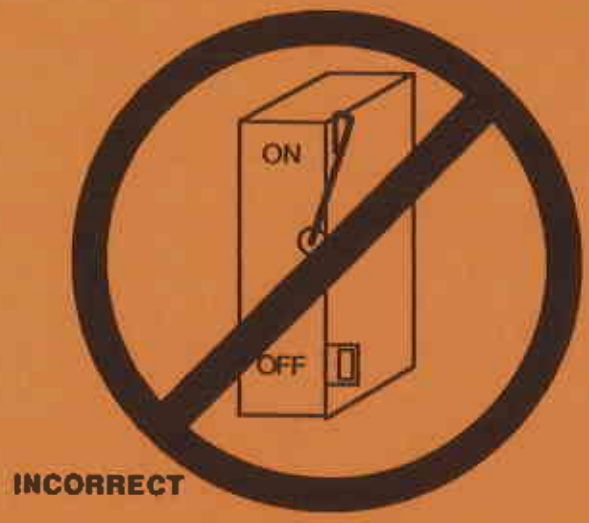
CAS #64742-52-5

Signature: _____ Title: _____
Telephone: _____ Date: _____
Revision Date: _____ Sent To: _____
Supersedes: _____

Turbo believes the statements, technical information and recommendations contained herein are reliable, but they are given without warranty or guarantee of any kind, express or implied, and we assume no responsibility for any loss, damage, or expense, direct or consequential, arising out of their use.

DISCONNECTING POWER & LOCK OUT

Turbo Refrigerating Company insists that **disconnecting** and **locking out** the power to the motor driving the unit provides the only real protection against injury. Other devices should not be used as a substitute for **locking out** the power prior to removing guards, covers, or other safety devices. Turbo warns that the use of secondary devices may cause employees to develop a false sense of security and fail to **lock out** power before removing guards, covers, or other safety devices. This could result in a serious injury should the secondary device fail or malfunction.



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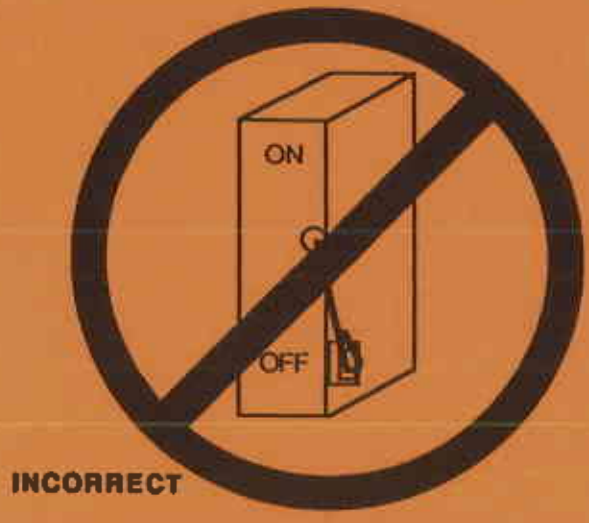

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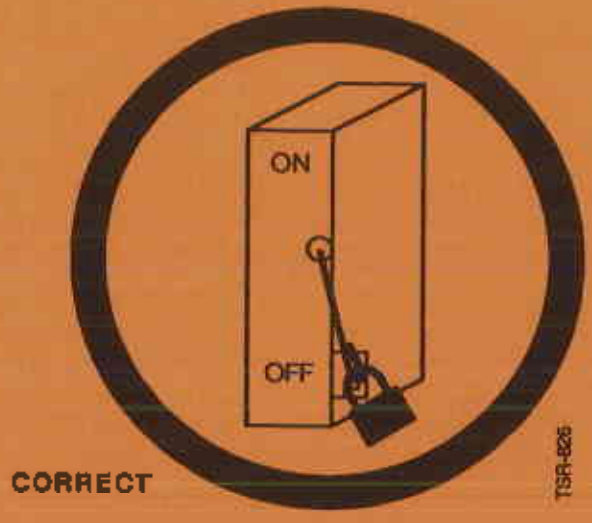

CORRECT

TSR-826

WARNING! Read this section first. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Safety Lockout Procedure
Effective November 1, 1989

I. Purpose

The purpose of this procedure is to prevent injury and/or death to personnel by requiring that certain precautions be taken before servicing or repairing equipment. It has been developed and implemented so as to comply with 29 CFR 1910.147, of the Occupational Safety and Health Act, as amended.

These precautions include:

1. Shutting off and locking out electrical power.
2. Releasing pressure in pneumatic and hydraulic systems.
3. Effectively isolating those portions of equipment and machinery that are energy intensive and are being serviced or maintained.

II. Scope

This procedure includes those employees whose duties require them to do maintenance work on power-driven equipment. It covers the servicing or maintenance of machines or equipment in which the unexpected energization, start-up or release of stored energy could cause injury.

III. Supervisory Responsibility

It is the responsibility of all supervisors having contact with such operations to:

A. Instruct all affected employees as to the content of this program.

B. Ensure compliance with this procedure.

IV. Safety Locks

Safety locks and keys will be issued to designated employees. Locks and keys must be returned to the plant manager when an employee transfers to another assignment or terminates his employment. Safety and supervisory personnel shall have access to master keys for protective locks, and under certain controlled conditions, be available to assist in the removal of safety locks.

Safety locks are painted yellow for electricians and red for maintenance personnel. These locks are to be used only for locking out machinery, tooling, and equipment described in this procedure.

V. Safety Department Responsibility

It is the responsibility of the Safety Coordinator to inspect the plant on a periodic basis to ensure compliance with this procedure. If it is determined that this procedure is not being complied with, immediate corrective action will be initiated. Wherever possible, such action will be taken in conjunction with the first-line supervisor; however, higher level management personnel will be involved if the violation is of a serious or repetitive nature.

VI. Rules and Regulations

The following rules and regulations have been established and are mandated:

A. Any electrician or maintenance person whose duties require that he or others be exposed to the hazards of electrical shock or moving equipment, must perform those duties in a safe and uncompromising manner. The following steps outline such precautions:

1. The employee must understand the equipment with which he is working and its hazards.
2. When working with electrical equipment where the accidental starting of such equipment or release of stored energy would create a hazard, the employee must turn off all power to the unit or use energy isolating devices and ap

WARNING! Read this section first. Failure to carefully follow these instructions could result in permanent injury or loss of life.

ply his personal lock, and have the supervisor of that area apply his personal lock. At all times when maintenance is being performed on our equipment, that equipment will have 2 locks on it, one by the person performing the maintenance plus the one of the supervisor.

3. In instances where multiple circuits are in a circuit breaker box, an attaching mechanism will be placed on the outside of the box to allow that box to be locked out and prevent the door from being opened.

B. Each employee who performs the duties prescribed above will be provided with an individual safety lock and one key. If more that one employee is assigned to a task, each employee is required to place his own lock and tag so the controls cannot be operated, even though another person may have completed his own task, and remove his own lock.

C. If the equipment controls are so located that only one lock can be accommodated, a special attachment that accommodates several locks must be used. This attachment will be issued to all designated employees.

D. Should an employee be required to work on another piece of equipment and need to leave his lock on the present equipment, another lock must be obtained from the plant manager.

E. Should it be necessary to operate a piece of equipment which is locked out, every effort should be made by supervision to locate the employee whose lock is on the equipment. If that employee cannot be located, the supervisor may obtain a master key for the lock. The supervisor must personally assure himself that it is safe to remove the lock. The lock should than be returned to the proper employee.

This procedure must be used with extreme caution and good judgement. There is danger that the employee involved will return thinking that the machine is still locked out, when it has actually been turned back on.

F. If a machine is locked out and it is necessary to leave the area, recheck the lock upon returning to make sure that the machine is still locked out. While supervision will make every attempt to avoid the removal of locks, there may be situations when it must be done. This recheck is for your protection.

G. It is sometimes necessary to operate equipment for purposes of testing or making adjustments prior to the actual completion of the work. It is recognized that electricians must work on live circuits from time to time, particularly when trouble-shooting, but extreme caution must be used under these circumstances. Never work alone when changing live wiring.

VII. Outside Contractors

Whenever outside servicing personnel are to be engaged in activities covered by the scope and application of this lockout and tag procedure, such personnel are to be informed of this procedure by the person responsible for their work activity and are to direct them to follow its requirements. Failure to do so shall require that they do not be permitted to continue working in the plant.

VIII. Failure To Follow Procedures

These procedures have been developed to protect employees from serious injury. It is necessary that all employees follow them. Those employees not complying with the provisions in this procedure will be subject to disciplinary action, up to and including discharge.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

INSTALLATION & PRE-START-UP REQUIREMENTS

To install and prepare the Turbo Ice Generator (TIG) unit for operation, you will need two to four people whose skills include mechanical, welding, and plumbing capabilities as well as a qualified electrician.

This section includes step-by-step instructions on installing and connecting your TIG unit. Your TIG unit has been tested and inspected at the factory prior to packing and shipping. The general installation sequence is as follows:

1. Delivery Inspection
2. Hoisting or Moving
3. Site Preparation
4. Mounting and Leveling
5. Building Openings (Ice Chutes) to Storage
6. Aligning Compressors and Motors
7. Electrical Connections
8. Water Connections
9. Refrigerant Piping
10. Testing Refrigeration System for Leaks
11. Evacuating the System
12. Charging the Unit with Refrigerant Oil
13. Refrigerant Charging
14. Air-Cooled Condensers
15. Evaporative-Cooled Condensers
16. Water-Cooled Condensers

IMPORTANT

Pay special attention to any bold print or boxed in paragraphs. Following this information is essential for a safe, efficient installation.

To Help You Get Started

- Read instructions completely before installation.
- Gather all required tools.
- Establish front and rear, and left and right of the TIG unit by facing the motor/compressor and evaporator sections (see Figure 3-1).
  - On the left is the motor/compressor section of the TIG unit.
  - On the right is the evaporator section and screw conveyor discharge of the TIG unit.
  - On the rear of the TIG unit are the water connections.
  - All refrigerant connections are on the left side of the evaporator section.

  Use this method when referring to parts that are left, right, front, or rear.

Helpful Hints

- Do not discharge ice directly from the TIG unit into the storage bin or delivery system. Use an inclined screw conveyor (auger) to transport the ice to the ice entry opening in the storage bin or delivery system. The screw conveyor should be pitched to drain:
  - melting snow
  - ice fines (slivers of ice)
  - condensation
  - water accidentally dumped out of the TIG unit screw conveyor discharge
  - cleaning solutions used to clean the evaporator or upper frame
- **Always remember - SAFETY FIRST !!!**

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

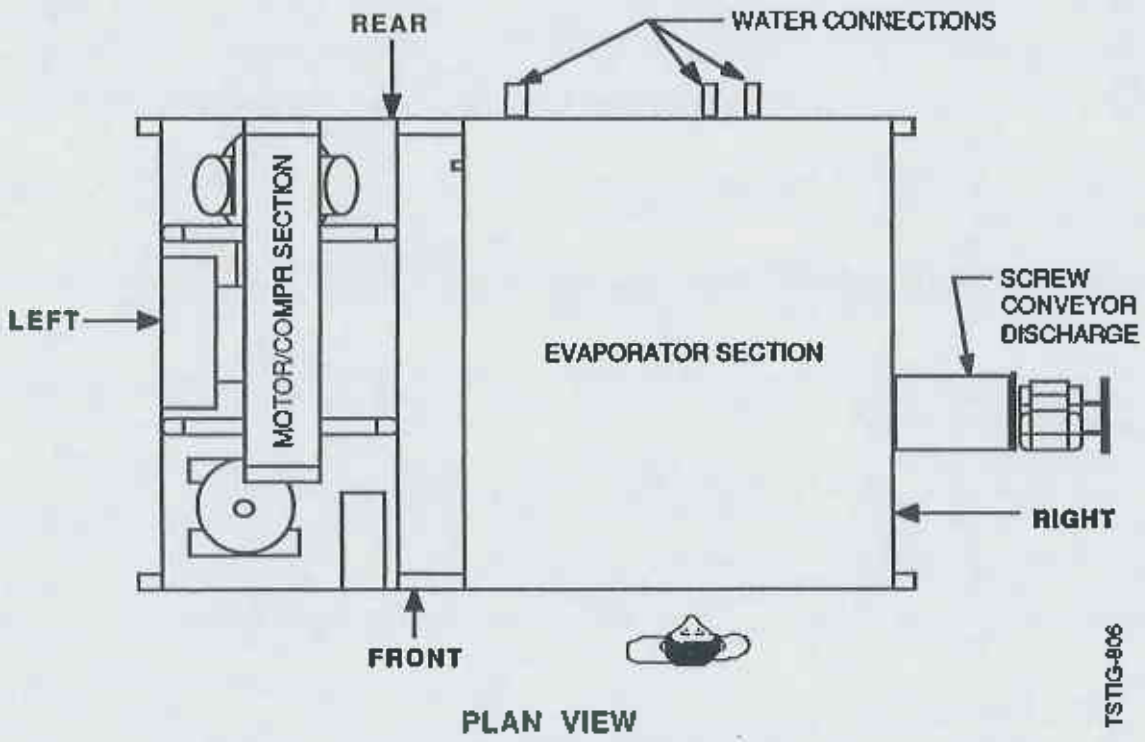

Figure 3-1 TIG Unit Orientation (Typical SC Model)

Note:
On SCA and SCE models, the air-cooled or evaporative-cooled condenser is also mounted on the left end of the unit.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

TOOLS

To install the TIG unit, you will need two to four people whose skills include mechanical, welding, and plumbing capabilities as well as a qualified electrician. The following is a list of tools required for safe erection and assembly of the TIG unit:

- Wrenches and sockets (a full set up to 1 1/8")
- Phillips (not cross-point) and standard (slotted) screw drivers
- Level (four feet long)
- Tape measure (fifty feet long)
- Pry bar
- Chain hoists (one ton) or two "come alongs" (1000#)
- Allen wrenches (sizes 1/8" to 1/2")
- Chains (two - 3/8 inch, minimum - ten feet long)
- Arc welder
- Amp probe
- Voltage tester
- Continuity tester
- Framing square
- Forklift

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

1. DELIVERY INSPECTION

All self-contained TIG units are thoroughly inspected and tested at the factory to assure shipment of a mechanically sound piece of equipment.

Inspect the TIG unit thoroughly upon arrival at the installation site to check for any shipment damage.

Report any damage to the transportation company immediately so that an authorized agent can examine the TIG unit, determine the extent of the damage, and take the necessary steps to rectify the claim without costly delays. Notify Turbo of any claims made.

Turbo ice generators are shipped on "air-ride" trailers to ensure that the equipment arrives in the best possible condition.

Delivery Inspection Checklist

1. Panels.
2. Loose equipment and crate - open for inspection.
3. Evaporator plates.
4. Valves and piping.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

2. HOISTING OR MOVING

Equipment Rigging Instructions

The TIG unit must be lifted by the lifting lugs provided by Turbo. Please note that these lifting lugs are not intended to be used for extended lifting periods. Depending on the orientation of the lifting lugs, the use of a spreader bar and blocks may be required to protect the exterior panels. In some cases, remove certain exterior panels for the rigging operation.

Figure 3-2 shows the configuration with lifting lugs on the ends. This configuration is used on smaller TIG units. The use of blocks and spreader bars are required to avoid damage to the cabinetry.

Figure 3-3 shows the lifting lug operation used on larger TIG units. The lifting lugs can be used by running the sling through the 3" pipes which run through the units.

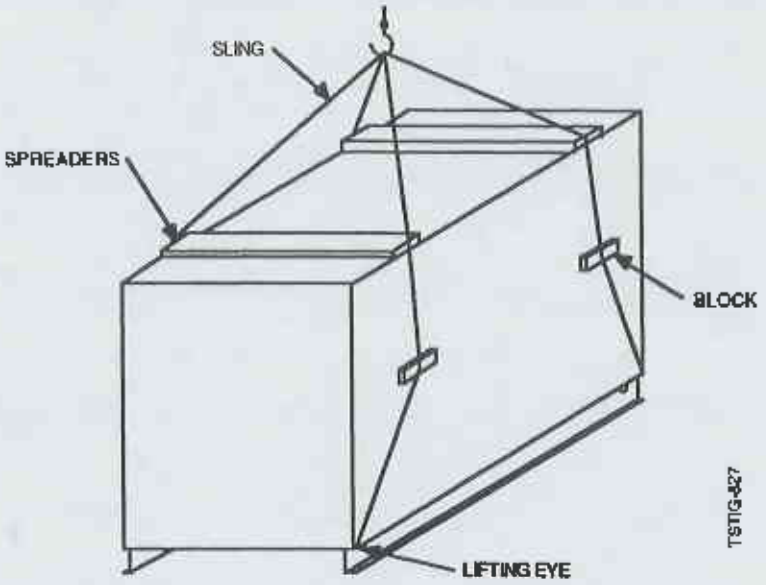

Figure 3-2 Small TIG Unit Configuration

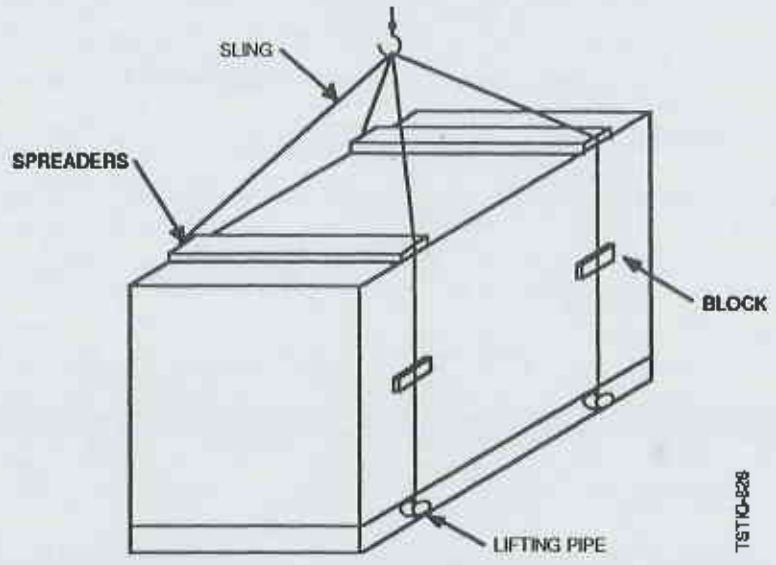

Figure 3-3 Large TIG Unit Configuration

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Figure 3-4 shows an TIG unit with a condenser mounted on a common skid. The lifting method is similar to that of Figure 3-3, with both spreader bars and blocks being required.

Figure 3-5 shows a larger TIG unit requiring middle support during lifting. Additional lifting lug(s) will be provided as required for proper rigging.

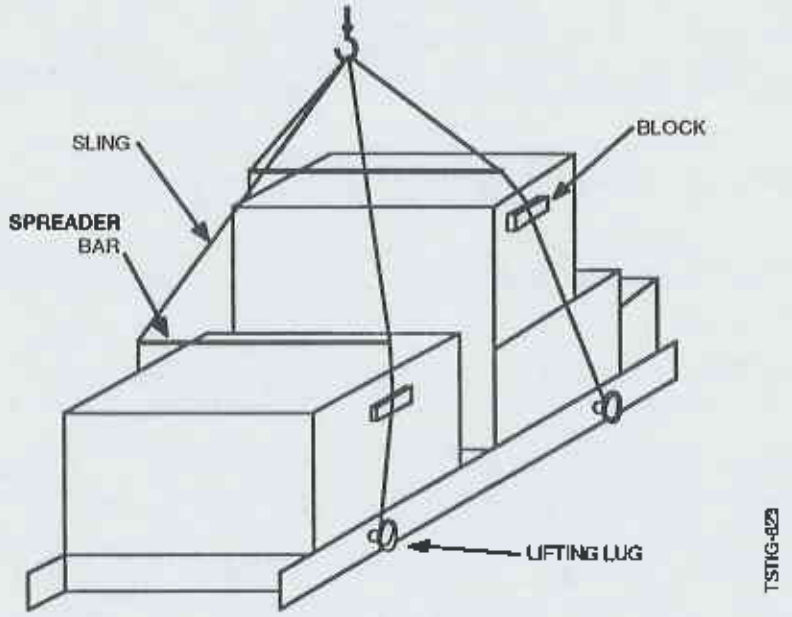

Figure 3-4 Common Skid

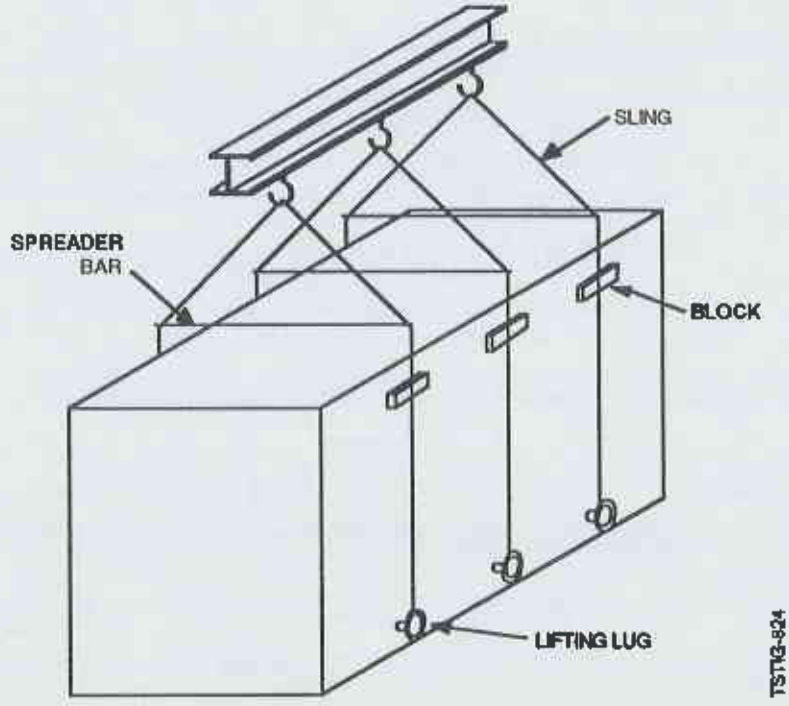

Figure 3-5 Larger TIG Unit With Middle Support

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

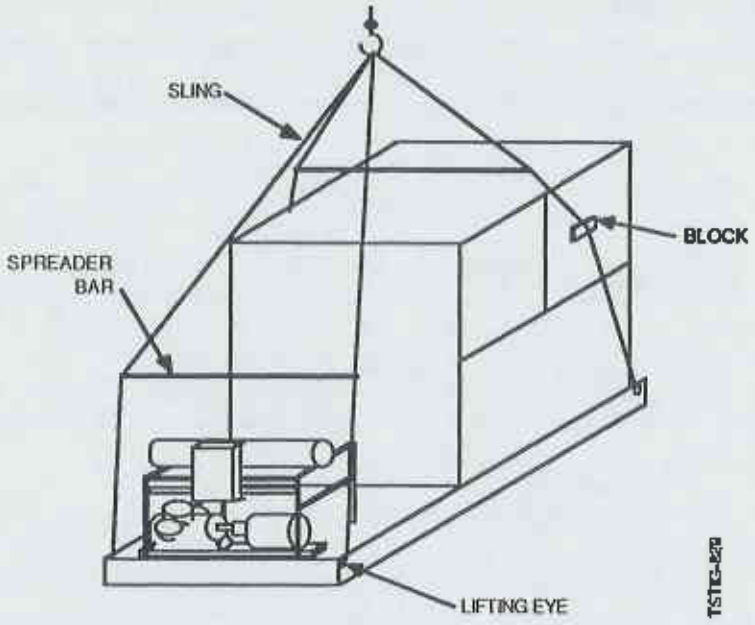

Figure 3-6 TIG Unit With An Outboard Water-Cooled Condensing Unit

Figure 3-6 shows a typical TIG unit with an outboard water-cooled condensing unit. This configuration is typical of all SC, SCAR, and SCER models. The lifting method is the same as for Figure 3-2.

Figure 3-7 shows a typical TIG unit with an air-cooled condensing unit. This configuration is typical of SCA and SCE models. Multiple spreader bars and blocks are required.

Note:
TIG units with a weatherizing enclosure on outboard equipment would be similar to Figure 3-2.

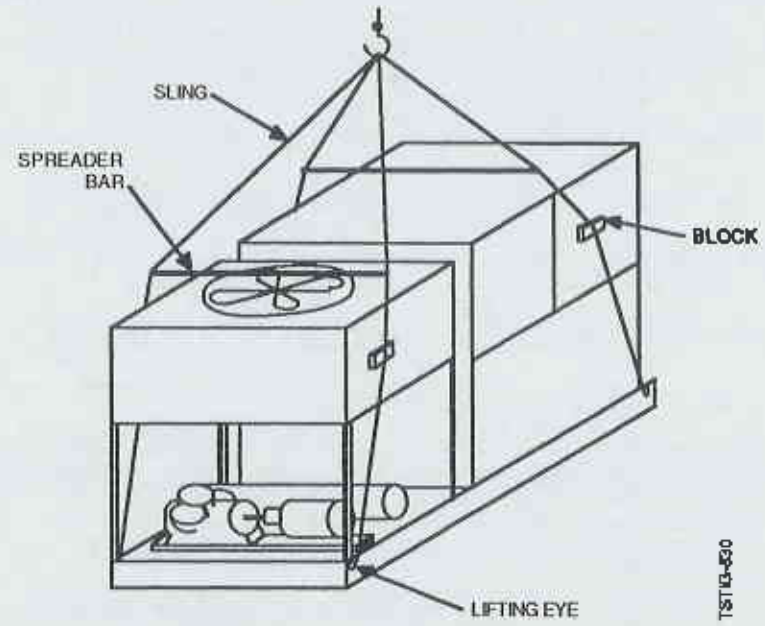

Figure 3-7 TIG Unit With An Air-Cooled Condensing Unit

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Hoisting or Moving

If a TIG unit is installed in a location that requires the TIG unit to be lifted by means of a crane, Turbo requires that the lifting and/or slinging be done from the bottom of the TIG unit. Use a spreader at the top of the TIG unit to prevent the unit panels from crushing. A competent rigging and hoisting contractor can handle the job without danger or damage to the TIG unit.

If a TIG unit has to be moved along a floor, road, driveway, etc., use either pipes as rollers or dollies (of sufficient capacity) under the TIG unit.

IMPORTANT

Never lift or sling the TIG unit with devices fastened to the top frame structure. Only lift the TIG unit from the bottom.

The self-contained TIG unit model contains an outboard condensing unit located next to the evaporator section. The evaporator and condensing sections are located on a common base frame provided with either lifting eyes or lifting pipes. Before hoisting, the rigger must ensure that the load is properly balanced to prevent tilting or tipping of the TIG unit. Test the load before lifting off the truck or ground.

WARNING

Hoisting or moving heavy equipment should only be done by competent rigging and hoisting contractors. Never allow personnel under the unit while it is in the air. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

3. SITE PREPARATION

Install the TIG unit in an area where the ambient temperature does not fall below 40°F or rise above 100°F. The upper (freezing) compartment of the unit is insulated against excessive heat infiltration. The lower (machinery) compartment is designed to provide ventilation for the machinery and motors.

Provide adequate working space on all sides and the top of the TIG unit for easy access to service and clean.

Concrete Slab

If the TIG unit is to be mounted on a concrete slab, the surface of the slab must be level or shimming must be provided under the unit to ensure that it is level. When shimming is required, use caution to prevent long unsupported spans under the structural base frame.

IMPORTANT

Failure to follow these guidelines could result in excessive equipment vibration or uneven water distribution over the evaporator plates.

When preparing the slab, it may be desirable to embed steel plates or anchors in the concrete to secure the unit in place after it is set. Refer to Figure 3-8.

Base frame details for each model are available from Turbo to allow placement of metal inserts to match the structural base frame. No part of the unit base frame should be cantilevered or unsupported.

Raised Curbing

A raised curbing around the outside of the TIG unit is recommended to contain any condensate, leakage, or cleaning fluid from the unit. To determine maximum curbing height, check the clearance between the bottom of the unit doors and the bottom of the structural base frame. A curbing height of two (2) to three (3) inches is all that would be needed. This height would clear the doors on all standard units. Refer to Figure 3-8.

Elevated Installation

Some installations require mounting the TIG unit at an elevation above grade. In such cases, a structural steel platform capable of supporting the dynamic as well as static load must be provided. Due to variations in local and state codes, a local firm specializing in structural steel should be consulted to determine the requirements for the steel to be erected. Turbo can be contacted for information required by the local firm to provide the steel platform. The steel supporting the unit

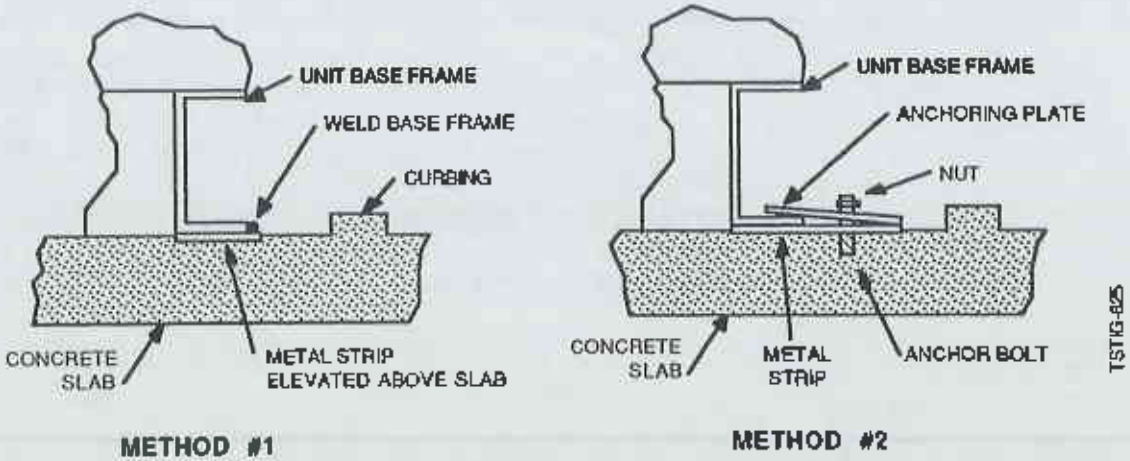

Figure 3-8 Typical Concrete Slab Detail

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

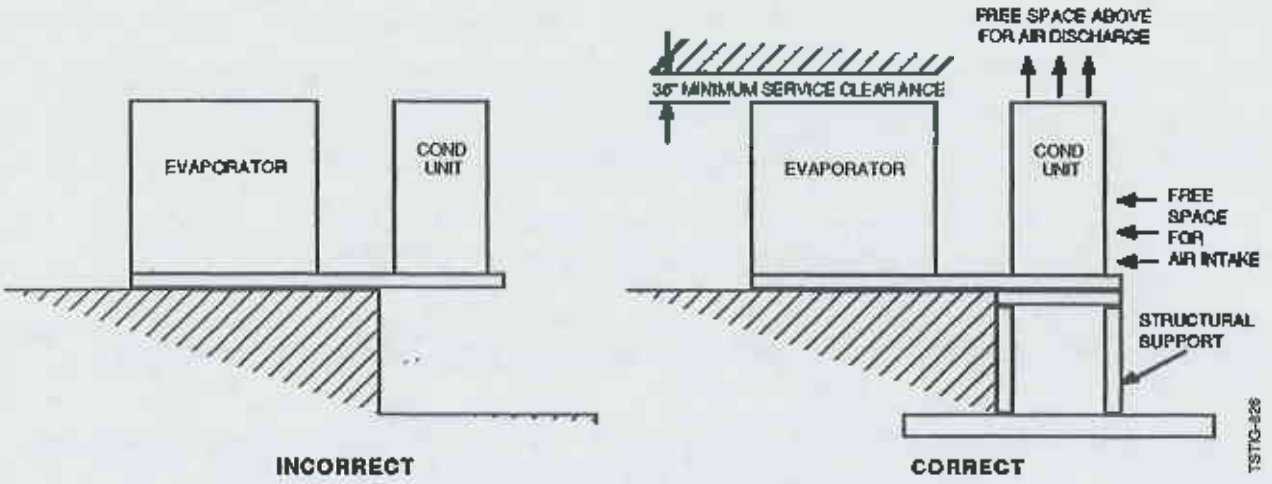

Figure 3-9 Elevated Installation

must be level or shimmed to obtain a satisfactory level. The same guidelines for support and unsupported sections apply as for the concrete slab. Refer to Figure 3-9.

Access, Service, and Air Space

In laying out the unit installation, adequate space should be allowed around the unit for access and service. Particular attention should be given to the condensing unit end of the TIG unit. Removal or service of larger, heavier components (condensers, compressors, etc.) may require access by a forklift or other lifting devices which require additional space.

On air-cooled condensers, evaporative condensers, and cooling towers, adequate space must be allowed for air intake and air discharges to prevent insufficient air supply or recirculation of discharge air.

Space must be allowed for electrical disconnects and load centers near the equipment and for conduit runs from the load center to the equipment.

Water Pressure Lines

Water piping to the make-up water connection and cooling tower (if so equipped) must be properly sized to deliver the specified flow and the specified pressure. Design parameters for TIG units use 40 psig city water pressure as the standard. If the available water pressure is below 40 psig, Turbo should be consulted to determine if a booster pump is required. The maximum water pressure is 100 psig. Systems with pressures over 100 psig should be equipped with pressure reducing valves installed in the lines to the TIG units.

Floor Drain

Periodic cleaning of the TIG water tank is required. Provisions should be made for a floor drain to dispose of this water as well as for the unit overflow drain.

Water Treatment

All TIG units are supplied with make-up strainers to remove solids and material large enough to plug openings in the distribution system. Consult a local water treatment company to determine if additional water treatment or filtration is required to produce the desired ice quality and reduce maintenance of the water distribution system.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

NOTICE

Page 37 (step 4. Mounting and Leveling) has been deleted.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

5. *BUILDING OPENINGS (ICE CHUTES) TO STORAGE*

All TIG units discharge the ice through a standard nine (9) inch screw conveyor down spout from the end of the unit opposite the outboard condensing unit. If the TIG unit is mounted directly above the ice storage, it discharges into an inclined screw conveyor (not provided by Turbo) prior to delivery into the storage bin. Refer to Figure 3-11.

Incline Screw Conveyor

The use of an incline screw conveyor removes any condensate inside the auger and prevents:

- water from melting snow (ice fines)
- water overflow into storage through discharge trough
- overflow of cleaning fluids used to clean the evaporator or water tank into storage
- any other source of water accidentally dumped into the discharge trough flowing into storage area.

Insulation

The discharge chutes from the TIG and incline screw as well as the inclined screw should be insulated to reduce heat infiltration and condensation.

WARNING

The TIG unit should never be operated without the discharge chutes and screw conveyor being in place. Access to the discharge down spout or incline screw could result in serious injury or loss of life. Never use a stick or probe to eliminate an obstruction. Never attempt to clean an obstruction in the discharge without *locking* out the electrical power. Failure to carefully follow these instructions could result in permanent injury or loss of life.

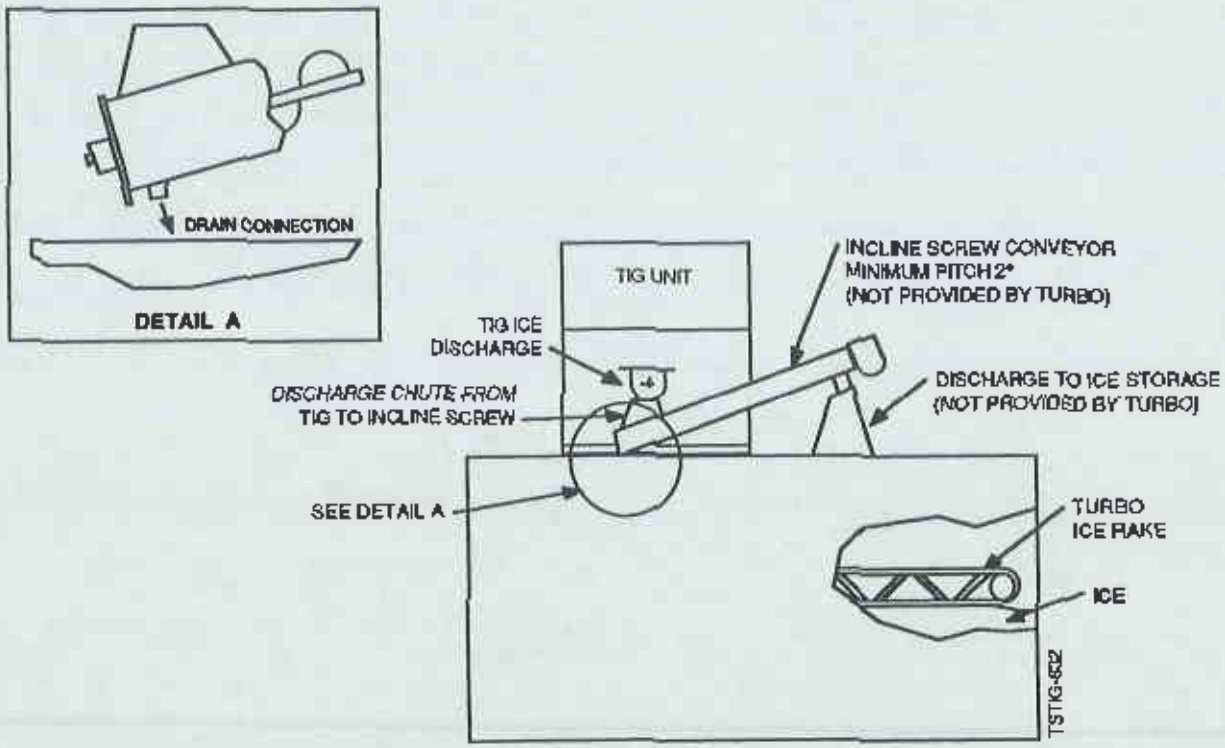

Figure 3-11 Typical Ice Delivery to Storage

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

6. ALIGNING COMPRESSORS AND MOTORS

TIGs are furnished with direct coupled motors and compressors. The coupling center section is shipped loose for field installation. The compressor and motor are carefully aligned at the factory before testing.

Coupling Center

Check for alignment before inserting the coupling center section.

Compressor Motor

Inspect the compressor motor alignment with a dial indicator to check if it may have been disturbed during shipment or installation. See Table 3-1.

Motor & Compressor Flanges

Check the alignment of the motor and compressor flanges with a dial indicator on the motor flange. The procedure for checking alignment and alignment tolerances follow. Both angular and parallel must be checked. For the details on the compressor manufacturer alignment procedure, refer to the Installation, Start-Up and Service Instructions located in the Appendix & Notes Section.

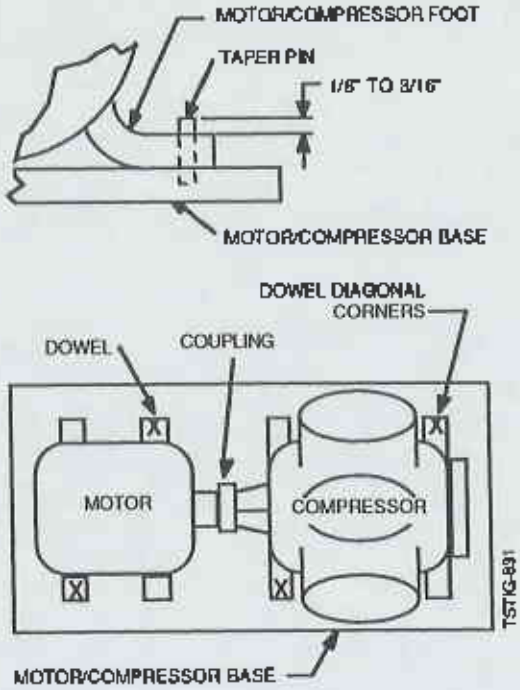

Figure 3-12 Doweling

Motor/Compressor Assembly

The motor/compressor assembly is doweled to the base after the factory alignment is completed to help maintain alignment and aid in repositioning the motor after servicing.

Compressor Alignment

If, for any reason, the compressor alignment is not within tolerance after reinstallation of the coupling, it must be realigned (refer to Table 3-1).

Doweling Procedure

Since doweling is performed after the motor/compressor alignment has been hot checked (i.e. compressor has been run and brought up to operating temperature after initial alignment), some models are shipped from the factory without doweling.

Note:
All self-contained SC, SCA, and SCE models are factory run and doweled. SCAR and SCER utilize remote condensers and are not factory run.

In such cases, doweling is done after the initial start-up of the equipment. The following procedure is used:

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

1. With the compressor at operating temperature, verify the compressor alignment.

2. With the compressor still at operating temperature, drill and ream two (2) holes diagonally opposite on both the compressor and motor. Do not ream the holes too deep. Part of the dowel pin should protrude above the compressor or motor foot (see step 4 below). See Figure 3-12.

   Tools Required:
   - drill
   - 9/32" diameter drill
   - #6 taper reamer

3. Insert the #6 x 2 1/2" hardened taper dowel pins in the holes.

4. Using a rubber hammer or mallet, tap the dowel lightly into position. Leave 1/8" – 3/16" of the dowel pin above the motor foot (required to tap and loosen the dowel for removal when required).

5. Coat the dowels with white lead or lubricant to prevent rusting.

Reference

Refer to the compressor manufacturer alignment procedure in the Installation, Start-Up and Service Instructions in the Appendix & Notes Section.

Table 3-1 Compressor Alignment Tolerances

PARALLEL ALIGNMENT	
TOP–BOTTOM	±5 MILS
SIDE–SIDE	±5 MILS
ANGULAR ALIGNMENT	
TOP–BOTTOM	±7 MILS
SIDE–SIDE	±7 MILS

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(REFER TO COMPRESSOR MANUFACTURERS INSTALLATION, START-UP, AND SERVICE INSTRUCTIONS FOR ADDITIONAL DETAILS).

NOTE:
THE COMPRESSOR ALIGNMENT SPECIFIED ABOVE SHOULD BE USED INSTEAD OF THE SPECIFICATIONS RECOMMENDED IN THE MANUFACTURER'S GUIDE.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

7. ELECTRICAL CONNECTIONS

WARNING

All electrical work should be done only by a qualified electrician. Do NOT turn power on at this time. Failure to carefully follow these instructions could result in permanent injury or loss of life.

IMPORTANT

Electrical wiring diagrams are located in each control panel and are furnished with each operating manual. These diagrams should be consulted before making the electrical service connections.

Electrical Service Connections

TIGs are furnished completely prewired internally but require electrical service connections to:

- the L1, L2, and L3 connectors on each of the motor starters (three phase)
- the L1 and L2 connections of the control circuit (single phase).

All of these connections are located inside the TIG control panel. Install disconnect switches (by others) in the incoming power lines ahead of the control panel on the TIG.

Checking Rotation

WARNING

Make sure the conveyor screw is clear of all obstacles and warn all personnel to stay clear of the conveyor screw at all times. Failure to carefully follow these instructions could result in permanent injury or loss of life.

The conveyor screw should be rotating in a clockwise direction when viewed from the end with the ice discharge facing you. As long as the conveyor screw is rotating in the proper direction and the incoming power wiring is properly phased, all other components will be rotating correctly due to the proper phasing of the internal wiring at the factory (i.e. same phasing is used to all motor starters).

Note:
When checking rotation, only the power to the screw conveyor should be on. Turn the three-phase power to the compressor and water pump off.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

8. WATER CONNECTIONS

Make-Up Water

The source of make-up water and its' temperature are important. The make-up water is the supply water from which the ice is made. The quality of the ice will depend on the type of water supplied.

Water Type

The ice can be no better than the water from which it is made. Extremely hard water will tend to make cloudy, softer ice and will leave deposits within the machine, necessitating frequent cleaning. Hard water will not harm the TIG, but it will increase the maintenance necessary to keep the machine clean.

Water Temperature

The temperature of the water is an important factor in determining the icemaking capacity of the TIG unit. All icemaking capacities are based on a design make-up water temperature of 60°F. As the water temperature increases, the ice-making capacity will decrease due to the additional cooling load on the refrigeration system. Conversely, as the make-up water temperature decreases, the icemaking capacity will increase since less refrigeration is required to remove the heat from the water. Correction factors for different water temperatures are shown in Table 3-2.

Make-Up Water Connection

All standard TIG and TIGAR models use a 1 1/2" make-up water connection. Actual make-up water flows are shown in Tables 3-3 and 3-4.

Make-Up Water Pressure & Temperature

The float valves used in the make-up water line are typically rated for a maximum water pressure of 65 psig and 125°F fluid temperature. Minimum water pressure should be approximately 5 psig to ensure continuous water feed at all times.

IMPORTANT

Never undersize a make-up water line. Ice capacity cannot be reached without the proper make-up water line size.

Drains

There are three drain connections on TIG models.

Two Pan Drains

A water tight pan is provided under each TIG to collect condensate, etc. Connect a drain line of proper size to the pan drain. This line will normally be dry or contain only a small amount of water. There are two drain connections on a TIG unit: one in the center bottom of the pan (plugged) and one in the end of the pan.

Table 3-2 Correction Factor for Feedwater Temperature

WATER TEMPERATURE	35°F	40°F	50°F	60°F	70°F	80°F	90°F
ICE CAPACITY MULTIPLIER	1.17	1.13	1.06	1.00	0.94	0.89	0.85

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EXAMPLE:
TIG16SC WITH 40°F MAKE-UP WATER.
NOMINAL CAPACITY WITH 60°F WATER = 16 TONS/DAY.
CORRECTION FACTOR FOR 40°F WATER = 1.13.
CORRECTED ICE CAPACITY = 16 X 1.13 = 18.08 TONS/DAY.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

One Overflow Drain

Blowdown or overflow of water in the tank can be adjusted from 0 to 25% to reduce collection of residual solids. The icemaking process tends to concentrate (freeze-out) minerals and suspended solids in the water. Depending on the water quality (hardness, etc.), this can cause enough concentrations in the water tank to produce white or cloudy ice. A float valve on the make-up water line is provided to allow adjustment of the overflow or blowdown rate on a continuous basis.

Lowering the float arm reduces the overflow rate, while raising the float arm allows more water to overflow since the water level in the tank has to raise to a higher level before the float valve shuts off. At start-up, adjustments can be made to obtain the desired blowdown rate. Periodic checks should be made to ensure that deposits are not building up in the tank.

A local consultant on water treatment is also advisable to determine if additional water treatment (chemical, filtration, etc.) is required to obtain the desired ice quality.

IMPORTANT

Normal freeze up precautions should be taken when drain lines must be exposed to freezing temperatures.

Table 3-3 TIG Models (1 1/2" FPT Make-Up Water Connection)

MODEL	16	21	31	42	63	80
MAKE-UP WATER FLOW, GPM	3	4	5	7	11	13

TSTIG-901

Table 3-4 TIGAR Models (1 1/2" FPT Make-Up Water Connection)

MODEL	25	50	75	100
MAKE-UP WATER FLOW, GPM	4	8	13	17

TSTIG-902

Water Cooled Condensers

Water condensers supplied on TIGs are the conventional condenser receiver combination type. They feature shell and tube type construction, cleanable with removable heads. The water in and out connections are sized to permit maximum water flow at peak requirements. All models are furnished with the connections piped to the outside of the unit for ease of installation.

Water Requirements

Condenser water requirements are based on 85°F water to the condenser, 95°F water off the condenser, and 105°F condensing. The condensers design water flow rate is based on 3 gpm/ton of refrigeration*. The actual rate of flow is wholly contingent on the water temperature and evaporator load but will not exceed the design flow.

* Tons of refrigeration = total heat of rejection @ 10°F SET/105°F SDT divided by 15,000 BTU/ton.

Water Regulating Valve (SC Models Only) Optional

A water regulating valve can be furnished in the TIG unit and must be field installed external of the TIG in the outlet water line. A 1/4" SAE flare type valve is provided on the water cooled condenser for the water regulator high pressure gas connection.

Water Temperatures

When cooling towers are used and no other positive means of regulating head pressure

are provided (such as fan and pump pressure switches), a water regulating valve will be required. Adequate head pressure is important to provide proper refrigerant flow through expansion valves or other refrigerant control devices in order to maintain the suction pressure above the setting of the low pressure cut-out to prevent short cycling and pump-down of the system.

When contemplating the use of city or well water for condensing, a careful check should be made of the seasonal variation in the water temperatures. Water flow lines should be sized large enough for the required flow at the maximum water temperature to be encountered. For applications requiring condenser water above 85°F, consult Turbo. When TIGs are installed in an area where the ambient falls below freezing, refer to section 8. "Optional Features and Accessories" for Winterizing on page 104.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

9. REFRIGERANT PIPING

Piping in a refrigerant system has two functions:

1. To carry the refrigerant through the system as a liquid or a gas with a minimum pressure drop.

2. To return any oil entrained in the refrigerant to the compressor. Suction mains should be pitched toward the compressor.

Avoid trapping the lines except for specific purposes. If traps are used, the horizontal dimension should be as short as possible to avoid excessive trapping of oil.

Steel Pipe Joints

In making up joints for steel pipe, the following procedures should be followed:

- Clean threads on the pipe and fittings to remove all traces of grease or oil.

- Wipe the threads dry with a lintless wiping cloth.

Refrigerant Installations

For threaded connections on piping for refrigerants, use Teflon thread sealing tape. Wrap the tape around the threaded male portion of the joint about two full turns, thread into the female portion, and tighten. If thread sealing tape is not available, conventional thread filling compound may be used. Use thread filling compound sparingly and on the pipe only. Do not put any thread filling compound on the first two threads, this prevents any of the compound from entering the system.

Pipe Type

Piping for freon refrigerant systems must be type K or L copper (depending on the application). Steel pipe is used in large installations when joints are welded and on ammonia systems.

Freon Refrigerant Installations

For freon refrigerant installations, use copper pipe with solder type fittings where possible. The use of screw type fittings should be held to an absolute minumum to prevent freon refrigerants from leaking through.

Copper Tubing

Type "K" is suitable for working pressures up to 400 psi. Type "L" is suitable for working pressures up to 300 psi. Check local requirements before installation because some local codes forbid the use of type "L". Never use type "M"; it does not have adequate wall thickness to withstand the operating pressures.

Only wrought copper fittings should be used for freon refrigerant piping. Cast fittings used for water service are porous and not suitable for the refrigerant service. Exception: In larger pipe sizes, wrought fittings are not available. Specially tested cast fittings are available to use with complete safety.

Soldering

When soldering copper tubing joints, silver solder such as "SilFos", "Phoson #15", "Silbond 15", or any solder that has 15% silver content can be used. Soft solder should never be used because its melting point is too low. Soft solder lacks mechanical strength and tends to break down chemically in the presence of moisture.

Steel Pipe

Carbon steel or stainless steel pipe can be used for refrigerant lines but must be either sand blasted or pickled to ensure complete removal of wax, oil, or other processing films.

Pipe Line Hangers

Hangers and supports for coils and pipe lines should receive careful attention. Hangers must have ample strength and be securely anchored to withstand any vibration from the compressor and adequately support the pipe lines.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

10. TESTING REFRIGERATION SYSTEM FOR LEAKS

Testing for leaks assures a tight system that operates without loss of refrigerant.

In order to test for leaks, the system pressure must be built up. Test pressures for various refrigerants are listed in ASA B.9 Code Brochure entitled "Safety Code for Mechanical Refrigeration". These pressures will usually suffice but check local codes as they may differ.

IMPORTANT

Do not use the compressor to build up the pressure - it is not designed to pump air. Serious overheating and damage may result.

Prior To Testing

Before testing, follow these instructions:

1. If test pressures exceed the settings of system relief valves or safety devices, remove the system relief valves or safety devices and plug the connection during the test.
2. Open all valves except those leading to the atmosphere.
3. Open all solenoids by lifting their stems manually.
4. Open all by-pass arrangements.

Oil free dry nitrogen may be used to raise the pressure to the proper level for testing.

Testing

When the proper pressure is attained:

1. Test for leaks with a mixture of four parts water and one part liquid soap applied to all flanges, threaded, soldered, or welded joints with a one inch round brush. A small amount of glycerine added to the test solution will strengthen the bubbles and improve the solution.
2. Observe the entire joint. If a leak is present, the escaping gas will cause the test solution to bubble.
3. After all leaks are found and marked, relieve the system pressure and repair leaks.

IMPORTANT

Never attempt to repair soldered or welded joints while the system is under pressure. Soldered joints should be opened and resoldered. Do not simply add more solder to a leaking joint.

4. After all the joints have been repaired and the system is considered "tight", test the TIG with refrigerant.
5. Attach a drum of the proper refrigerant to the system and allow the gas to enter until a pressure of 5 psig is reached.
6. Remove the refrigerant drum and bring the pressure to the recommended test level with oil free dry nitrogen.
7. Check the entire system again for leaks, using a halide torch or electronic leak detector. Check all flanged, welded, screwed, soldered and gasket joints, and all parting lines on castings. If any leaks are found, they must be repaired and rechecked before the system can be considered tight.

IMPORTANT

No repairs should be made to welded or soldered joints while the system is under pressure.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

11. EVACUATING THE SYSTEM

Reasons To Evacuate

Refrigeration systems operate best when only refrigerant is present in the system. Steps must be taken to remove all air, water vapor, and all other non-condensables from the TIG before charging it with refrigerant. If air, water vapor, or non-condensables are left in the system, various operating difficulties can be encountered:

1. The moisture will react with the oil in the system forming sludge which can clog passage-ways and lead to lubrication problems.
2. Air and non-condensables will lodge in the condenser, decrease the space for condensing liquid and cause the head pressures to rise.
3. A combination of a moisture and refrigerant, along with free oxygen, can cause the formation of acids and other corrosive compounds which could corrode the internal parts of the system.

Helpful Hints

If properly evacuated as outlined below, the system will be oxygen free, dry, and there will be no non-condensables to cause problems later.

- If at all possible, the piping should not be insulated before the evacuation process is started.
- The evacuation should not be done unless the room temperature is 60° or higher (to allow for proper moisture boil off).
- If free moisture is in the system before evacuation (such as water collected in traps or low places in the piping), this can easily be detected by feeling of these traps and low places. If moisture is present it will condense in the low places and freeze. It can be removed by gently heating the trap the farthest away from the vacuum pump. This causes the water to boil, the ice to melt, and the vapor to collect in the next trap towards the vacuum pump. Repeat this process until all pockets of water have been boiled off and the vacuum pump has had a chance to remove all of the water vapor from the system.

Proper Measuring Instrument

It is not possible to read high vacuums or low absolute pressures with a pressure gauge or mercury monometer. Use the proper gauge manufactured by McLeod, Stokes, and Airserco. These gauges usually read in the range from 20 to 20,000 microns.

High Vacuum Pump

- Use a high vacuum pump capable of attaining a blanked off pressure of 10 microns or less.
- Attach this pump to the system and allow it to operate until the pressure in the system has been reduced somewhere below 500 microns.
- Connect the high vacuum pump into the refrigeration system following the manufacturers instructions.

Note:
For best results, connect the pump to the high side and the low side of the system so that the entire system is thoroughly evacuated.

- Connect the vacuum indicator or gauge into the system in accordance with the manufacturer's instructions.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

First Evacuation

A single evacuation of the system is not satisfactory to remove all of the air, water, and non-condensables present. To do a complete job, the triple evacuation method is recommended:

1. When the pump is first turned on, reduce the system pressure as low as the pump is able to bring it.
2. Allow the pump to operate for five (5) or six (6) hours.
3. Stop the pump and isolate the system.
4. Allow it to stand at this vacuum for another five (5) to six (6) hours.
5. Break the vacuum.
6. Raise the system pressure up to zero (0) with oil free dry nitrogen.

Second Evacuation

1. Start the second evacuation, again allowing the pump to operate and reduce the pressure to less than 500 microns.
2. Allow the pump to operate for two (2) or three (3) hours.
3. Stop the pump and allow the system to stand with this vacuum for a minimum of three (3) hours.
4. Break the vacuum with the oil pumped dry nitrogen.
5. Raise the pressure in the system to zero (0).

Third Evacuation

For the third evacuation, the foregoing procedure is again followed:

1. Operate the pump until the system pressure is reduced below the 500 micron figure.
2. Allow the pump to operate an additional six (6) hours.
3. Stop the system and allow to stand for approximately twelve (12) hours at the low pressure.
4. Break the vacuum with the oil free dry nitrogen.
5. Allow the pressure in the system to come up to slightly above zero (0) pounds (drier cartridges and moisture indicators may be installed in the system).
6. Evacuate the system below the 500 micron figure and charge with the refrigerant being used for the system.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

12. CHARGING THE UNIT WITH REFRIGERANT OIL

When properly charged, the oil level in the compressor should be visible at the center of the compressor sight glass (located on hand-hole cover on the side of compressor). An oil reservoir is also used on these units. The oil level on the oil/reservoir should be visible at the center of the top sight glass. Other equipment such as the oil filter or oil coolers (when used) also require oil charge. Therefore, the oil level in the compressor and oil reservoir should be rechecked after the compressor has been operated. If additional oil is required, add only the oil specified by the manufacturer. Use only dehydrated, wax-free, refrigerant grade oil of suitable viscosity (refer to Table 3-5).

Periodic Checks & Records

The above oil check should be done at start-up, or after any service work is performed. Periodic checks should also be done on a regular basis. Complete records should be kept of any additions or removal of oil to the system.

Refrigerant Oil

Unless otherwise specified, the following refrigeration oil should be used:

- Sun Oil Suniso 3GS
- DuPont synthetic oil, 150 SSU only
- Texaco Capella B1

IMPORTANT

- **Do not mix different types or grades of oil.**
- **Do not over fill with oil, this is especially true on the hermetic type compressors.**
- **Make sure the oil is fresh and not contaminated.**

Oil Quality

If the quality of the oil is unknown or is not clear, Turbo recommends that an oil test kit be obtained from a local refrigeration supply house. This will ensure that the oil is acid free and safe to use.

Periodic analysis of oil samples by local testing laboratories can also detect unusual build-up of metals or other contaminants (which result from wear or other debris in the oil) before they become a problem.

Table 3-5 Compressor Oil Charge

CARRIER COMPRESSORS	5H40/46	5H60/66	5H80/86	5H120/126
– OIL CHARGE (PINTS)	18	21	41	61
ROYCE COMPRESSORS	CG040	CG060	CG080	CG120
– OIL CHARGE (PINTS)	24	30	32	60

TSTIG-855

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

installations or to a location away from personnel exposure for indoor or outdoor installations. Refer to Figures 3-13, 3-14, and 3-15.

WARNING

All relief valves must be piped to a safe discharge location. Failure to carefully follow these instructions could result in permanent injury or loss of life.

All relief valves are tagged with the above or a similar warning.

Do not attempt to add refrigerant to the system before piping all relief valve connections.

ANSI/ASHRAE 15-1978 code permits a maximum back pressure through the relief valve discharge piping of 25% of the inlet pressure while the device is discharging at rated capacity. Based on the set pressure and capacity of the relief device, the maximum length of discharge piping can be calculated using the formula:

$$L = \frac{9P^2d^2}{C^2} = f\,DL_1$$

where:

L = length of relief valve discharge piping, in feet

P = 0.25 [(relief valve pressure setting) x 1.1 + 14.7]

d = internal diameter of discharge piping (or tubing), in inches

C = minimum required discharge capacity, in pounds of air per minute

f = 1.6 for R-22

f = 0.5 for ammonia

D = outside diameter of vessel in feet

L_1 = length of vessel in feet

Turn to next page for example problem.

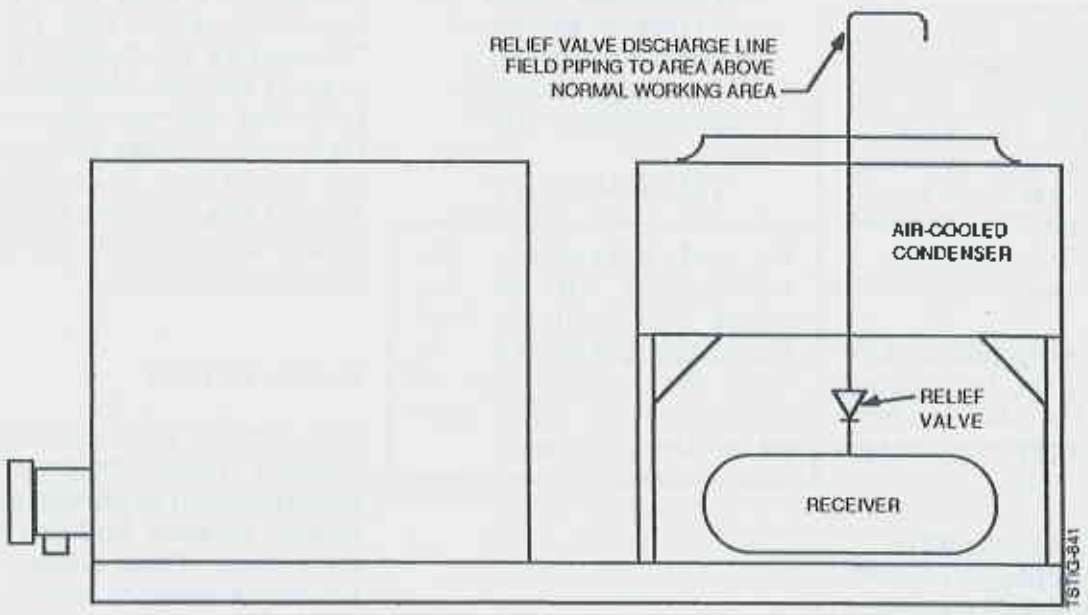


Figure 3-13 Typical Air-Cooled Condenser Relief Valve Field Piping

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Example:

TIG 21SCE uses a 12 3/4" diameter x 48" receiver.

Design relief pressure is 350 psig.

Refrigerant is R-22.

Therefore, $C = f\ DL = (1.6)\frac{(12\ 3/4)}{12}\ \frac{(48)}{12} = 6.8$ pounds of air per minute.

A 1/2" x 3/4" (inlet x outlet) pressure relief valve rated at 41.6 pounds of air per minute is used.

Maximum discharge piping length:

$$L = \frac{9P^2d^5}{16C^2} = \frac{(9)\ (9,985)\ (0.38)}{(16)\ (46.24)} = 46.1 \text{ feet}$$

where:

$P =$ $0.25\ [(350)\ (1.1) + 14.7] = 99.9$

$P^2 =$ 9,985

$d =$ 0.824" (3/4" sch40 pipe)

$d^5 =$ 0.38

$C =$ 6.8 pounds of air per minute

$C^2 =$ 46.24

Therefore, a 3/4" sch40 pipe is completely adequate for normal installations with relief valve discharge piping less than 46 feet long. If longer piping is required, a larger size piping would be required.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

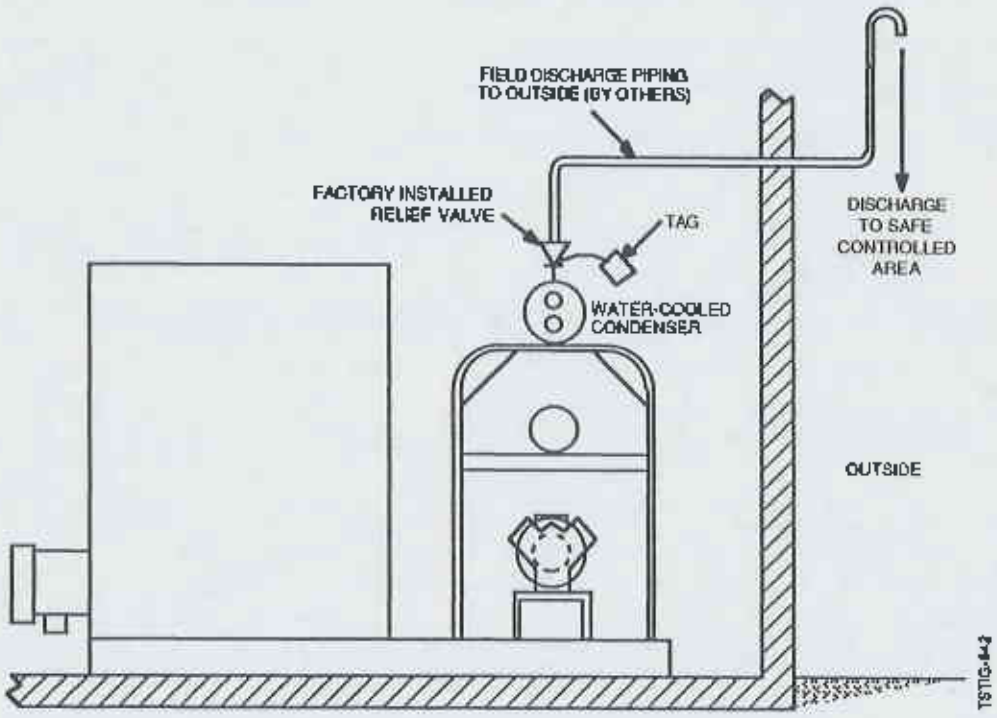


Figure 3-14 Typical Indoor Installation Relief Valve Piping

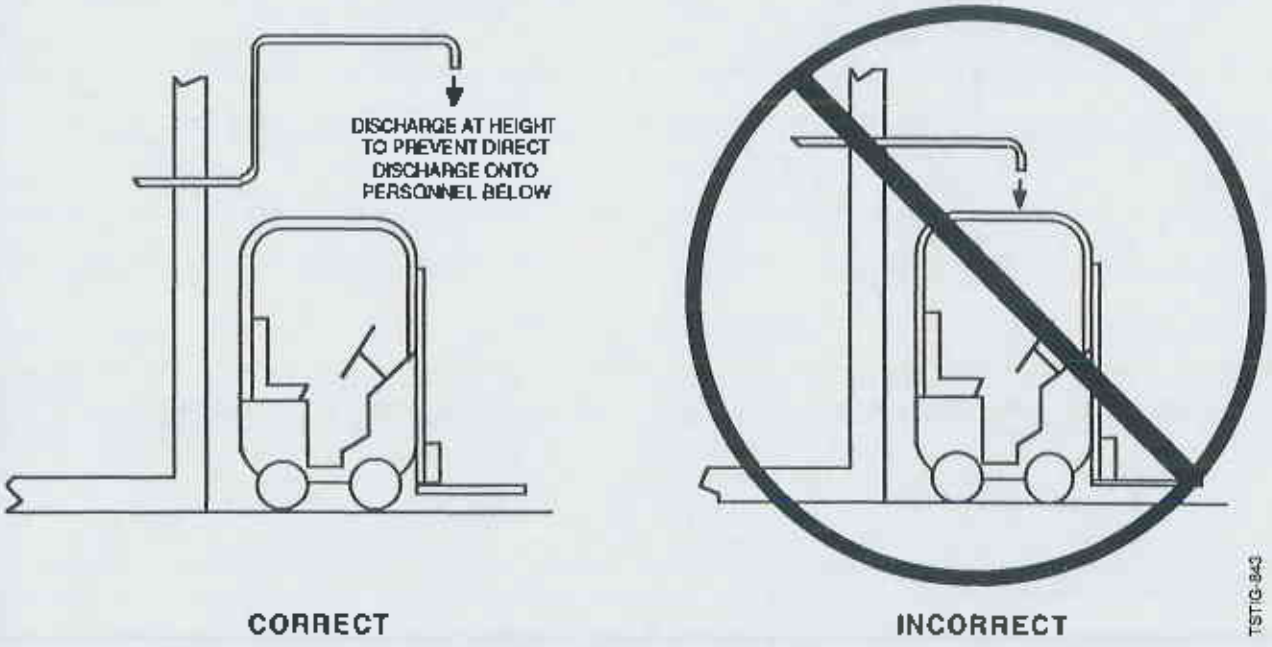


Figure 3-15 Correct and Incorrect Relief Valve Discharge Piping

Read Safety Section before this section. Failure to carefully follow these instructions could result in permonent injury or loss of life.

- The receiver must have sufficient capacity to hold all of the liquid refrigerant in the system which must be returned to the receiver when high ambient conditions are encountered.

Note:
If the receiver is too small, liquid refrigerant will be held back in the condenser during the high ambient conditions and excessively high discharge pressures will be encountered.

IMPORTANT

Sufficient refrigerant must be in the system to permit the winter control to operate satisfactorily and maintain a liquid seal on the receiver.

Valve Functions

Valve "L" (Upstream Regulator)

Valve "L" (located in the condensate line from the air cooled condenser to the receiver) is the modulating type. Its' spring tension is set so that a minimum pressure in the condenser is required before valve "L" will begin to open. Any increase in pressure opens valve "L" more, permitting more condensate to pass into the receiver. If the spring tension is increased (by clockwise adjustment), a higher pressure will be required to open the valve. If the spring tension is decreased (by counter-clockwise adjustment), a lower condenser pressure required. Valve "L" is set at the factory (on SCA models) to open at 180 psig for R-22 which should permit satisfactory operation. If a field adjustment is required and the condenser pressure does not vary with the adjustment, this indicates a shortage of refrigerant in the system.

During start-up, when the condensate in the condenser has been exposed to a low ambient air temperature, it is cooled down below the temperature corresponding to the existing condensing pressure. The pressure in the receiver needs to be raised to a point that corresponds to the pressure required for proper operation of the thermo expansion valve. This is accomplished by permitting hot discharge gas to bypass the condenser and enter the receiver through valve "G" to maintain pressure until the condenser warms up.

Valve "G" (Downstream Regulator)

Valve "G" is a modulating valve that acts in reverse so that the spring tension opens the valve to admit hot gas. Valve "G" remains open until the pressure (temperature) in the receiver rises to the set point and then closes. Valve "G" is preset at the factory to close at 160 psig for R-22. If a field adjustment is required, a clockwise adjustment increases the spring tension. A higher rise in pressure is obtained before the valve closes, shutting off the hot gas flow into the receiver. A counter-clockwise adjustment would permit the valve to close at a lower pressure.

Valves "L" and "G"

When adjusting valves "L" and "G", a certain differential in pressures (approximately 20 psig) must be maintained to insure enough of a difference between discharge pressure and receiver pressure so that hot gas will enter the receiver when required.

When the system is not in operation, no refrigerant gas will enter the condenser. Eventually the pressure in the condenser will drop to a point that corresponds to the ambient air temperature. During this period, there may be a large difference between the pressure in the warm receiver and the cold condenser. The service for which valves "L" and "G" are designed does not require them to be gas tight. During this shut down period, it is possible for refrigerant gas to escape from the high pressure in the warm receiver through valves "L" and "G" back into condenser (because of low ambient at a low pressure). A check valve "LC" is placed in the drain to prevent migration of the liquid back to the condenser. This lowers the pressure in the receiver making it impossible for the thermo expansion valve to open when the unit calls for refrigeration again.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Valve "LC"

To prevent the escape of gas, a check valve ("LC") is located in the line which feeds the receiver. This valve is gas tight and must be maintained as such.

Valve "LD" is also a check valve which must be installed in the discharge line as close to the compressor as possible. Valve "LD" insures that no gas in the condenser will migrate to the compressor head. Refer to Figure 3-16 for valve arrangement.

Alternate Head Pressure Controls

Fan Cycling

On some models, a pressure switch(es) is used to cycle the fan(s) on and off in response to an increase or decrease in discharge pressure. This method reduces the refrigerant charge by eliminating the need to flood the condenser coil. It is generally limited to applications using condensers with several fan motors, allowing several capacity reduction steps. Under certain conditions, rapid cycling of the fan(s) may result when used on models with only one or two fans.

Variable Speed Motor (VSM) Controller

A variable frequency solid-state controller is used to vary the output RPM of the condenser fan motor(s). A pressure differential switch is used to signal the controller to increase or decrease the motor speed from 0 to 100% to maintain the pressure set point.

The VSM controller eliminates the need for flooding the condenser coil thus reducing the refrigerant charge and receiver size.

VSM controllers can also be used with single or multiple fan motors and maintain a steady pressure control (i.e. eliminates sudden reductions or increases in airflow associated with cycling the fan on and off).

See Figure 3-17 for typical piping with fan cycling or VSM controls. For the type of head pressure control used on a unit, refer to the manual cover sheet.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

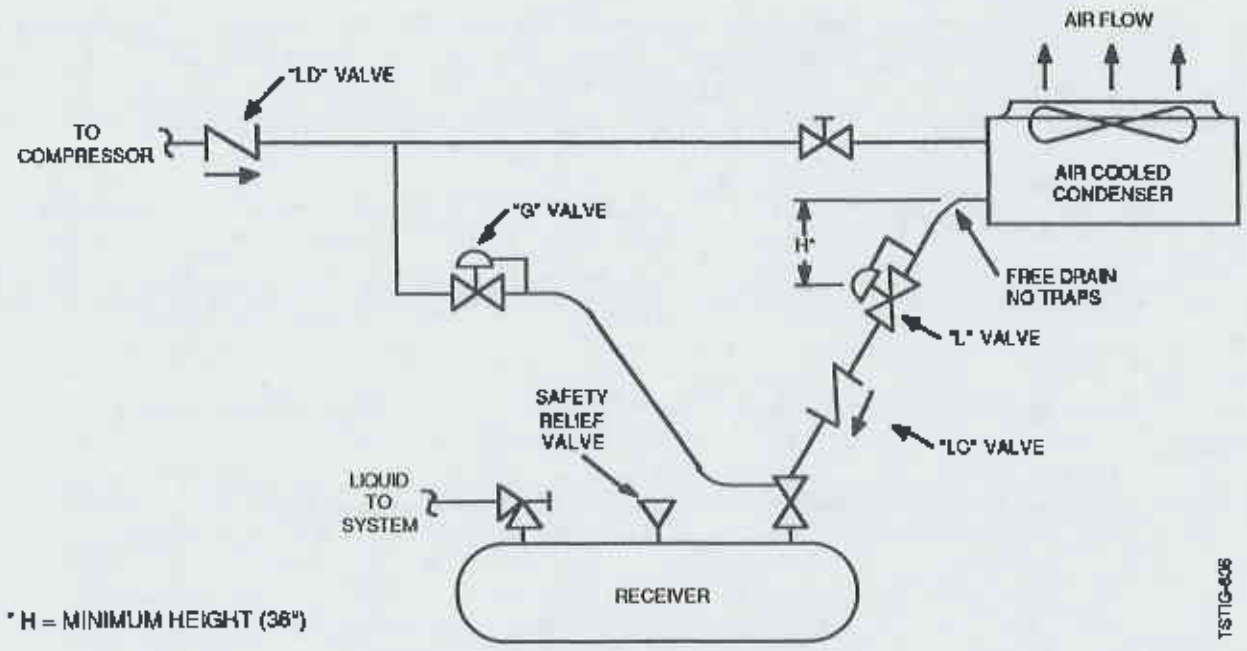


Figure 3-16 Typical Air-Cooled Control & Winter Control Valve Piping (Flood-Back Method)

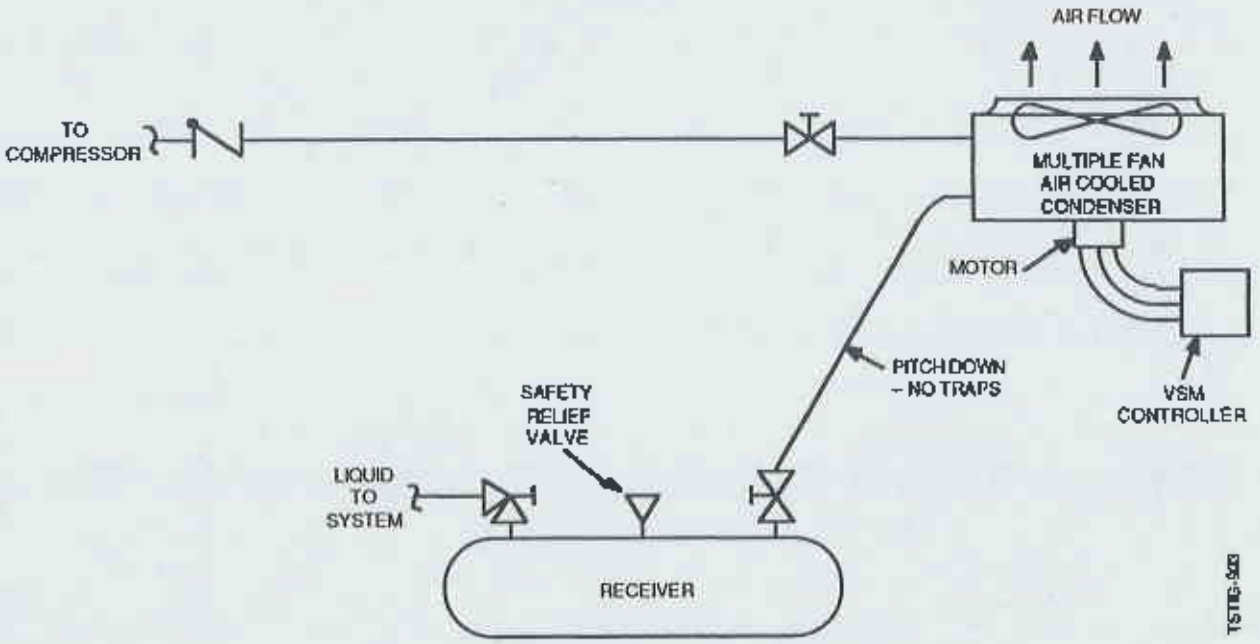


Figure 3-17 Typical Piping for Fan Cycling or Variable Speed Fan Motor (VSM) Controls

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

15. EVAPORATIVE-COOLED CONDENSERS

Mounting

Evaporative condensers supplied with TIG SCE models are based on 78°F design wet bulb and 95°F condensing (181.8 psig). The condenser is mounted on a common base frame with the evaporator section. A receiver is mounted on the same frame (below the condenser outlet) a distance that ensures free flow of the liquid from the condenser to the receiver without traps. Pitch the drain line down from the condenser to the receiver. Control of the evaporative condenser fan(s) and water pump is wired into the unit control panel.

Equipment Furnished

Self-contained evaporative-cooled (SCE) models are furnished with a properly sized condenser to reject the total heat of rejection (THR) of the evaporator and the heat of compression. A receiver, isolation valves, safety relief valve, and head pressure controls are supplied. The piping and wiring are factory installed.

For remote evaporative-cooled (SCER) models, all of the above is available as an option for field installation and piping to the evaporator. Motor starters for the pump and fan motors can also be provided.

Head Pressure Control

Two types of head pressure control are used on TIG units:

1. Variable speed fan motor control (VSM).
2. Flood-back control.

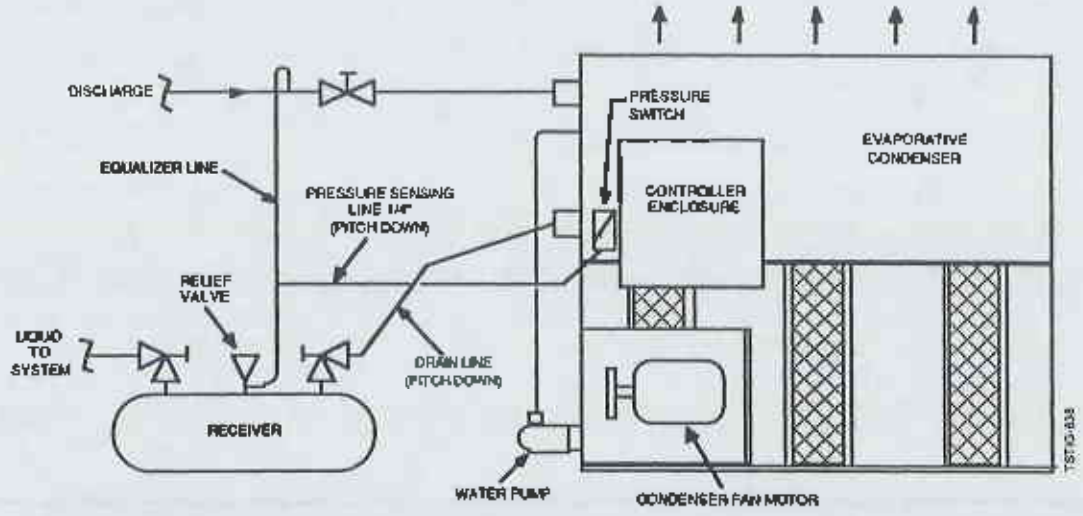
Refer to Figure 3-18.

VSM Controls

A solid state variable frequency constant torque drive monitors the pressure at the inlet to the condenser. This signal is directed to the frequency control to adjust the fan motor RPM either up or down to maintain the pressure at the set point.

A differential pressure switch with two (2) SPST switches is used to sense the discharge pressure.

1. As the pressure reaches the upper set point, the switch contact closes, sending a signal to the controller to increase the fan RPM.
2. As the pressure falls back below the set point, the controller holds the RPM constant.
3. If the discharge pressure



NOTE THE SENSING LINE FOR THE VSM PRESSURE SWITCH SHOULD ALSO BE PITCHED DOWN TO PREVENT TRAPPING OF LIQUID OR OIL IN THE LINE

Figure 3-18 Typical VSM Controller Installation

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

falls below the set point of the lower switch, the contact of this switch closes to signal the controller to reduce the fan RPM, allowing the pressure to either raise or hold steady.

The above sequence continues maintaining the discharge pressure between the two set points.

On SCE models, the pressure switch settings (although they are factory set) should be checked and adjusted as required during start-up.

Adjustment

The discharge pressure can be increased or decreased by changing the setting of the two pressure switches.

Using a screwdriver, turn both adjustment screws clockwise to raise the pressure and counterclockwise to decrease the pressure.

By adjusting both adjustment screws the same, the differential between the switches is maintained. The differential should be adjusted only if the pressure variation exceeds 12–16 psig. Refer to Figure 3-19.

Flood-Back Controls

Refer to step 14. "Air-Cooled Condensers" on page 61.

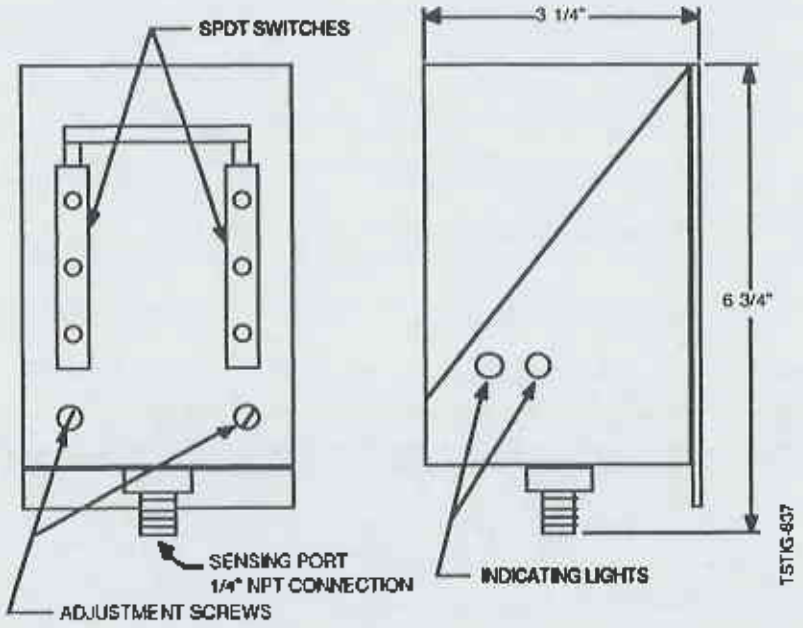


Figure 3-19 Differential Pressure Switch

VSM Controls vs Flood-Back Controls

Flood-back controls are used on smaller systems where:

- the system refrigerant charge is relatively small.
- adequate elevation between the condenser outlet and receiver is available to prevent the liquid refrigerant from stacking in the condenser during operations when flood-back is not required.

Flood-back controls require higher refrigerant charges and larger receivers.

VSM controls are more practical on larger systems to reduce the refrigerant charges.

Notes:

1. Cycling the condenser water pump is not recommended due to scale build-up on the condenser coils (caused by the residue of solids left on the tubes by evaporation of the water).
2. In some low ambient conditions, it may be practical to drain the condenser water sump and operate the condenser as an air cooled condenser (this does not contradict note #1 because the coil is not alternately wetted and then dried).
3. Sump heaters or indoor sumps should be considered in installations when the system is operated frequently in low ambient conditions.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Differential Pressure Switch Specifications (VSM Controller Input)

Pressure Range
0 to 300 psig

Proof Pressure
350 psig

Switch Output
2 SPDT switches

Electrical Rating
15 amps
125/250/480 VAC resistive

Approvals
UL
CSA

Temperature Operating Limits
–40°F to 160°F

Accuracy
±1% of adjustable range

Enclosure
NEMA 4 cast aluminum

Weight
Approximately 3 pounds

Variable Speed Motor Controller Specifications

Power, Input - Voltage
208, 220, 230, 240 VAC
(LV switch position)

380, 415, 440, 460 VAC
(HV switch position)

Power, Input - Phase
3-phase

Power, Input - Frequency
50 or 60 hertz

Power, Output - Voltage
208, 220, 230, 240 VAC
(LV switch position)

380, 415, 440, 460 VAC
(HV switch position)

Power, Output - Phase
3-phase

Power, Output - Frequency
30, 50, 60, 75, 90, 100, 120, 180 hertz can be selected. Standard switch setting is 60 hertz.

Power, Output - (VSM) Amp Capacity
Model V00800A00 – 8 amps
Model V01200A00 – 12 amps
Model V01500A00 – 15 amps
Model V02200A00 – 22 amps
Model V03200A00 – 32 amps
Model V04200A00 – 42 amps
Model V04600A00 – 46 amps
Model V06000A00 – 60 amps

Power, Output - Temperature Operating Limits
32°F to 104°F

Power, Output - Temperature Storage Limits
–4°F to 140°F

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

16. WATER-COOLED CONDENSERS

Mounting

Water-cooled condensers supplied with TIG SC models are mounted on a common base frame with the evaporator. The condenser is located on a structural support directly above the motor/compressor assembly. A compressor discharge line is piped to the condenser inlet and a liquid line connection is piped to the evaporator.

Design Conditions

The selection of a water-cooled condenser is dependent on the evaporator load, refrigerant used, the source and temperature of the cooling water, the amount of water circulated, and the desired operating pressure.

All SC condenser selections are based on the following conditions (for R-22):

- 85°F water entering
- 95°F water leaving
- 105°F saturated condensing temperature, SDT (210 psig)
- 40°F saturated evaporator

THR (total heat of rejection) = (evaporator load at 10°F SET and 105°F SDT in BTUH) + (heat of compression in BTUH)

Example:

TIG 16SC with 5H60 compressor

Compressor capacity @ 10°F SET and 105°F SDT = 31.5 tons = 378,000 BTUH

Compressor BHP @ 10°F / 105°F = 47.4

THR = (378,000) + (47.4) (2,545) = 498,633 BTUH

Tower gpm = (THR ÷ 15,000 BTUH / tower ton) (3.0 gpm / tower ton) = (498,633 / 15,000) (3.0) = 99.7 = 100 gpm

Equipment

Self-contained water-cooled (SC) models are furnished with a properly sized condenser to reject the THR (total heat of rejection) of the evaporator and the heat of the compressor. A safety relief valve and isolation valves for the inlet and outlet are also provided. Piping and wiring of the components are factory installed.

Optional water regulating valves for head pressure control, cooling towers, and cooling tower pumps can also be supplied.

Water Treatment

For maximum operating efficiency and equipment life of the condenser and cooling tower, Turbo recommends that a local water treatment supplier be consulted to analyze the water system to be used.

Fouling caused by scaling results in high heat pressure, higher operating cost, and lower capacity.

Operation

Superheated discharge gas enters the shell side of the water cooled condenser. Water is circulated through the tubes to remove the heat from the gas. The amount of surface area in the condenser, the flow rate (gpm) of the water, and the temperature of the water entering the condenser are all sized to remove the heat of compression and the heat absorbed by the refrigerant in the evaporator and converts the gas back to the liquid phase at the condenser pressure. Shell-and-tube (horizontal) condensers are used for this purpose.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

A typical water cooled system operates as follows:

For a system with:
- Water-cooled condenser
- Pressure-actuated water regulating valve
- Cooling tower with fan cycling thermostat
- Cooling tower pump
- Low discharge pressure switch

1. A switch sensing the discharge pressure closes at 150 psig to start the cooling tower fan and pump (starters, pump, and cooling tower are all optional equipment).

2. The water pump runs all the time (i.e. do not cycle water pump on and off).

3. As the water temperature in the cooling tower sump reaches the set point (usually 80–85°F) of the thermostat, the contacts close to energize the cooling tower fan motor magnetic starter. The fan runs until the temperature of the water drops below the differential of the thermostat and the contacts open to turn the fan off.

4. The water flow through the condenser is controlled by a pressure actuated water regulating valve that modulates open or closed in response to the discharge pressure. Water regulating valve kits are also options available from Turbo. As the discharge pressure increases, the water regulating valve opens to increase the water flow through the condenser. Conversely, as the discharge pressure drops, the valve modulates closed to reduce the water flow.

Note:
As the water temperature available from the cooling tower increases, the flow rate through the condenser must also increase to maintain the desired pressure setting. Therefore, for the controls to work properly, the settings of both the water regulating valve and cooling tower sump temperature thermostat must both be properly adjusted.

5. The setting of the water regulating and the resulting discharge pressure can be changed by turning the adjusting stem located on the top of the valve clockwise to raise the pressure and counterclockwise to reduce the discharge pressure. By turning the valve in, the spring in the bonnet is compressed, requiring a greater discharge pressure to move off its seat, thus allowing the water flow to decrease. As the stem is turned out, the compression of the spring is decreased and the force required to open the valve is also decreased. Thus, water flow through the valve increases and the discharge pressure is lowered.

Refer to Figures 3-20 and 3-21 for typical water-cooled condenser piping and wiring.

General Information

1. The shell-and-tube condenser used is also used as a receiver to hold the system refrigerant operating charge when the unit is pumped down (i.e. a separate receiver is not required).

2. A safety relief is provided on each condenser. Refer to step 13. "Refrigerant Charging" on page 57 for guidelines on relief valve venting.

Control Panel Winterizing

Ambient temperatures can affect many of the electronic controls in the VSM control panel. In general, the devices Turbo uses operate properly in temperatures between 32°F and 140°F. In operating ambients under 40°F, Turbo recommends that a source of heat be available in the control panel to maintain a temperature above 40°F. This will ensure continuous, reliable operation of all components (even in severe applications*). A winterizing kit consisting of a heat source and control thermostat can be provided as a factory installation or as a retrofit to existing control panels.

* The control panel winterizing kit is designed for equipment operations in ranges from 0 to 40°F. Consult Turbo for equipment operations in conditions below 0°F.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

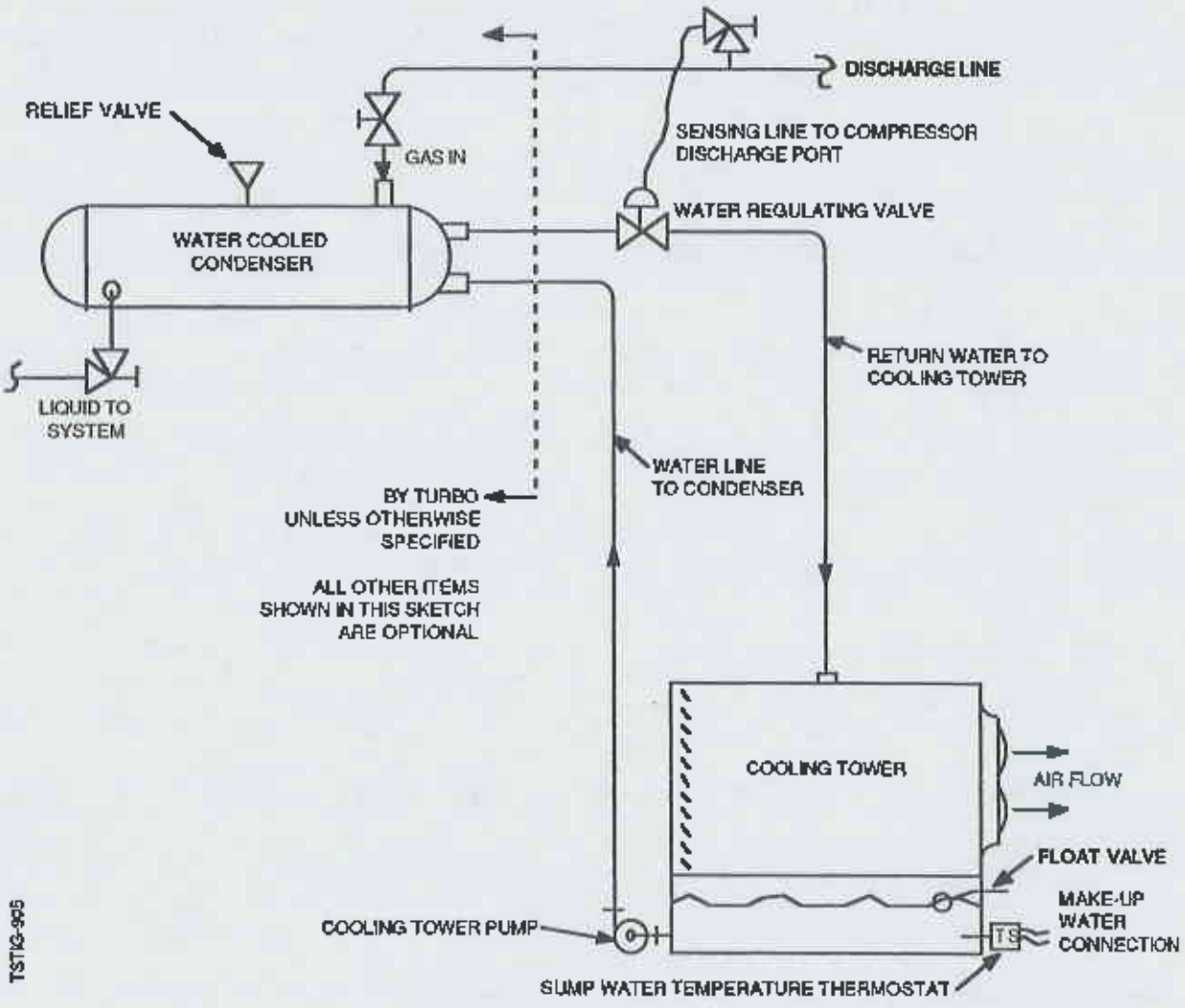


Figure 3-20 Typical Water-Cooled Condenser Piping

Installation

All components are factory installed and pre-wired.

Operating Sequence

As the control panel temperature drops below the set point of 40°F, the contacts of CPHT thermostat close to energize the panel heater coil. As the temperature rises above the differential setting of the thermostat, the contact opens to turn off the heater. The thermostat continues to maintain the interior temperature above 40°F. Refer to Figure 3-22.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

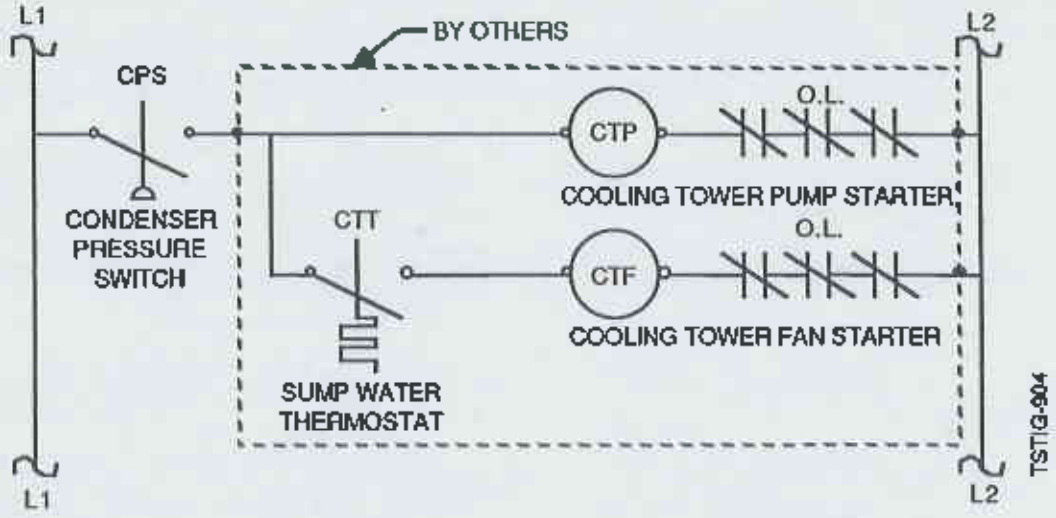


Figure 3-21 Typical Wiring for Water-Cooled System

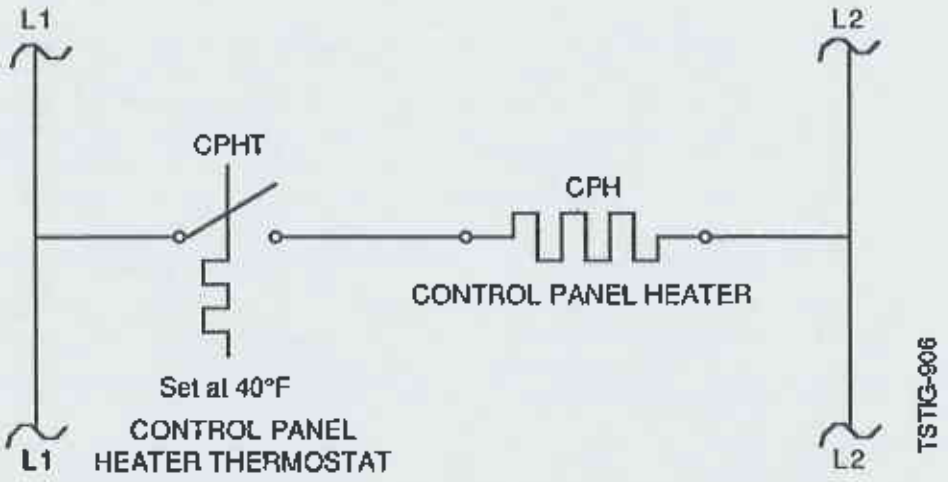


Figure 3-22 Control Panel Winterizing Wiring

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

OPERATING INSTRUCTIONS

This section describes the TIG ice generator operating sequence and the function of the ice generator components and control panel components. Operation hints are provided for safe, efficient, and reliable operation of the equipment. Only standard features are discussed in this section. For optional features and accessories, refer to section 8 on page 104.

Controls

All TIG models operate in the same basic way and control panel components are the same except for size (larger magnetic starters, etc.). Each panel contains:

- programmable controller
- magnetic starter for the
  - compressor
  - water pump(s)
  - harvest screw(s)
- magnetic motor starter for evaporator condenser fan and pump (where applicable-SCE models)
- magnetic motor starter for fan(s) on air-cooled condensers (where applicable-SCA models)
- water pump(s)
- harvest screw
- any other controls required for normal operation.

Note:
Controls necessary for components used to distribute the ice to points of use are not furnished by Turbo.

Control Panel Door

The control panel door contains:

- keyed master control selector switch "on/off"
- two 10-amp control circuit breakers
- reset buttons for the magnetic starter overload relays
- warning labels
- data nameplate
- emergency stop button.

Refer to the Safety Section on page 11 for a listing of all warning labels that should be on the control panel door. If any labels are missing, contact Turbo immediately to obtain the missing labels. **Think SAFETY!**

Note:
The serial number on the data nameplate should be referenced when inquiring about the controls. A file is maintained under this serial number to ensure that all information required to assist you with problems can be handled quickly and accurately.

WARNING

The keyed selector switch is not a service disconnect. Lock out electrical power to controls before performing service. Have a qualified electrician perform all service. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Electrical Components Description

Keyed Selector Switch - ON/OFF

A two position cam operated switch with a normally closed (NC) contact block and a normally open (NO) contact block are provided to input a signal to the programmable controller. These signals initiate the logic required to start the ice generator, and to terminate ice production. Turning the selector switch to the "off" position initiates a shutdown sequence that includes pump-down of the system refrigerant charge into the receiver or combination condenser/receiver. Actual termination of operation occurs when the low pressure safety switch opens at a preset suction pressure.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Emergency Stop Push Button

A large, red, mushroom head push button with a normally closed contact block is located on the control panel door and is wired into the main control circuit wiring. If immediate termination of operation is required, the push button is pushed in. This cuts off the single phase control circuit power and stops all electrical devices located within the unit including compressor crankcase heaters, and optional winterizing controls.

WARNING

Never use the emergency stop button as a service disconnect. Failure to carefully follow these instructions could result in permanent injury or loss of life.

To restart, the push button must be pulled out. Before resetting:

- Turn the keyed switch to the "off" position to pump-down the system before restarting to avoid slugging the compressor with liquid refrigerant.
- If the system is off for over 30 minutes, allow the crankcase heaters to warm up the compressor crankcase before restarting. (Refer to compressor manufacturer's specifications.)
- If the emergency stop was used, determine why and take action to correct.

Control Circuit Breaker

A 10-amp circuit breaker is located in each leg of the single phase control circuit power to the control panel. On panels using control circuit step-down transformers, the circuit breakers are located on the secondary side of the transformer. Separate circuit breakers (by others) are required for the transformer and electrical panel service.

Control circuit overloads or shorts can cause the breakers to trip. In the tripped mode, the circuit breaker "reset" pops up. Reset is accomplished by pushing the "reset" button in. Before resetting:

- Have a qualified electrician check all components in the electrical panel and on the machine to determine the overload cause. Correct all defects or problems immediately.
- *Never by-pass the circuit* breaker protection.

Magnetic Starters With Melting Alloy Overload Relay

Each electrical motor used in the ice generator is provided with a magnetic starter to start and stop each motor. Each starter contains an overload relay (melting alloy type) to protect the motor from overloads.

Overloads produce high ampere that exceed the rating of the melting alloy overload causing it to produce enough heat to open a circuit in the overload relay. The wiring of the starter coil is connected in series with the overload relay. As a result, the starter will de-energize when the overload relay contact opens.

A reset mechanism is located on the overload relay and a push button is on the control panel door to operate the "reset" mechanism on the starter overload relay.

WARNING

- **Have a qualified electrician determine the cause of the overload before resetting.**
- **Never bypass the overload relay.**
- **Never use an overload size larger than the size specified by the factory.**

Failure to carefully follow *these instructions* could result in permanent injury or loss of life.

Three melting alloy heater elements are factory sized and supplied to match the motor horsepower and voltage.

All magnetic starters are supplied with dual voltage/dual frequency coils (115 or 230 VAC; 50/60 hertz).

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Auxiliary interlocks are mounted on the magnetic starters to control auxiliary operations (i.e. the compressor crankcase heater(s) is interlocked to the compressor(s) motor starters. The normally closed interlock turns the crankcase heater(s) on when the compressor is off).

Additional auxiliary interlocks can be provided. Consult Turbo for information.

Programmable Controller

A UL listed programmable controller (PC) is used to control the operating sequence of the unit. The PC consists of:

- power supply
- central processing unit (CPU)
- input/output modules (I/O).

Each electrical device or group of devices is connected to an I/O contact.

Standard inputs include:

- master control switch
- safety circuit
- water pump interlock
- harvest screw interlocks.

Outputs include:

- each electrical motor
- liquid (refrigerant) solenoid valve
- hot gas solenoid valves.

Additional I/Os can be provided for remote equipment operation (optional).

All icemaking, harvest, and time delays are programmed into the PC. Certain time and time-delay presets can be easily field adjusted through the PC programmer pad supplied.

A keyed switch is located on the PC programmer to prevent unauthorized access or changes to either the program or preset time and counter values. The PC programmer may also be removed when not in use.

Electric Motors

Standard, open, drip-proof 230/460/3/60 motors are used for the compressor, water pump, and harvest screw.

Optional 208 or 575 voltage motors are available for 60 hertz systems and 50 hertz frequency is also available. Each motor is bottom wired to a magnetic starter at the factory. Starter top wiring (incoming power) and motor disconnects and/or circuit breakers should be furnished by others to meet all local electrical codes.

Initial Start-Up Checklist

After the initial start-up procedure has been completed, the following start-up, refrigeration, harvest, and shutdown sequences are typical. Each is described below.

Typical Daily Start-Up Sequence

The following start-up sequence is typical for TIG models:

1. The keyed master control switch (MCS) is turned to the "on" position.
2. Through the PC, a signal energizes the refrigerant liquid solenoid valve for a preset time interval.
3. With the liquid solenoid open, the refrigerant charge enters the system causing the pressure to rise above the low (evaporator) pressure safety switch setting.
4. If all other safety switches are in a "non-trip" status, the compressor motor and water pump motor energizes and the liquid solenoid remains open.
5. All sections are in the refrigeration mode.
6. After a preset time, a defrost sequence is initiated.

Note:
The refrigeration time which controls the ice thickness can be easily and quickly adjusted through the PC programmer.

If the unit fails to start, refer to the Trouble-Shooting Section on page 81.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Typical Defrost Sequence

A defrost sequence is started to remove the ice from a group or section of plates.

1. The PC turns on the harvest screw conveyor. If the harvest screw does not start, the unit will automatically shut-down to prevent an ice build-up in the ice discharge slide.

2. A pilot solenoid valve (PS) is energized to supply hot gas to a gas powered check valve located in the evaporator suction line. This isolates the evaporator in defrost.

3. At the same time, a hot gas solenoid valve (HG) is energized to introduce hot gas into the evaporator. This results in an increase in the evaporator pressure and temperature (pressure/temperature relation of the refrigerant).

4. Sub-cooled liquid produced by the section in defrost is metered to the remaining sections in refrigeration.

5. The following conditions produce a plate temperature high enough to eliminate the bond between the ice and the plate:

   - the removal of refrigeration effect (isolation of the evaporator section)
   - the addition of hot gas
   - the heat in the water that continues to flow over the section in defrost
   - the metering of liquid to the sections in refrigeration.

6. The ice falls from the plates into the ice slide/ harvest screw which breaks the sheets of ice into fragments.

7. Water is drained from the ice through the perforated harvest screw trough. (A dry out section is provided prior to the ice discharge opening located outside the machine.)

8. After a pre-set harvest time, the hot gas solenoid and pilot solenoid are de-energized and the section is returned to the refrigeration mode.

Note:
The harvest screw run time is adjustable to allow complete removal of all ice after the harvest sequence. Factory preset at 60 seconds.

Each section goes through the same sequence. The sequence continues until either the MCS switch is turned "off", or an optional bin-level switch opens to indicate that the ice storage is full, or a safety switch trips.

Typical Water Systems

Make-Up Water Circuit

1. A ball valve is provided in the make-up water line to shut off water for extended time periods.

2. Water for producing Turbo ice enters the TIG unit through the make-up water connection. The make-up water is screened through a strainer before entering the TIG unit to help screen out solids.

3. The make-up water goes into the water tank by way of a mechanical float valve. The float valve will shut off when the level of make-up water in the tank reaches the proper height. Water level is adjustable by raising or lowering the float valve.

Helpful Hint:
A solenoid valve may be installed in the make-up water line if the unit is off for extended time periods.

4. The water is distributed throughout the water tank by a make-up water header.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Pump and Water Distributor Circuit

1. The water is drawn from the tank and pumped to the water distribution header through a flow control (ball) valve. The ball valve can be adjusted to obtain a uniform flow to the water distribution pans without excessive splashing.

2. The water distribution header evenly fills the water distribution pans.

3. The water distribution pans allow a thin film of water to run over both sides of the evaporator plates. As the water and evaporator reach the proper temperature, ice begins to form on the plate. This water runs continuously while the machine is in operation.

4. A check valve is installed in the pump discharge line to prevent water surges to the tank during shutdown. A metering hole is provided in the check valve to allow a controlled drain of all water lines above the check valve.

5. The water that does not freeze, flows off the evaporator plates onto the ice slide and into the screw conveyor trough. The screw conveyor trough is perforated. This allows the water that has fallen from the evaporator plates or drained from ice to flow back into the water tank to be recirculated back through the pump water distribution circuit.

Overflow Drain Circuit

1. An overflow drain box is provided in the water tank to allow tank overflow for control of the water quality.

   - If residual solids or minerals in the water are a problem, the float valve in the make-up water line can be raised to increase the overflow of the tank. This overflow will reduce the concentration of solids or minerals in the water tank.

   - If less overflow or zero overflow is desired, the float valve actuator can be lowered.

2. The overflow drain box is piped to the outside of the unit for field connection to a drain line.

3. During shutdown, the water that drains back to the tank from the water circulating system and water distribution pan(s) may cause the tank to overflow.

Typical Shutdown Sequence

The Turbo ice generator can be turned off in two ways, both of which leave the unit in a "pump-down" mode. Emergency stop and safety failure switches stop the unit immediately without "pump-down". "Pump-down" of the refrigerant into a receiver or combination condenser/receiver is recommended on all TIG models.

Normal shut down is initiated by turning the keyed master control switch (MCS) to the "OFF" position, or by a remote signal through the optional bin level switch (BLS) contacts. Any normally closed (NC) contact in series with the MCS contact blocks in the control system wiring will also initiate the shutdown sequence. This can include bin-o-matics or limit switches in remote ice storage bins or hoppers, process controls, time clocks, remote ice delivery equipment, or remote safety interlocks.

After a normal shutdown sequence is initiated, the following events occur:

- The main liquid solenoid valve (LS) is de-energized to stop the flow of refrigerant to the evaporator plates.

- Compressors and water pump continue to run. All evaporator sections remain in the icemaking mode.

- If an evaporator section is in harvest, the shutdown sequence will not start until the harvest of that section is completed.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

- As the compressor continues to run with the LS closed, the refrigerant in the evaporator plates and piping will be pumped into a receiver or combination condenser/receiver.
- Suction pressure at the compressor will drop until it reaches the setting of the low pressure safety switch in the control circuit.
- When the pressure drops below the setting of the safety switch, the contacts of the switch will open.
- The compressor and water pump will both stop immediately.

WARNING

TIG models are equipped with continuous pump-down cycle and the compressor can restart automatically even if the keyed master control switch is "OFF". Never attempt service of the compressor without locking out the electrical service. Failure to carefully follow these instructions could result in permanent injury or loss of life.

- As long as the evaporator pressure is below the setting of the low pressure safety switch, the unit will stay "OFF".
  - If the evaporator pressure rises due to incomplete pump-down or liquid bypass around the LS, the compressor will automatically restart and run until the system is again "pumped-down" and the compressor stops. If this sequence continues more than three (3) times, the source of the pressure (defective solenoid valve, etc.) should be located and repaired.
  - The PC controller is programmed to allow only three (3) starts in a fifteen minute time span to prevent short cycling of the compressor (which could result in excessive wear or damage to the compressor).
- Make-up water to the unit is shut off by the mechanical float valve that feeds water to the icemaker water tanks.

Note:
In a normal shutdown sequence, ice will be left on the evaporator plates.

- Any ice or water coming from the plates after shutdown will drain through the perforated harvest screw trough into the water tank located below it.

Helpful Hints

- If the equipment is to be shut off for extended time periods (more than 48 hours):
  - Close the hand valve in the water make-up line to prevent loss of water through the tank overflow drain.
  - Close the isolation valve ("King" valve) on the outlet of the receiver or combination condenser/receiver.
  - Turn off the three-phase electrical power to the compressor, water pump(s), and harvest screw motors (disconnect or circuit breakers furnished by others).
  - Do not turn off the single phase control circuit power. This turns off power to the compressor crankcase heater, and optional winterizing equipment (if furnished).

IMPORTANT

If the control circuit power has been turned off, it should be turned on for a minimum of twenty-four (24) hours prior to use to ensure that any liquid refrigerant that migrates to the compressor crankcase is eliminated prior to start-up. Failure to follow these instructions could result in failure or damage to the compressor.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Specifications

Refrigerant

R-22.

Evaporator Temperature (icemaking)

0°F (24 psig).

Discharge Pressure

Water-Cooled Condenser
105°F condensing (210 psig).
85°F water in/105°F water out.
78°F design wet bulb.

Evaporative-Cooled Condenser
95°F (185 psig).
Based on total heat of rejection (THR) at 10°F evaporative and 95°F condensing.
78°F design wet bulb.

Air-Cooled Condenser
120°F (250 psig) condensing.
Based on THR at 10°F evaporator/120°F condensing.
100°F design dry bulb.

Discharge Pressure Control

Evaporative-Cooled Condenser

1. Upstream pressure regulator in the discharge line entering the condenser. Hot gas bypass through a downstream pressure regulator provided to maintain receiver pressure during "cold" start up. Factory installed on SCE models; supplied for field installation on SCER models.
2. Variable speed fan motor control adjusts the RPM of the condenser fan motor to maintain a desired discharge pressure (optional).

Water-Cooled Condenser
Pressure actuated water regulating valve(s) are optional. Field installed. Cooling tower and cooling tower pumps are not supplied (optional).

Air-Cooled Condenser
Fan cycling with flood back control consisting of upstream regulator in drain line of condenser to receiver. Downstream regulator in a hot gas bypass line to the inlet of the receiver.

Refrigerant Feed

Externally equalized thermal expansion valve.

Superheat Setting*

7°F.

* Superheat is defined as the temperature of the suction gas measured at the thermal expansion valve bulb less the saturated suction gas temperature at the pressure indicated at the TXV bulb. For example: measured 7°F at the TXV bulb, evaporator suction pressure is 24 psig. This equals to 0°F saturated suction temperature.
Superheat = 7°F - 0°F = 7°F.

Make-Up Water

Make-Up Water Temperature
60°F at water distribution header inlet.

Make-Up Water Pressure Required
8 psig at inlet to water distribution header.

Make-Up Water Flow
Each plate requires 8 gpm (an adjustable water flow control valve is provided to make final adjustment of the water flow).

Make-Up Water Feed
Mechanical float valve with adjustable float arm.
Minimum flow is 3 gpm.
Maximum flow is 15 gpm.

Make-Up Water Blowdown
0 to 50% - adjustable.

Safety Switch Settings R-22 Models

Low Pressure Cutoff
5 psig.

High Pressure Cutout
250 psig (water and evaporative cooled).
275 psig (air cooled).

Oil Pressure (net)
40 psig (oil pressure above suction).
1 minute time delay (manual reset).

Relief Valve (receiver, condensers)
350 psig nonadjustable.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Motor Full Load Amps (FLA)

Refer to table in the Appendix & Notes Section.

Operating Refrigerant Charges

Refer to table in the Appendix & Notes Section.

Condenser Sizing

Refer to table in the Appendix & Notes Section.

Evaporator Plates

304 stainless steel
Hydraulically blown to inflate to proper rise.

Design operating pressure
200 psig.

Burst pressure
1,500 psig.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

TROUBLE-SHOOTING

This section lists common problems and suggests solutions. Many problems are easy to solve - if you know what caused them.

If your problem is more complex and not stated in this section, contact Turbo Refrigerating Company at:

1-817-387-4301

Ask for the service department.

The following pages describe problems you might encounter and provide diagnostic instructions and solutions.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

PROBLEMS AND SOLUTIONS

Problem	Causes	Solutions
Compressor will not start.	No three phase or control circuit power, tripped circuit breaker.	Check fuses and disconnect. Reset tripped circuit breakers.
	Blown fuse.	Reset or replace manual reset.
	Oil failure tripped.	Determine cause of low oil pressure before re-starting (see low oil pressure in Section 3. "Installation & Pre-Start-Up Requirements").
	Defective dual pressure switch.	Check switch wiring on controller. Replace.
	Improper signal at the programmable controller.	The run and power lights must be on for unit to operate. Check for loose connection and control circuit power to controller.
	MCS turned off.	Turn switch to "ON" position.
	Starter coil defective.	Check starter coil for burnout or loose wiring. Replace as required.
	Oil temperature safety.	Compressor off on high oil temperature. Determine cause of high oil temperature before resetting (see high oil temp in Section 3. "Installation & Pre-Start-Up Requirements").

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Compressor will not start (continued).	Emergency stop button depressed.	Determine reason emergency stop button was used and correct before resetting.
	Overload relay on magnetic starter tripped.	Determine cause of motor overload. Depress manual reset button.
Unit drawing high amps.	Loose terminal connections.	Tighten connections (qualified electrician).
	Defective motor bearings or motor.	Replace. Check compressor/motor alignment and mounting bolts before restarting.
	Refrigerant system overcharged causing high discharge pressure.	Determine actual refrigerant charge and remove refrigerant as required.
	Condenser inoperative - high discharge pressure.	Check condenser head pressure control operation. Check electrical and/or pressure connections to controls.
	Air or non-condensables in system.	Replace refrigerant charge.

Notes:

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Unit will not make ice or is not producing full sheet of ice.	High discharge pressure:	
	– Defective water regulating valve. (water cooled).	Check pressure sensing connection to regulator. Replace.
	– Fouling at condenser. (water cooled).	Clean condenser by brushing and/or acid treatment. Consult manufacturer for water treatment recommendations.
	– Faulty water pump. (water or evaporative cooled).	Replace pump. Check pump suction and discharge for obstructions.
	– Fouling at condenser. (air cooled)	Clean with air, water hose, or brushing. Remove debris from condenser inlet.
	– Flood back valves out of adjustment. (air or evaporative cooled).	Adjust to maintain 180 psig (see Section 3, step 14. Air-Cooled Condensers on page 61).
	– Belt worn or loose causing belts to slip. (air or evaporative cooled)	Adjust, replace belts.
	– Fan turning too slow. (air cooled)	Change sheave to increase speed up to FLA of motor. Consult factory before restarting. Check for restrictions.
	Low on freon.	Add refrigerant to eliminate bubbles. Search for leak and repair.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Unit will not make ice or is not producing full sheet of ice (continued).	Leaking defrost valve allowing high gas by-pass.	Repair with valve kit or replace.
	Thermal expansion valve improperly adjusted.	Adjust expansion valve superheat to 8–10°F. Check TXV power head. If defective, replace.
	Plugged or restricted filter drier.	Replaced drier cores.
	Moisture in system (yellow sight glass).	Replace drier cores. May require replacement of refrigerant charge. Determine source of water contamination.
	Air or other non-condensable in refrigerant system.	Bleed air from condenser. Replace refrigerant charge.
	Restriction in piping.	Check all isolation valves for proper position - open or closed.
	Power off to condensing unit.	Check power, breaker, and disconnects to all motors, starters, and control switches.
	Insufficient water flow to condenser (water cooled):	
	– Strainer plugged.	Clean or replace.
	– Float valve defective (make-up water line to cooling tower).	Check adjustment. Replace if required.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Unit will not make ice or is not producing full sheet of ice (continued).	Condenser pump prime lost - low water level in sump.	Add water to cooling tower. Determine cause of water loss.
	Condenser water make-up valve closed or restricted.	Clean, repair, open, or replace valve.
	Recirculating water pump off:	
	– Motor overloads tripped.	Check pump for restrictions. Reset starter overload relay.
	– Recirculating pump prime lost. Low water level in reservoir.	Locate water feed restriction. Add water to tank.
	– Strainer plugged.	Remove and clean.
	– Check valve stuck closed.	Remove and clean.

Notes:

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Unit will not defrost.	Hot gas solenoid inoperative.	Check wiring to coil. Check for burned out coil and replace.
	Pilot solenoid for gas powered check inoperative.	Same as above.
	Insufficient water over plates.	Check distribution pans for fouling and clean. Clean strainer if so equipped, clean screen on pick-up at pump. Check pump for proper rotation.
	Too low discharge pressure.	Check condenser pressure controls.
	Gas powered check inoperative.	Valve dirty, clean. Pilot solenoid inoperative.
	Leaking defrost valve or valve inoperative (models using 3-way defrost valve). Valve will not shift.	Repair or replace valve. Check wiring to coil. Check for burned out coil. Disassemble and clean.
	Ice building on ends of plate causing bridging.	Check heat tapes for operation if so equipped. Check for low water flow caused by dirty pan.

Notes:

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Low suction pressure.	Low on refrigerant.	Check for leaks, repair. Add refrigerant.
	Obstruction or dirty in filter drier.	Replace filter drier.
	Low water flow over plates.	Check water distribution pan for dirt, pump for performance.
	Expansion valves improperly adjusted or defective (starving).	Check expansion valve adjustment. Replace if required.
High suction pressure.	Too high water temperature.	Water temperature above 60°F (based on incoming city water).
	Leaking defrost valve.	Repair or replace.
	Expansion valve improperly adjusted (overfeeding refrigerant).	Check expansion valve adjustment (close to reduce refrigerant valve). Set superheat at 8–10°F.

Notes:

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Problem	Causes	Solutions
High discharge pressure.	Refrigerant system overcharged.	Verify actual charge. Reduce charge as required.
	Dirty condenser.	Clean.
	Non-condensables in refrigerant.	Air in system. Remove by purging.
	Head pressure controls improperly set.	Readjust to correct setting. Normally 180 - 210 psig for water cooled; 170 - 190 psig for evaporative cooled; 210 - 250 psig for air cooled.
	Discharge line check valve inoperative.	Check and replace if required.
	Check position of all isolation valves and pressure controls.	Open all valves fully. Make sure all pressure controls are properly adjusted and pressure regulator are in automatic position.

Notes:

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Low oil pressure.	Oil not returning from accumulator.	Adjust hand expansion valve open to 1/4 turn open from fully closed. Observe sight glass for flow. Check strainer and solenoid valves.
	Plugged or stopped up oil strainer.	Clean. Purge line.
	Faulty solenoid valve or coil in oil return line.	Repair or replace.
	Low oil in crankcase.	Add oil, observe sight glass. Maintain 1/8 to 1/2 sight glass. If oil returns above 1/2 sight, remove excessive oil.
	Defective compressor oil pump.	Check rotation. Replace as required (refer to manufacturer's Installation, Start-Up and Service Instructions in Section 10. "Appendix & Notes").

Notes:

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Problem	Causes	Solutions
Excessive vibration of motor and compressor.	Misalignment.	Realign to within specifications (see Section 3, step 6. Aligning Compressors and Motors on page 41).
	Loose motor/compressor hold down bolts.	Tighten.
	Flooding of compressor.	Adjust txv. Check mounting of remote bulb and position on the suction line.
	Defective or worn bearing.	Remove coupling and check bearing.
	Structural support under unit insufficient.	Reinforce structural support. Shim as required.
Excessive motor temperature.	Voltage drop at motor starter/contactor.	Phase imbalance. Consult electric company.
	Loose connection at starter/contactor causing high amp draw.	Tighten connection. (qualified electrician)
	Restricted air ventilation.	Clean obstructions.

Notes:

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TROUBLE-SHOOTING

This section lists common problems and suggests solutions. Many problems are easy to solve - if you know what caused them.

If your problem is more complex and not stated in this section, contact Turbo Refrigerating Company at:

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Ask for the service department.

The following pages describe problems you might encounter and provide diagnostic instructions and solutions.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

PROBLEMS AND SOLUTIONS

Problem	Causes	Solutions
Compressor will not start.	No three phase or control circuit power, tripped circuit breaker.	Check fuses and disconnect. Reset tripped circuit breakers.
	Blown fuse.	Reset or replace manual reset.
	Oil failure tripped.	Determine cause of low oil pressure before re-starting (see low oil pressure in Section 3. "Installation & Pre-Start-Up Requirements").
	Defective dual pressure switch.	Check switch wiring on controller. Replace.
	Improper signal at the programmable controller.	The run and power lights must be on for unit to operate. Check for loose connection and control circuit power to controller.
	MCS turned off.	Turn switch to "ON" position.
	Starter coil defective.	Check starter coil for burnout or loose wiring. Replace as required.
	Oil temperature safety.	Compressor off on high oil temperature. Determine cause of high oil temperature before resetting (see high oil temp in Section 3. "Installation & Pre-Start-Up Requirements").

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Compressor will not start (continued).	Emergency stop button depressed.	Determine reason emergency stop button was used and correct before resetting.
	Overload relay on magnetic starter tripped.	Determine cause of motor overload. Depress manual reset button.
Unit drawing high amps.	Loose terminal connections.	Tighten connections (qualified electrician).
	Defective motor bearings or motor.	Replace. Check compressor/motor alignment and mounting bolts before restarting.
	Refrigerant system overcharged causing high discharge pressure.	Determine actual refrigerant charge and remove refrigerant as required.
	Condenser inoperative - high discharge pressure.	Check condenser head pressure control operation. Check electrical and/or pressure connections to controls.
	Air or non-condensables in system.	Replace refrigerant charge.

Notes:

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Unit will not make ice or is not producing full sheet of ice.	High discharge pressure:	
	– Defective water regulating valve. (water cooled).	Check pressure sensing connection to regulator. Replace.
	– Fouling at condenser. (water cooled).	Clean condenser by brushing and/or acid treatment. Consult manufacturer for water treatment recommendations.
	– Faulty water pump. (water or evaporative cooled).	Replace pump. Check pump suction and discharge for obstructions.
	– Fouling at condenser. (air cooled)	Clean with air, water hose, or brushing. Remove debris from condenser inlet.
	– Flood back valves out of adjustment. (air or evaporative cooled).	Adjust to maintain 180 psig (see Section 3, step 14. Air-Cooled Condensers on page 61).
	– Belt worn or loose causing belts to slip. (air or evaporative cooled)	Adjust, replace belts.
	– Fan turning too slow. (air cooled)	Change sheave to increase speed up to FLA of motor. Consult factory before restarting. Check for restrictions.
	Low on freon.	Add refrigerant to eliminate bubbles. Search for leak and repair.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Unit will not make ice or is not producing full sheet of ice (continued).	Leaking defrost valve allowing high gas by-pass.	Repair with valve kit or replace.
	Thermal expansion valve improperly adjusted.	Adjust expansion valve superheat to 8–10°F. Check TXV power head. If defective, replace.
	Plugged or restricted filter drier.	Replaced drier cores.
	Moisture in system (yellow sight glass).	Replace drier cores. May require replacement of refrigerant charge. Determine source of water contamination.
	Air or other non-condensable in refrigerant system.	Bleed air from condenser. Replace refrigerant charge.
	Restriction in piping.	Check all isolation valves for proper position - open or closed.
	Power off to condensing unit.	Check power, breaker, and disconnects to all motors, starters, and control switches.
	Insufficient water flow to condenser (water cooled):	
	– Strainer plugged.	Clean or replace.
	– Float valve defective (make-up water line to cooling tower).	Check adjustment. Replace if required.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Unit will not make ice or is not producing full sheet of ice (continued).	Condenser pump prime lost - low water level in sump.	Add water to cooling tower. Determine cause of water loss.
	Condenser water make-up valve closed or restricted.	Clean, repair, open, or replace valve.
	Recirculating water pump off:	
	– Motor overloads tripped.	Check pump for restrictions. Reset starter overload relay.
	– Recirculating pump prime lost. Low water level in reservoir.	Locate water feed restriction. Add water to tank.
	– Strainer plugged.	Remove and clean.
	– Check valve stuck closed.	Remove and clean.

Notes:

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Unit will not defrost.	Hot gas solenoid inoperative.	Check wiring to coil. Check for burned out coil and replace.
	Pilot solenoid for gas powered check inoperative.	Same as above.
	Insufficient water over plates.	Check distribution pans for fouling and clean. Clean strainer if so equipped, clean screen on pick-up at pump. Check pump for proper rotation.
	Too low discharge pressure.	Check condenser pressure controls.
	Gas powered check inoperative.	Valve dirty, clean. Pilot solenoid inoperative.
	Leaking defrost valve or valve inoperative (models using 3-way defrost valve). Valve will not shift.	Repair or replace valve. Check wiring to coil. Check for burned out coil. Disassemble and clean.
	Ice building on ends of plate causing bridging.	Check heat tapes for operation if so equipped. Check for low water flow caused by dirty pan.

Notes:

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Low suction pressure.	Low on refrigerant.	Check for leaks, repair. Add refrigerant.
	Obstruction or dirty in filter drier.	Replace filter drier.
	Low water flow over plates.	Check water distribution pan for dirt, pump for performance.
	Expansion valves improperly adjusted or defective (starving).	Check expansion valve adjustment. Replace if required.
High suction pressure.	Too high water temperature.	Water temperature above 60°F (based on incoming city water).
	Leaking defrost valve.	Repair or replace.
	Expansion valve improperly adjusted (overfeeding refrigerant).	Check expansion valve adjustment (close to reduce refrigerant valve). Set superheat at 8–10°F.

Notes:

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
High discharge pressure.	Refrigerant system overcharged.	Verify actual charge. Reduce charge as required.
	Dirty condenser.	Clean.
	Non-condensables in refrigerant.	Air in system. Remove by purging.
	Head pressure controls improperly set.	Readjust to correct setting. Normally 180 - 210 psig for water cooled; 170 - 190 psig for evaporative cooled; 210 - 250 psig for air cooled.
	Discharge line check valve inoperative.	Check and replace if required.
	Check position of all isolation valves and pressure controls.	Open all valves fully. Make sure all pressure controls are properly adjusted and pressure regulator are in automatic position.

Notes:

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Low oil pressure.	Oil not returning from accumulator.	Adjust hand expansion valve open to 1/4 turn open from fully closed. Observe sight glass for flow. Check strainer and solenoid valves.
	Plugged or stopped up oil strainer.	Clean. Purge line.
	Faulty solenoid valve or coil in oil return line.	Repair or replace.
	Low oil in crankcase.	Add oil, observe sight glass. Maintain 1/8 to 1/2 sight glass. If oil returns above 1/2 sight, remove excessive oil.
	Defective compressor oil pump.	Check rotation. Replace as required (refer to manufacturer's Installation, Start-Up and Service Instructions in Section 10. "Appendix & Notes").

Notes:

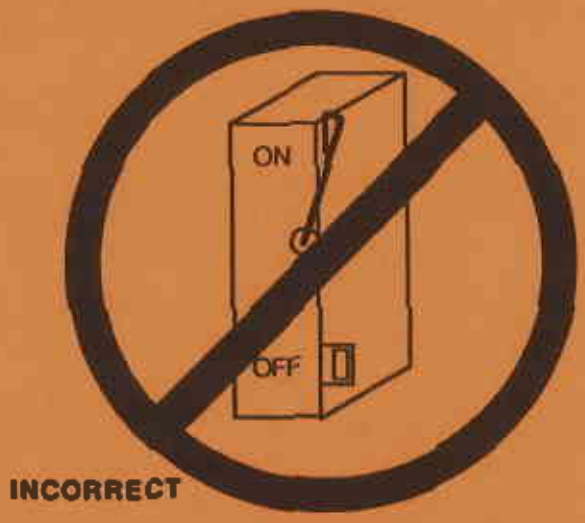
Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Problem	Causes	Solutions
Excessive vibration of motor and compressor.	Misalignment.	Realign to within specifications (see Section 3, step 6. Aligning Compressors and Motors on page 41).
	Loose motor/compressor hold down bolts.	Tighten.
	Flooding of compressor.	Adjust txv. Check mounting of remote bulb and position on the suction line.
	Defective or worn bearing.	Remove coupling and check bearing.
	Structural support under unit insufficient.	Reinforce structural support. Shim as required.
Excessive motor temperature.	Voltage drop at motor starter/contactor.	Phase imbalance. Consult electric company.
	Loose connection at starter/contactor causing high amp draw.	Tighten connection. (qualified electrician)
	Restricted air ventilation.	Clean obstructions.

Notes:

DISCONNECTING POWER & LOCK OUT

Turbo Refrigerating Company insists that **disconnecting** and **locking out** the power to the motor driving the unit provides the only real protection against injury. Other devices should not be used as a substitute for **locking out** the power prior to removing guards, covers, or other safety devices. Turbo warns that the use of secondary devices may cause employees to develop a false sense of security and fail to **lock out** power before removing guards, covers, or other safety devices. This could result in a serious injury should the secondary device fail or malfunction.



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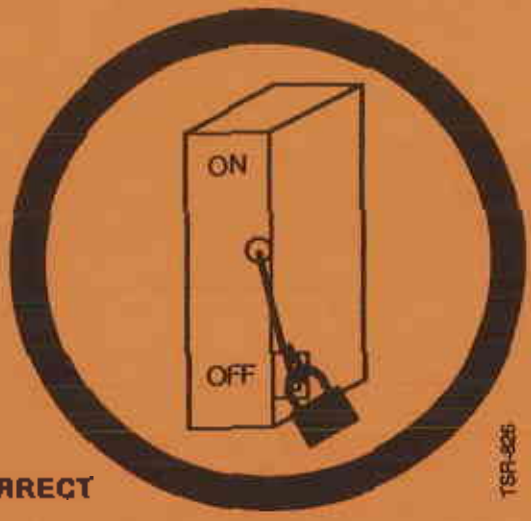

CORRECT

TSR-826

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

MAINTENANCE

To help you get the best performance from your TIG system, follow the maintenance instructions listed below.

If you have questions concerning the maintenance or upkeep of your equipment, contact the service department of Turbo Refrigerating Company (1-817-387-4301).

Daily Inspections

1. Inspect the icemaker at least twice a shift to determine that the unit is operating properly.
2. At the start, observe that the discharge and suction pressures are correct on the gauges and are stable.

Weekly Inspections

- Check the oil level in the compressor.
- Check for signs of oil leakage.
- Check the sight glass for full charge and moisture indication.
- Check the receiver. Inspect valve packings and relief valve for indications of refrigerant loss.
- Check for percentage of freon 20–30% while operating.
- Unit should be checked at least once a week. A visual inspection should include and not be limited to: leaks, vibration of piping on other components, capillary tubes rubbing, unusual noises, bolts, nuts, screws tight, and general neat housekeeping appearance.

After Initial Ten Hours of Operation

- Retighten all bolts.

After Initial Fifty Hours of Operation

- Retighten all bolts.
- Have a qualified electrician check the control panel for loose connections or loose lugs on the magnetic starter.

Every Six Weeks

- Grease all greasable fittings on the shaft bearings.

One of the main problems with the TIG or any icemakers is water: scale build up. Solid forming on the plates, build up of solids in the pan. Solid building up on the interior of water cooled condenser if so equipped. To avoid these problems, consult a local water treatment consultant and follow the following guidelines:

Plates Forming Scale

Flush plates with an acceptable ice plate cleaner. Have water analyzed.

Icemaking Surface Cleaning

Scale on the icemaking plates resulting from mineral deposits in the water and other sources of contamination can reduce the efficiency of the plate. If left untreated, it may result in deterioration of the metal surface thus reducing the life of the plates.

The life and efficiency of the plates are dependent on proper care and cleaning of the surface. Since conditions and installation of equipment vary from location to location, it is difficult to provide a simple solution to selecting a cleaning and sanitizing method. To obtain the best care for your unit, contact a local reputable supplier of chemical and cleaning sanitizing products. Based on the knowledge of the local water conditions, the material to be cleaned (304 stainless steel), and the operating conditions of the equipment, they can recommend a cleaning and sanitizing product to meet your specific needs.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Table 6-2 Sample Daily Ice Plant Log Sheet

Date: _____

	Ice Depth	Vault Temp.	Ice Maker		Compr. Oil Press.	Defrost Water Temp.			Defrost Water Press.			Ambient Temp.
			Head Pressure	Suction Pressure		1	2	3	1	2	3	
1st Shift Start												
1st Shift End												
2nd Shift Start												
2nd Shift End												
3rd Shift Start												
3rd Shift End												

Operators

First Shift: _____
Second Shift: _____
Third Shift: _____

Liquid Line Ice Maker Sight Glass

First Shift			
Second Shift			
Third Shift			

Remarks

First Shift: _____

_____

Second Shift: _____

_____

Third Shift: _____

_____

TSTG-820

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

SPARE PARTS LIST

It is a good idea to keep spare parts on hand in case of emergencies. You will save operation time and money because you will not have to wait for parts to be ordered and delivered.

Part numbers may change without notice. When ordering or specifying parts, the serial number and model of the unit must be referenced.

Legend

SI = Items that should be stocked to maintain safe equipment operation, for normal maintenance, or frequent replacement items that can cause interruption of operation.

RI = Replacement items that are normally not subject to normal maintenance or replacement.

Water System

Part Number	SI	RI	Description	TIG (quantity) 16	21	31	42	63	80
012-2007-0501	x		Float Valve	1	1	1	1	1	1
014-1600-05	x		Strainer	1	1	1	1	1	1
028-0800-01		x	Pump	1	1		2		
028-0800-03		x	Pump			1		2	3

TSTIG-907

Oil Return Assembly

Part Number	SI	RI	Description	TIG (quantity) 16	21	31	42	63	80
036-0505-00	x		Oil Heater	1	1	1	1	1	1
019-0001-22	x		Thermostat	1	1	1	1	1	1
012-3200-00	x		Solenoid Valve	1	1	1	1	1	1
014-0200-06	x		Strainer	1	1	1	1	1	1
012-0602-03	x		Relief Valve	1	1	1	1	1	1
014-0700-03		x	Oil Float Valve	1	1	1	2	2	2

TSTKG-908

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Legend

SI = Items that should be stocked to maintain safe equipment operation, for normal maintenance, or frequent replacement items that can cause interruption of operation.

RI = Replacement items that are normally not subject to normal maintenance or replacement.

Electrical Control Panel (230/460/3/60) (115/460)

				TIG (quantity)					
Part Number	SI	RI	Description	16	21	31	42	63	80
035-0501-06	x		Relay Coil	1	1	1	1	1	1
035-0303-09	x		Pilot Light - Red	1	1	1	1	1	1
035-0303-08	x		Pilot Light - Green	1	1	1	1	1	1
TIGELE03	x		Starter Coil	1	1	1	1	1	1
TIGELE04	x		Starter Heater Overload	3	3	3	3	3	3
027-0003-01		x	Cooling Fan	1	1	1			1
TIGELE05		x	Relay	1	1	1	1	1	1
035-2100-01		x	Starter Water Pump 230 Volt			1		2	3
035-2100-01		x	Starter Water Pump 460 Volt						
035-2100-00		x	Starter Water Pump 230 Volt	1	1		2		
035-2100-00		x	Starter Water Pump 460 Volt	1	1	1	2	2	3
035-2100-01		x	Starter Harvest Screw 230 Volt	1	1	1	1	1	1
035-2100-00		x	Starter Harvest Screw 460 Volt	1	1	1	1	1	1
TIGELE06		x	Starter Compressor	1	1	1	1	1	1
035-0400-12		x	Starter Reset Kit (SC only)	3	3	3	5	6	7
035-0400-11		x	Starter Protective Boots (SC only)	3	3	3	5	6	7

TSTIG-911

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Legend

SI = Items that should be stocked to maintain safe equipment operation, for normal maintenance, or frequent replacement items that can cause interruption of operation.

RI = Replacement items that are normally not subject to normal maintenance or replacement.

Electrical Switches & Controls

				TIG (quantity)					
Part Number	SI	RI	Description	16	21	31	42	63	80
035-0304-10	x		Emergency Stop Button	1	1	1	1	1	1
035-0305-00	x		Contact Block N.O.	1	1	1	1	1	1
035-0305-01	x		Contact Block N.C.	1	1	1	1	1	1
TIGEL501	x		Tape with Back-Up Program	1	1	1	1	1	1
TIGEL502	x		Tape Player (for program loading/back-up)	1	1	1	1	1	1
080-0000-19		x	Series 1 Jr Programmable Logic Controller	1	1	1			
080-0000-12		x	Series 1 Programmable Logic Controller				1	1	1
080-0000-10		x	Series 1 CPU				1	1	1
080-0000-24		x	Series 1 Input Module				1	1	1
080-0000-25		x	Series 1 Output Module				3	3	3
080-0000-11		x	Series 1 Programmer (hand held)	1	1	1	1	1	1

TSTIG-912

Safety Switches

				TIG (quantity)					
Part Number	SI	RI	Description	16	21	31	42	63	80
018-0000-11	x		High/Low Dual Pressure Switch	1	1	1	2	2	2
018-0000-12	x		Oil Failure	1	1	1	2	2	2
017-0707-01		x	Gage (high pressure 30–400 psig)	1	1	1	2	2	2
017-0707-00		x	Gage (low pressure 30–300 psig)	1	1	1	2	2	2

TSTIG-913

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Legend

SI = Items that should be stocked to maintain safe equipment operation, for normal maintenance, or frequent replacement items that can cause interruption of operation.

RI = Replacement items that are normally not subject to normal maintenance or replacement.

Harvest Screw Components

Part Number	SI	RI	Description	TIG (quantity) 16	21	31	42	63	80
224-1006-04	x		Safety Cover	1	1	1	1	1	1
032-0400-55	x		Belts	1	1	1	1	1	1
052-1112-29	x		Belt Guard	1	1	1	1	1	1
034-1700-07		x	Motor	1	1	1	1	1	1
029-0401-20		x	Bearings	1	1	1	1	1	1
052-2626-20		x	Conveyor Shaft Bolts	4	4	4	4		
052-2626-22		x	Conveyor Shaft Bolts					4	4
224-1030-11		x	Poly Bearing Plate	1	1	1	1	1	1

TSTIG-914

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Legend

SI = Items that should be stocked to maintain safe equipment operation, for normal maintenance, or frequent replacement items that can cause interruption of operation.

RI = Replacement items that are normally not subject to normal maintenance or replacement.

Refrigerant System

Part Number	SI	RI	Description	TIG (quantity)					
				16	21	31	42	63	80
022-0900-05	x		Compressor Crankcase Heater	1	2	2	4	4	4
012-0602-03	x		Relief Valve	1	1	1	1	1	1
TIGRS01	x		Air Cooled Condenser Motor	(1)	(1)	(1)	(1)	(1)	(1)
TIGRS02	x		Air Cooled Condenser Belts	(1)	(1)	(1)	(1)	(1)	(1)
TIGRS03	x		Air Cooled Condenser Head Pressure Controls						
TIGRS04	x		Evaporative Condenser Pump	1	1	1	1	1	1
TIGRS05	x		Evaporative Condenser Fan Motor	1	1	1	1	1	1
TIGRS06	x		Evaporative Condenser Head Pressure Controls						
014-0100-02	x		Drier Cores	3	3	3	4	4	4
035-0502-01	x		Liquid Solenoid Coil	1	1	1	1	2	2
013-0700-04	x		Thermal Expansion Valve	3					
013-0700-05	x		Thermal Expansion Valve		3	4			
013-0700-07	x		Thermal Expansion Valve				4	6	6
035-0502-00	x		3-Way Defrost Valve Coil	3					
035-0502-01	x		Hot Gas Solenoid Valve Coil		3	4			
035-0501-03	x		Hot Gas Solenoid Valve Coil				4	6	6
035-0501-03	x		Suction Pilot Solenoid Coil		3	4	4	6	6
022-0500-04		x	Compressor	1					
022-0500-06		x	Compressor		1		2		
022-0500-08		x	Compressor			1		2	
022-0500-09		x	Compressor						2
075-1000-00		x	Compressor Oil Cooler	1	1	1	2	2	2

TSTKG-909

(1) Quantity may vary due to variation in condenser selections for different ambient conditions.

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Legend

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RI = Replacement items that are normally not subject to normal maintenance or replacement.

Refrigerant System (continued)

Part Number	SI	RI	Description	TIG (quantity)					
				16	21	31	42	63	80
013-0001-36	x		Thermal Expansion Valve Power Head	3	3	4	4	6	6
TIGRS07		x	Thermal Expansion Valve Internal Parts Kit	3					
TIGRS08		x	Thermal Expansion Valve Internal Parts Kit		3	4			
TIGRS09		x	Thermal Expansion Valve Internal Parts Kit				4	6	6
224-1098-016		x	Metering Check Valve	3					
224-1098-021		x	Metering Check Valve		3				
224-1098-031		x	Metering Check Valve			4			
224-1098-042		x	Metering Check Valve				4		
224-1098-063		x	Metering Check Valve					6	
224-1098-080		x	Metering Check Valve						6
012-4200-03		x	Hot Gas Solenoid Valve		3	4			
012-4200-10		x	Hot Gas Solenoid Valve				4	6	6
012-3700-15		x	Suction Pilot Solenoid		3	4	4	6	6
218-0000-00		x	Evaporative Plate	15	18	28	36	54	72
012-0705-12		x	3-Way Defrost Valve	3					
012-0412-06		x	Gas Powered Check Valve		3	4	4	6	6
012-4200-03		x	Liquid Solenoid Valve	1					
012-4200-04		x	Liquid Solenoid Valve		1	1			
012-4200-05		x	Liquid Solenoid Valve				1	2	2

TSTIG-015

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Legend

SI = Items that should be stocked to maintain safe equipment operation, for normal maintenance, or frequent replacement items that can cause interruption of operation.

RI = Replacement items that are normally not subject to normal maintenance or replacement.

Condenser Group (SC Model) 85/95/105°F SDT

Part Number	SI	RI	Description	TIG (quantity) 16	21	31	42	63	80
021-0001-09		x	Water Regulating Valve (SC Model)	1	1	1	1	1	1
TIGCON01		x	Condenser Gasket Set (SC Model)						
TIGCON02		x	Air-Cooled Condenser 100°F or 120°F SDT	1	1	1	1	1	1
TIGCON03		x	Evap. Cond. (SCE Model) 78°WB/95°F SDT	1	1	1	1	1	1
TIGCON04		x	SC Model Cooling Tower Fan	1	1	1	1	1	1
TIGCON05		x	SC Model Cooling Tower Pump	1	1	1	1	1	1
TIGCON06		x	SC Model Cooling Tower Thermostat	1	1	1	1	1	1
TIGCON07		x	SCA Model Fan Motor	1	1	1	1	1	1
TIGCON08		x	SCE Model Pump	1	1	1	1	1	1
TIGCON09		x	SCE Model Fan	1	1	1	1	1	1

TSTIG-916

Miscellaneous

Part Number	SI	RI	Description	TIG (quantity) 16	21	31	42	63	80
057-0102-00	x		Refrigerant Oil	1 gallon	1 gallon	1 gallon	1 gallon	1 gallon	1 gallon
057-0007-00	x		Harvest Screw Gear Reducer Lubricant	1 gallon	1 gallon	1 gallon	1 gallon	1 gallon	1 gallon
057-0007-02	x		Harvest Screw Bearing Grease 14.5 oz. cartridge	1	1	1	1	1	1
072-1200-00		x	Refrigerant (R-22) 30 lb. drum	1	1	1	1	1	1
224-1026-016		x	Evaporative Condenser Compartment Drip Pan	1	1				3
224-1026-031		x	Evaporative Condenser Compartment Drip Pan			2	2		
224-1026-063		x	Evaporative Condenser Compartment Drip Pan					3	

TSTIG-910

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

OPTIONAL FEATURES & ACCESSORIES

You can maximize your TIG system's operating potential by adding optional features and accessories. If you need to know more details about the options listed below, contact Turbo.

Option 1 Weatherizing Kit

Standard self-contained TIG units consist of an evaporator and condensing unit section mounted on a common base frame. The evaporator section is totally enclosed, including insulated panels around the evaporator plates.

A supporting structure and sheet metal enclosure can be provided to cover the outboard equipment which includes the:

- motor/compressor assembly
- suction accumulator/heat exchanger
- liquid line filter-drier
- safety switch and gauge console.

The enclosure protects the equipment from rain, wind, snow, and access from unauthorized personnel.

The enclosure is not winterized for ambient temperatures below 40°F (refer to Option 2. Winterizing on page 104). Winterizing can be provided for such applications.

On smaller units, access inside the enclosure is obtained by removing the fixed panel(s). On larger units, a hinged access door is provided.

Weatherizing is recommended on all outdoor installations to provide a suitable working environment for service during all types of weather conditions.

Option 2 Winterizing

When TIG units are installed in an area where the ambient falls below freezing, precautionary measures need to be provided to prevent freeze up of the water pump, water circulating tank and condenser (water-cooled models).

- When the ambient is below 0°F, insulated lower panels and electric forced air heat can be furnished.

- When the ambient is between 0°F and +32°F, an electric forced air heater can be furnished.

The electric heaters are factory installed in the lower section of the TIG unit and are thermostatically controlled.

Draining

For long periods of down time in low or below freezing ambients, drain the:

- water pump
- water tank
- water-cooled condenser.

One-quarter (1/4) inch drain valves are provided on the water pump head and water-cooled condenser head. The water tank can be drained by removing the overflow stand pipe. Provisions need to be made to drain the:

- preheater
- heat exchanger
- piping.

Water Lines

Condenser water lines and make-up water lines should be properly protected from freezing by insulating and applying electric heating tape to the pipe surface. All exposed water lines should be properly insulated by others when the unit is installed.

Electrical

The magnetic contactor for the electric resistance heater is installed in the control panel and prewired. Fused disconnects or branch circuit breakers are furnished by others to provide circuit protection in accordance with local or state codes and regulations.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

The heater consists of a three-phase electric heater with a single-phase fan motor. Each heater has a built-in overheat thermostat. Full load amps for the heater element and heater fan are provided for each installation.

Controls

The heater contactor is controlled by an adjustable thermostat located in the control panel and prewired.

As the cabinet interior temperature drops below the set point, a set of thermostat contacts close to energize the heater contactor. When the interior temperature raises above the differential of the thermostat, the contacts will open to de-energize the heater contactors. This ensures that the engine compartment interior and the equipment located inside will be maintained above freezing.

Option 3
Bin-O-Matic Controls

When the ice generator is used in conjunction with a storage bin, an automatic means of shutting off the ice generator when the bin or delivery point is full should be provided. This will ensure:

- that the ice generator is not accidentally left on, resulting in production delay or
- overloading the system, causing damage to the equipment.

Such a system allows the unit to be operated until the bin is full without having someone at the switch to shut the unit off when the storage bin is full.

Controls and Guidelines

The bin-o-matic controls consist of a motorized paddle switch mounted in the storage bin. A set of N.C. (normally closed) contacts of the switch are connected in series with the MCS (master control switch) of the TIG/TIGAR unit. All wiring and installation must be done in the field. Guidelines for installing the bin-o-matic and a wiring schematic are provided with each kit. All wiring/wiring connections, and conduit/conduit connections are by others.

Specifications

Voltage
115/1/60
27 watts

Physical Dimensions
7" x 12 3/4"

Dust Tight
Aluminum Housing
Unit weighs just 7 1/2 pounds. KA model U/L and CSA listed.

Option 4
Open Belt Driven Compressor

All self-contained TIG units are equipped with an open reciprocating compressor directly coupled to an open drip proof motor. This motor is suitable to handle the refrigeration load required to make rated capacity.

Compressors can be provided with a belt drive upon request. Such arrangements may require additional space or modifications of the unit structural base frame. Data sheets are provided on special units.

Belt Drive Uses

- Reduce operating speed to increase life of components (would require oversize compressor).
- Reduce noise if run at reduced speed (would require oversize compressor).
- Match compressor with the evaporator load to obtain the proper operating conditions.
- Provide rated capacity when operated in 50 hz system (i.e. at 50 hz, 1750 rpm motor runs at 1450 rpm; therefore, a belt drive is required to obtain rated capacity at 1750 rpm).
- Obtain additional compressor capacity from oversized compressor without using oversized motor required at higher rpm.

Note:
TIG SC requires 24.3 tons of refrigeration to produce rated capacity using an open compressor at 1750 rpm. The next larger size compressor

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

can be belt driven at 1312 rpm to obtain the same capacity or at 1450 rpm for additional compressor capacity and ice production. The lower rpm should extend the compressor life by reducing wear.

Common Structural Base

The motor, compressor, motor adjusting base, motor sheave, compressor flywheel, belts, and belt guard are all mounted on a common motor/compressor structural base suitable for the load. Drive speed is selected to match the evaporator and application.

Option 5 Head Pressure Controls (SC)

TIG SC models are furnished with a shell-and-tube water-cooled condenser. Design conditions for SC models provide for:

- 85°F water entering the condenser
- 95°F water leaving
- 105°F SDT (saturated discharge temperature) (210 psig).

To maintain these conditions, the condenser must be sized to reject the total heat of rejection of the system.

Control Water Temperature & Flow

Next, a means of controlling the water temperature and water flow must be provided. A cooling tower and cooling tower pump provide the means of pumping the water to the condenser and removing the heat absorbed by the water as it flows through the condenser (refer to Option 6. Cooling Tower on page 106).

Control Water Flow Rate

Since the load can vary, a means must also be provided to control the water flow rate to the condenser. As the load increases, the flow through the condenser must increase. Conversely, as the load decreases, the water flow must decrease. To accomplish this, a pressure actuated water regulating valve can be provided. A valve or valves are field installed in the outlet water line of the condenser. A sensing line connected to the discharge line senses increases and decreases in the discharge pressure. This pressure modulates the piston in the regulating valve to increase or decrease the flow as required.

Valves

Each valve has an adjusting stem to raise or lower the pressure setting. On larger units, a two valve set is provided with inlet and outlet manifolds for connection to the outlet water line of the condenser.

Water regulating valves are required on any system with a varying load to maintain a constant discharge pressure as well as to prevent the discharge from dropping below factory specification (170 psig).

In parallel compressor operation, temperature actuated valves are sometimes used in place of the pressure actuated valves.

All water regulating valves are sized to handle maximum water flow rate without excessive pressure drop through the regulating valve.

Option 6 Cooling Tower

The heat rejected to the water flowing through a water-cooled condenser must be either removed before the water is recirculated to the condenser or the water must be dumped. If the heat is not removed, the water temperature will continue to rise, resulting in high discharge pressure. Dumping the water (i.e. one time through the condenser) is not economical in most cases. Therefore, a means of removing the heat from the water before it is recirculated must be provided.

A cooling tower provides a system through which the returning water flows over a wet deck surface and fans circulate air to remove the heat from the water. Eliminators are provided on the air discharge to eliminate entrained water from the air stream.

As water in the cooling tower evaporates to release the heat from the condenser, some water is lost. A float valve is provided in the cooling tower sump to replace the water lost. Field piping to the make-up water connection is required.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Since evaporation of the returning water is required to remove the heat, cooling tower selections are based on the THR (total heat of rejection) and the design wet bulb temperature. As the wet bulb increases, additional surface (larger cooling towers) is required to handle the same THR (i.e. higher wet bulb temperatures suppress the ability of the surrounding environment to absorb additional moisture).

Installation

Cooling towers can be mounted indoor or outdoor. Outdoor installations may require sump heaters and other protection from icing.

Optional cooling towers provided by Turbo are provided with a water sump thermostat to cycle the fan and control the leaving water temperature.

Air Intake & Discharge Clearance

Clearance for air intake and discharge must be provided. When ordering a cooling tower, consult Turbo for guidelines on installing the cooling tower for optimum performance.

Magnetic starters for fan(s) are not included with the cooling tower.

Option 7 Cooling Tower Pump (SC)

To maintain the discharge pressure of the system, water must be supplied to the condenser. A separate cooling tower pump is available to pump water from the cooling tower sump to the condenser inlet. Pump selections are based on the maximum condenser water flow based on the THR (total heat of rejection) and the total pumping head of the system. Total pump head provided is normally fifty (50) feet to allow for:

- the pressure drop through the condenser
- water regulating valve pressure drop
- piping, including any elevation between the pump discharge and inlet to the condenser.

Note:
For typical installations, a vertical lift of twenty (20) feet is allowed between the pump (which could be installed at ground level) and the unit mounted on a platform or the roof of a building.

When ordering the pump, information on the location of the pump relative to the condenser should be stated so that the correct pump head can be specified.

Magnetic starters or controls are not included with the pump.

Option 8 Air-Cooled Condenser

SCA models are supplied factory piped and wired with an air-cooled condenser to remove the THR (total heat of rejection) of the system. SCAR models are shipped without the condenser which is then field piped and wired.

Optional air-cooled condensers can be provided by Turbo to meet the requirements of each model. Standard design conditions for air-cooled condensing units are 100°F ambient, 20°F TD across the condenser, and 120°F saturated condensing temperature (260 psig). Condensers can be selected at different dry bulb conditions for specific installations (consult Turbo).

Each condenser must be installed with adequate space for:

- inlet airflow
- discharge airflow
- free drainage of liquid from the condenser outlet to the receiver inlet
- a means of varying the airflow over the condenser coil to maintain a constant discharge pressure as well as to prevent excessively low discharge pressure (below 170 psig).

Properly sized receiver(s), isolation valves for inlet and outlet, high pressure relief valve, and receiver mounting brackets can also be provided as options.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Optional winterizing of the receiver is recommended for installations operating in ambients below 20°F.

Control of the airflow can be accomplished several ways and is discussed under Option 9. Head Pressure Controls (SCAR) on page 108.

Magnetic starters for the condenser fan motor(s) is not included. Field piping from the condenser to the unit high side is not provided. SCAR's are shipped with a refrigerant holding charge only. All refrigerant and refrigerant charging is by others.

Option 9 Head Pressure Controls (SCAR)

Air-cooled condensers require some means of varying the airflow over the condenser coil in response to increases and decreases in the refrigeration system loading. Several methods are available from Turbo. The standard controls consist of the use of flood-back controls in conjunction with fan cycling. A valve set (3 valves) can be provided to stack liquid in the condenser coil and control receiver pressure during operation in low ambient (below 40°F). Pressure switches are also provided to cycle the fan or fans off in response to:

- low discharge pressure due to abnormal operating conditions
- low pressure due to the harvest sequence.

Damper controls are not recommended for TIG units because of the operating sequence of these units, and the slow response time of damper controls

Other methods of discharge pressure control include:

1. Variable speed motor controllers (VSM).

2. Multi-speed fans.

In general, systems supplied with flood-back controls require larger receivers and refrigerant charge. VSM controls and multi-speed fans both reduce the receiver size and refrigerant charge by reducing the CFM of the system to match the load (thus eliminating the need to flood the condenser coil).

VSM controls provide a uniform control of the airflow over a wide range (i.e. stepless control), from 0 to 100%, thus eliminating the sudden increase and decrease of airflow associated with fan cycling.

Multi-speed motors provide airflow control over a more limited range but greatly reduce the number of steps in airflow reduction associated with fan cycling.

Magnetic starters for fan motors are not provided with air-cooled condensers or head pressure controls. If VSM controls are specified, a magnetic starter(s) is not required (i.e. integral part of VSM controls).

Option 10 Receiver (SCAR & SCER)

SCA and SCE models are furnished with factory installed receivers and receiver piping. SCER and SCAR models are shipped without the air-cooled or evaporative-cooled condenser or receiver, which are field installed and piped.

The optional receivers supplied with these systems are sized to hold the total refrigerant charge of the system during pump down. Receiver sizing is based on the:

- operating charge of the evaporator
- operating charge of the condenser
- receiver liquid seal
- flood-back refrigerant charge, if required.

Also supplied with the receiver option are:

- isolation valves for the receiver inlet and outlet
- high pressure relief valve
- receiver mounting brackets.

Winterizing of the receiver for operation in ambients below 20°F is not provided but is recommended to ensure adequate system pressure during equipment start-up.

Refrigerant charge is not furnished with the receiver.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Option 11 Evaporative-Condenser

SCE models are furnished with an evaporative condenser mounted on the frame with the evaporator, and all piping and wiring is provided. On SCER models, the evaporative-condenser is field installed. All piping and wiring from the condenser to the refrigeration high side is provided by others.

Optional evaporative-condensers are sized to handle the THR (total heat of rejection) based on the design condenser of 78°F wet bulb, and 95°F SDT (saturated discharge temperature) (185psig). For different wet bulb conditions, consult Turbo for selection.

Condensers must be installed with adequate space for:

- inlet airflow and discharge airflow
- free drainage of the liquid from the condenser outlet to the receiver inlet
- a means of controlling the airflow over the condenser coil to maintain a constant discharge pressure as well as prevent excessively low discharge pressure (below 170 psig).

A pressure switch wired in series with the condenser control wiring is provided to energize the water pump and fan controls after a minimum system pressure (150 psig) is obtained during start-up. The water pump is not cycled to control discharge pressure due to scaling problems caused by repeated wetting and drying of the coil surface.

Options

These items can also be furnished as options:

- properly sized receiver(s)
- isolation valves for the receiver inlet and outlet connections
- high pressure relief valve
- receiver mounting brackets.

Optional winterizing of the receiver is recommended for installations operating in ambients below 20°F.

Control of the airflow over the condenser coil can be accomplished several ways and is discussed under Option 12. Head Pressure Controls (SCER) on page 110.

Magnetic starters for the condenser fan motor and water pump are not included. Field piping from the condenser to the unit high side is not provided. SCER's are shipped with a refrigerant holding charge only. All refrigerant and refrigerant charging is by others.

Float Valve

As water in the evaporative-condenser evaporates to release the heat from the condenser, some water is lost. A float valve is provided in the evaporative condenser sump to replace the water lost. Field piping to the make-up water connection is required.

Since the evaporation of the recirculated water is required to remove the heat, evaporative-condenser selections are based on the THR (total heat of rejection), and the design wet bulb temperature. As the wet bulb increases, additional surface (larger evaporative-condenser) is required to handle the same THR (i.e. higher wet bulb temperatures suppress the ability of the surrounding environment to absorb the additional moisture).

Installation

Evaporative-condensers can be installed indoors or outdoors. Outdoor installations may require a sump heater and other protection from icing. An indoor sump may also be used.

Optional head pressure controls are available to control the airflow over the condenser coil. Refer to Option 12. Head Pressure Controls (SCER) on page 110.

Air Intake & Discharge Clearances

Clearance for air intake and discharge must be provided. When ordering an evaporative-condenser (if the condenser location is restricted), consult Turbo for guidelines on installing the evaporative-condenser for optimum performance.

Magnetic starters for fan(s) and water pumps are not included with the evaporative-condenser.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Option 12 Head Pressure Controls (SCER)

Evaporative-cooled condensers require some means of varying the airflow over the condenser coil in response to increases and decreases in the refrigeration system loading. Several methods are available from Turbo. The standard controls consist of the use of flood-back controls in conjunction with fan cycling. A valve set (3 valves) can be provided to stack liquid in the condenser coil and control receiver pressure during operation in low ambient (below 40°F). Pressure switches are also provided to cycle the fan or fans off in response to low discharge pressure due to abnormal operating conditions or low pressure due to the harvest sequence.

Damper controls are not recommended for TIG units because of the operating sequence of these units, and the slow response time of damper controls.

The water pump is not cycled to control discharge pressure to prevent scaling of the coil surface, due to repeated wetting and drying of the coil.

Other methods of discharge pressure control include:

1. Variable speed motor controllers (VSM).

2. Multi-speed fans.

In general, systems supplied with flood-back controls require larger receivers and refrigerant charge. VSM controls and multi-speed fans both reduce the receiver size and refrigerant charge by reducing the CFM of the system to match the load (thus eliminating the need to flood the condenser coil).

VSM controls provide a uniform control of the airflow over a wide range (i.e. stepless control), from 0 to 100%, thus eliminating the sudden increase and decrease of airflow associated with fan cycling.

Multi-speed motors provide airflow control over a more limited range but greatly reduce the number of steps in airflow reduction associated with fan cycling.

Magnetic starters for fan motors are not provided with evaporative-cooled condensers or head pressure controls. If VSM controls are specified, a magnetic starter(s) is not required (i.e. integral part of VSM controls).

Option 13 Stainless Steel Auger & Discharge Trough

TIG units are provided with a hot-dip galvanized harvest auger and discharge trough to discharge the ice from the unit during harvest. The auger trough, located inside the unit, is perforated stainless steel. All components in contact with the ice are either stainless steel or hot-dip galvanized to provide corrosion protection.

In some applications, a higher degree of corrosion protection may be required. A stainless steel auger and discharge trough can be provided for all areas in contact with the ice.

Existing units can be field modified to include the stainless steel auger and discharge trough.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

OPTIONS APPENDIX

Options Appendix contents are provided only when optional accessories are purchased.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

WEATHERIZING KIT

Standard self-contained TJG units consist of an evaporator and condensing unit section mounted on a common base frame. The evaporator section is totally enclosed, including insulated panels around the evaporator plates.

A supporting structure and sheet metal enclosure can be provided to cover the outboard equipment which includes the:

- motor/compressor assembly
- suction accumulator/heat exchanger
- liquid line filter-drier
- safety switch and gauge console.

The enclosure protects the equipment from rain, wind, snow, and access from unauthorized personnel.

The enclosure is not winterized for ambient temperatures below 40°F (refer to the winterizing option on page 104). Winterizing can be provided for such applications.

On smaller units, access inside the enclosure is obtained by removing the fixed panel(s). On larger units, a hinged access door is provided.

Weatherizing is recommended on all outdoor installations to provide a suitable working environment for service during all types of weather conditions.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

WINTERIZING

When TIG units are installed in an area where the ambient falls below freezing, precautionary measures need to be provided to prevent freeze up of the water pump, water circulating tank and condenser (water-cooled models).

- When the ambient is below 0°F, insulated lower panels and electric forced air heat can be furnished.
- When the ambient is between 0°F and +32°F, an electric forced air heater can be furnished.

The electric heaters are factory installed in the lower section of the TIG unit and are thermostatically controlled.

Draining

For long periods of down time in low or below freezing ambients, drain the:

- water pump
- water tank
- water-cooled condenser.

One-quarter (1/4) inch drain valves are provided on the water pump head and water-cooled condenser head. The water tank can be drained by removing the overflow stand pipe. Provisions need to be made to drain the:

- preheater
- heat exchanger
- piping.

Water Lines

Condenser water lines and make-up water lines should be properly protected from freezing by insulating and applying electric heating tape to the pipe surface. All exposed water lines should be properly insulated by others when the unit is installed.

Electrical

The magnetic contactor for the electric resistance heater is installed in the control panel and prewired. Fused disconnects or branch circuit breakers are furnished by others to provide circuit protection in accordance with local or state codes and regulations.

The heater consists of a three-phase electric heater with a single-phase fan motor. Each heater has a built-in overheat thermostat. Full load amps for the heater element and heater fan are provided for each installation.

Controls

The heater contactor is controlled by an adjustable thermostat located in the control panel and prewired.

As the cabinet interior temperature drops below the set point, a set of thermostat contacts close to energize the heater contactor. When the interior temperature raises above the differential of the thermostat, the contacts will open to de-energize the heater contactors. This ensures that the engine compartment interior and the equipment located inside will be maintained above freezing.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

BIN-O-MATIC CONTROLS

When the ice generator is used in conjunction with a storage bin, an automatic means of shutting off the ice generator when the bin or delivery point is full should be provided. This will ensure:

- that the ice generator is not accidentally left on, resulting in production delay or
- overloading the system, causing damage to the equipment.

Such a system allows the unit to be operated until the bin is full without having someone at the switch to shut the unit off when the storage bin is full.

Controls and Guidelines

The bin-o-matic controls consist of a motorized paddle switch mounted in the storage bin. A set of N.C. (normally closed) contacts of the switch are contracted in series with the MCS (master control switch) of the TIG/TIGAR unit. All wiring and installation must be done in the field. Guidelines for installing the bin-o-matic and a wiring schematic are provided with each kit. All wiring/wiring connections, and conduit/conduit connections are by others.

Specifications

Voltage
115/1/60
27 watts

Physical Dimensions
Refer to Figure 9-1.

Dust Tight Aluminum Housing
Unit weighs just 7 1/2 pounds. KA model U/L and CSA listed.

Conduit Opening
May be located in any position. Should be located to allow free drainage of condensate in conduit.

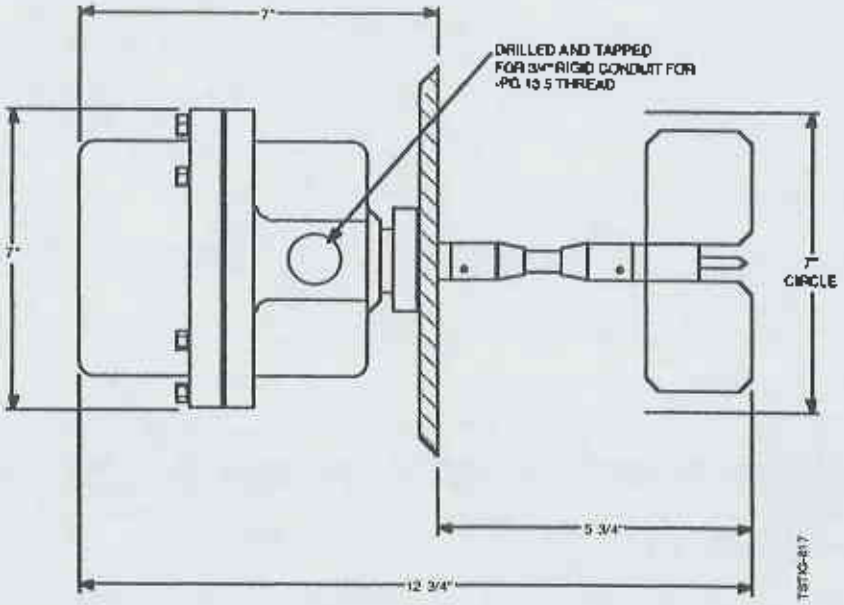

Figure 9-1 Dimension Specifications

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Mounting Interchangeablity
All units are 100% interchangeable with most other bin level control units.

1 1/4" Threaded Hub Unit
Available to fit into 1/2 of standard 1 1/4" coupling welded to bin.

Drilled and Tapped
For 3/4" rigid conduit.

Stainless Steel Flex Cable
Standard on all models. Has pull-out strength of more than 1,500 pounds.

Easy Shaft Extension
By just removing paddle from coupling and screwing in standard 1/4" pipe with standard pipe threads. Up to 21 feet can be added without interfering with sensitivity of unit. Custom made shaft extensions and guards can be supplied to specification. Flexible or solid shaft couplings are stainless steel providing added protection against inside bin moisture interference.

Interchangeable Paddle Assemblies
Permit proper paddle selection for each application. Stainless steel paddles, standard on all models. Optional paddles available in Teflon or Kel-F coated for sticky materials or extremely corrosive atmospheres.

Complete Motor Cut-Off
Prevents motor burnout and increases life. When paddles stall, current flow through motor windings is cut off by microswitch. Has vacuum impregnated coil.

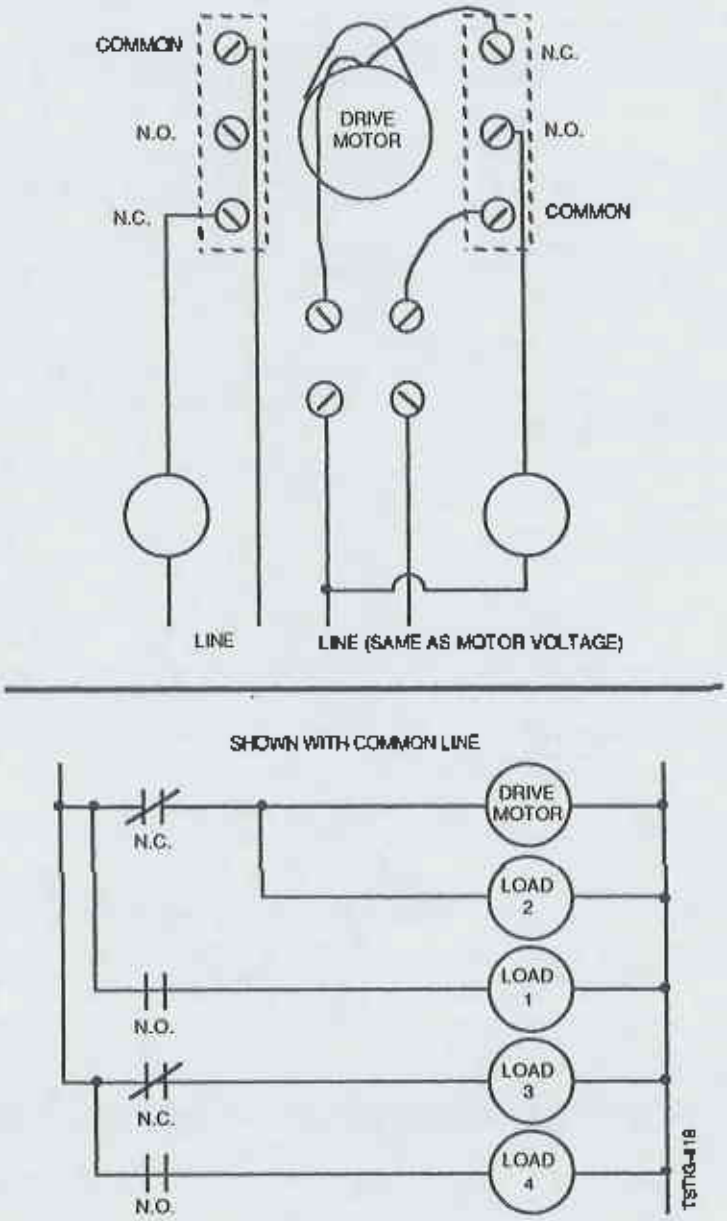

Figure 9-2 Wiring Diagrams

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

No False Signalling
Because built-in signal delay allows small amount of paddle motion in stalled position. The addition of a special internal vibration bumper is another preventive measure against false starts caused by material shift or excessive vibration.

Quick, Easy Wiring
For any application from simply blowing a horn or turning on an indicator light to activating a sophisticated automatic material handling system of conveyors, feeders, and other process controls. Refer to Figure 9-2.

Shaft Seal
Stainless steel, dust-tight, and leak-proof. Prevents material from reaching bearings and jamming unit. Resists internal bin pressure of 15 to 20 PSI. (Special seals available for higher pressures.)

Built-In Slip Clutch
Inside casing allows paddles to be turned manually in either direction without stripping gears of shaft or motor drive.

Exclusive Ramp-Actuated, Roller-Type Microswitch
Prevents false signalling, promotes positive response.

Field-Adjustable Sensitivity
From 4 to 12 inch ounces to compensate for changes in material and flow qualities. Simple to adjust...takes seconds.

Long-Life 27 Watt Motors
In all Popular voltages: 115V, 230V, 24V, 50 Hz or 60 Hz, as well as 24V or 12V DC. Vacuum impregnated coil for superior motor operating characteristics.

Wide Spectrum Lubrication for Motor and Bearings
From -65°F to +185°F special lubrication available.

Extended Drive Gear
Permits floating motor mount - simplifies maintenance.

Drive Shaft
Stainless steel - a vital control area. Offers positive protection against moisture and corrosive build-up which could impair proper functioning of unit.

2 S.P.D.T. Switches
(15 amp capacity) are standard on all units.

Mounting

The bin-o-matic is mounted near the ice entry point nearest the point where maximum ice height will occur.

Operation

The switch motor rotates the switch paddle. As long as the switch is free to rotate, the switch contacts remain unchanged. This allows continuous operation of the TIG/TIGAR unit.

When the bin or storage tank is full, ice will pile up around the switch paddle and restrict its rotation.

When the switch paddle stalls, an internal clutch disengages the drive motor and the contacts of the switch change position (i.e. the normally closed contact in the MCS circuit opens, placing the unit in the automatic pump down mode).

Note:
All TIG units utilize a "pump-down" cycle to terminate operation. This places all of the refrigerant charge into the high pressure receiver or combination condenser/receiver. Therefore, the unit does not stop operation immediately after the bin switch open or the MCS switch is turned off.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

PROGRAMMABLE CONTROLLER USERS MANUAL

WARNING

To ensure that the equipment described by this manual, as well as all equipment connected to and used with it, operates satisfactorily and safely, all applicable local and national codes that apply to installing and operating the equipment must be followed. Since codes can vary geographically and can change with time, it is the user's responsibility to determine which standards and codes apply, and to comply with them.

FAILURE TO COMPLY WITH APPLICABLE CODES AND STANDARDS CAN RESULT IN DAMAGE TO EQUIPMENT AND/OR SERIOUS INJURY TO PERSONNEL.

All equipment should be installed and operated according to all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA) as a minimum. Contact your local Fire Marshall and Electrical Inspector to determine which codes and standards apply to your specific case.

Personnel who are to install and operate the equipment should carefully study this manual and any others referred to by it prior to installation and/or operation of the equipment.

If you have any questions regarding the installation or operation of the equipment, or if more information is desired, contact your authorized Applications Engineering Distributor (AED) or for 24-hour service assistance or emergency parts, call (615) 461-2501.

Siemens Industrial Automation, Inc. authorizes Turbo Refrigerating Company to reproduce the following sections of the SIMATIC TI Series 305-8101 Users Manual (published by SIA), P/N 2593546-0030 on July 27, 1992.

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CONTENTS

FIGURES & TABLES

MODULAR CPUs

Quick Start

The Model TI325/TI330 is a modular CPU used in the Series TI305 modular I/O system. The CPU is installed in a Series TI305 base which can be a 5, 8, or 10-slot base. It provides up to 168 I/O points, of which 96 can be remotely mounted up to 3280 feet (1000 m) from the local base.

The purpose of Quick Start section is to get the experienced user started in the shortest possible time.

1. Unpack the equipment.

2. Insert a CPU module into slot 1 adjacent to the power supply, an input module, or input simulator (305-01S), into slot 2, and an output module into slot 3.

CAUTION

Do not connect the 220 VAC neutral terminal when powering the unit with 110 VAC. The unit is damaged if 110 VAC operation is attempted with this terminal connected.

3. Connect the controller to an AC power source. See Figure 1-1.

WARNING

To minimize risk of potential shock hazard, be sure the unit is properly installed in the enclosure to minimize access of electrically live terminals. Only persons knowledgeable in the safe use of high voltage should perform this test.

4. Place the mode select switch in the PRG position (program mode).

5. Turn unit power on. The POWER LED on the CPU illuminates.

6. Connect the TI305 programmer to the front of the CPU. The programmer display reads 0.0.0.0. and the ADR LED illuminates. See Figure 1-2.

7. Clear program memory using the TI305 programmer:

   CLR SHFT 3 4 8
   DEL NXT

8. Place the mode select switch on the programmer in the RUN position (run mode). The RUN LED illuminates.

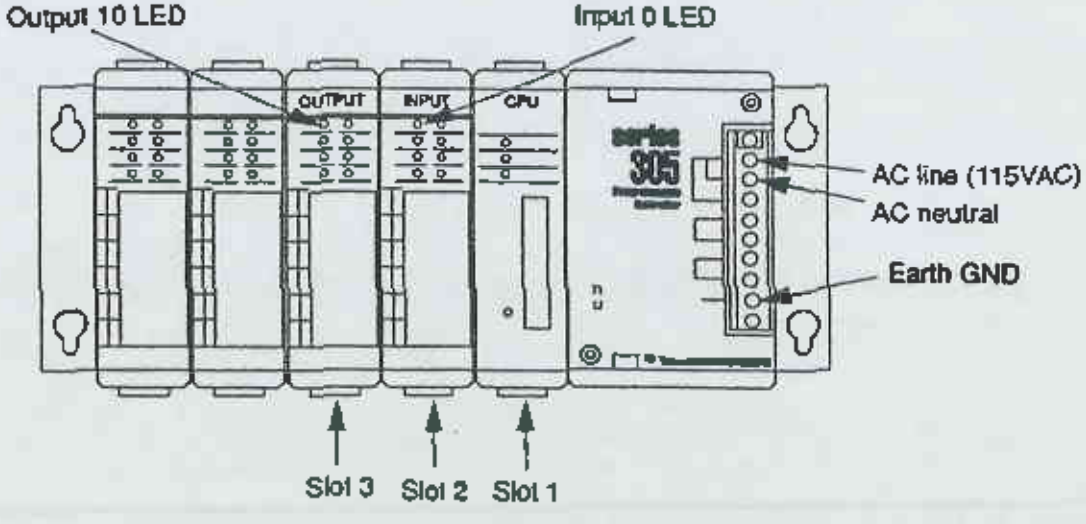


Figure 1-1 Model TI325/TI330 Controller

9. Test an output using the output module installed in slot 2.

   - Enter the following instruction from the programmer to force an output on. For this test, use output 10.

     SET SHFT 1 0 ENT

   - Output 10 LED on the output module illuminates. See Figure 1-1.

   - Turn output 10 off using the programmer as follows:

     RST SHFT 1 0 ENT

10. Test an output using an input module. If an input module is installed in slot 1, proceed as follows:

    - Turn controller power off.

    - Hard-wire an input device, such as a switch, to the first terminal on the input module.

    - Turn controller power on.

    - Place TI305 Programmer mode select switch in the PRG position (program mode). See Figure 1-2.

    - Enter the following keystrokes from the programmer:

      STR SHFT 0 ENT

      OUT SHFT 1 0 ENT

    - Place TI305 programmer mode select switch in the RUN position (run mode).

    - Close the switch hard-wired to the input module. The LED labeled 0 on the output module illuminates. See Figure 1-1.

11. If you encounter problems with the procedure, repeat steps 5–10. If the problems persist, refer to section 2 – Trouble-Shooting & Maintenance.

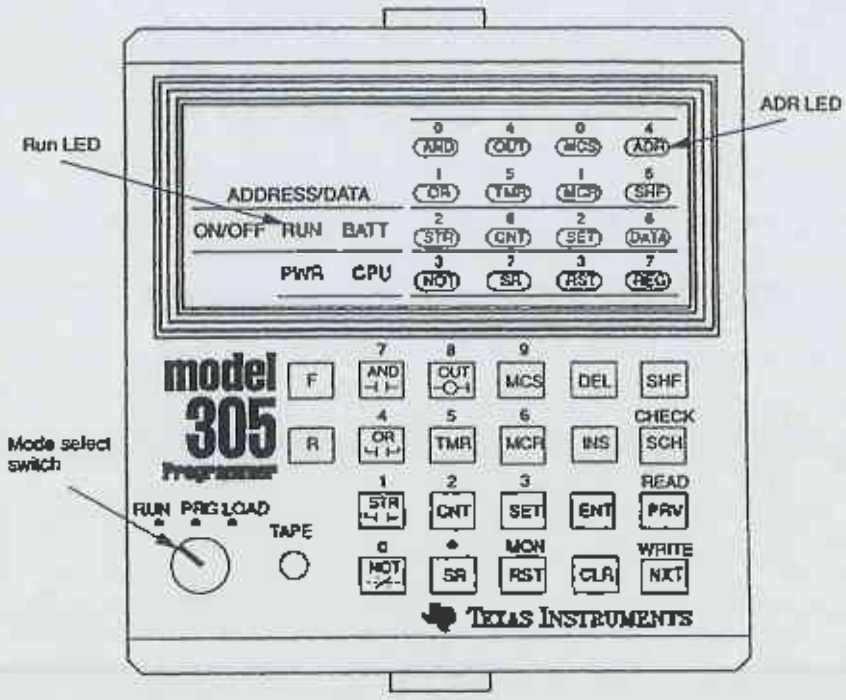


Figure 1-2 TI305 Programmer

TI325/TI330 I/O Processing

The CPU processes data by cyclic operation execution; the response time from receiving a signal to sending it varies with the input timing and program contents. See Figure 1-6.

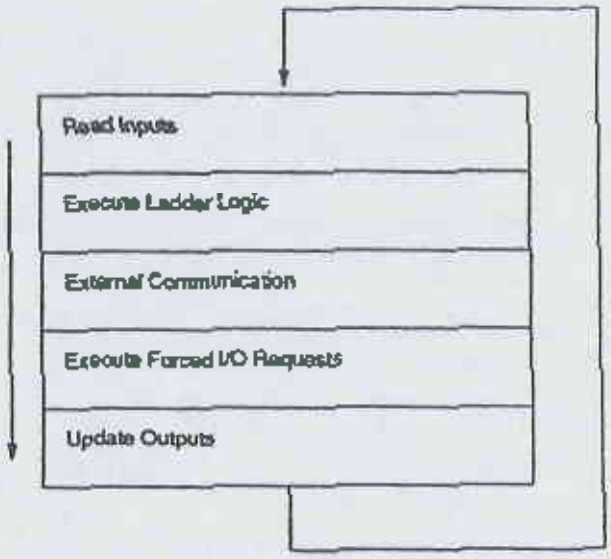


Figure 1-6 CPU Processing

TROUBLE-SHOOTING & MAINTENANCE

Overview

This section contains instructions for trouble-shooting the Series TI305 System to isolate faulty functions and components. Specific procedures are included for battery replacement and subsequent restoration to normal operation.

Trouble-shooting and maintenance must be done only by authorized personnel who are trained and experienced in electrical and electronics safety practices.

Trouble-shooting the Series TI305 System consists of observing system operation for malfunction symptoms and isolating the fault. Table 2-1 lists the most probable causes for typical malfunction symptoms. A reference to a detailed trouble-shooting procedure is listed for each probable cause.

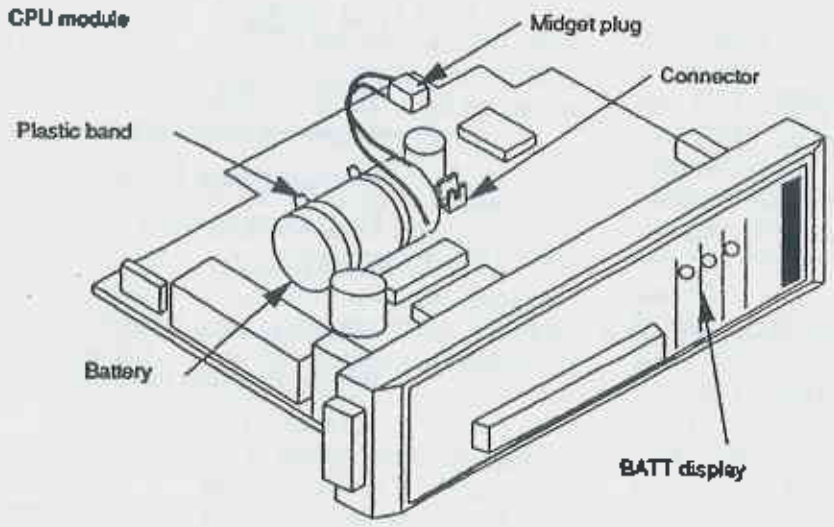


Figure 2-1 Replacing Battery in Model TI325/TI330 Controller

SYSTEM PROGRAMMING

TI305 Programmer

The TI305 programmer (Figure 3-1) provides the programming interface for the controller. With the programmer, you can perform these tasks:

- Enter program instructions into the memory of the controller.
- Edit existing programs or instructions.
- Trouble-shoot program operation.
- Test the controller for proper internal operations.

Note:
As an alternative to using the TI305 programmer, you can use the TISOFT operating system with an IBM XT/AT-compatible computer. You can order TISOFT and the *TI-SOFT User's Manual* (part number PC305-6201). A Data Communications Unit is also needed to interface the unit to the TI305. There are two versions:

1. 305-03DM — this RS-232 version will connect directly to the RS-232 port on your computer by using a null modem cable (TI P/N VPU200-3605).
2. 305-02DM — this RS-422 version will connect to a RS-422 port. To interface the 305-02DM to a RS-232 port, you can use a RS-232 to RS-422 converter (FACT Engineering 305-DCU-U or equivalent). This converter mounts directly on the 03DM; TI cable P/N 500-3602 will connect the converter to your computer.

For additional information, contact your distributor, or call 24-hour service assistance or emergency parts at (615) 461-2501.

Modes Of Operation

The programmer has three modes of operation, determined by the switch position:

Run Mode
In run mode, the controller scans and executes the ladder logic program. You can monitor program functions (operation codes) and parameters, but you cannot alter the program while in run mode.

Program Mode
In program mode, the controller does not scan or execute ladderlogic programs. You can enter or edit instructions or parameters while in the program mode. In program mode, the run indicator is off.

Load Mode
In load mode, you can record a program in CPU memory onto a cassette tape, or you can load a program from a cassette tape into the CPU memory.

Operation

The programmer provides the means for entering program instructions into the controller memory and for initiating nonprogramming functions. The function keys, mode selection switch, and display are shown in Figure 3-1.

Instruction LEDs

ADR
This LED is on when an address is being displayed.

SHF
This LED is on when you press SHF. The illuminated LED means that future key functions correspond to the labels above the selected key.

DATA
This LED is on when you are monitoring the contents of a register; the address/data display shows a four-digit BCD value in that register.

REG
This LED is on when you are monitoring the contents of a register; the address of the selected register is shown in the address/data display.

Keylock Switch

Keylock switch selects the operating mode of the controller. It can be turned to any position during programming, program execution, or load operations without turning controller power off.

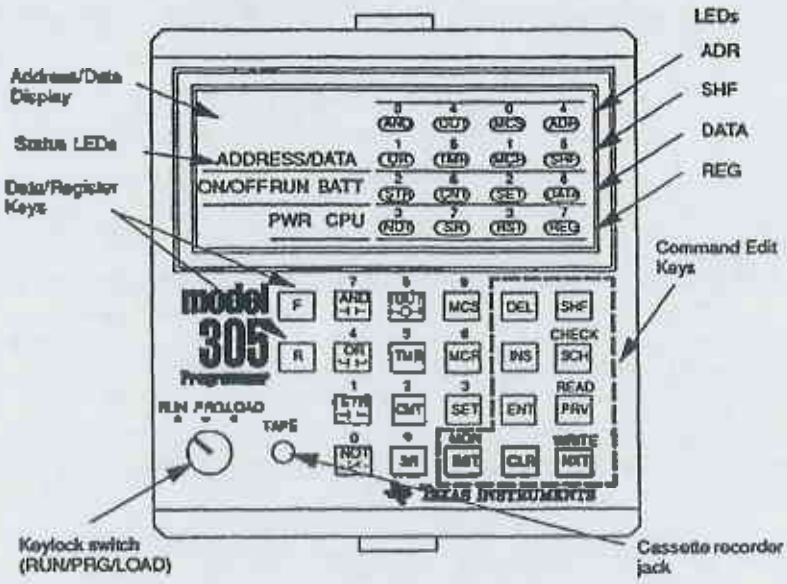


Figure 3-1 TI305 Programmer

Command Keys

CHECK allows you to verify that a program was successfully recorded from CPU memory to an audio cassette recorder, or loaded from an audio cassette recorder to CPU memory.

READ allows you to load a program from an audio cassette recorder to CPU memory.

WRITE allows you to save (record) from CPU memory to an audio cassette tape.

MON in run mode, allows you to monitor 16 I/O references at one time; you can also monitor current values of timers and counters.

Edit Keys

DEL when a program instruction is displayed in the address/data area, pressing DEL PRV deletes that instruction from CPU memory.

INS allows you to insert logic instructions between existing logic instructions.

ENT completes a logic entry.

CLR clears previously entered instructions.

SHF changes the command keys to numeric keys, and the function keys SCH, PRV, and NXT to the functions labeled above those keys.

SCH allows you to locate logic instructions, or reference numbers (contact points), for a memory address.

PRV causes the previous memory address or instruction to be displayed. Other uses are described throughout this section.

NXT causes the next memory address or instruction to be displayed. Other uses are described throughout this section.

Data/Register Keys

F allows you to enter a two-digit data operation or function value.

R selects a data register or a timer/counter accumulated data register, or selects a group reference number when programming data operation instructions.

Status LEDs

ON/OFF reflects the status of CPU memory for the instruction being displayed.

RUN is on when the mode selector switch is in the RUN position (run mode).

PWR is on when controller power supply is functioning properly.

BATT is on when internal battery is at a low power level and must be replaced.

CPU is on when there is an internal hardware fault.

Address/Reference Display is a four-digit display showing the location of either the memory address or the programmed instruction. When an address is displayed, periods appear at the bottom right corner of each digit, and the ADR LED is on.

Example: **0.0.0.1.**

Programmer Functions

Table 3-1 lists the functions, the keystrokes required to enter them, and the modes in which the function can be performed. Function operations are fully explained in sections that follow the table.

Table 3-1 TI305 Programmer Functions

Function	Keystrokes	Mode RUN	PRG	LOAD
Go to Run mode.	Turn mode select switch to the RUN position.		•	
Go to Program mode (PRG).	Turn mode select switch to the PRG position	•		•
Clear memory.	CLR SHF 3 4 8 DEL NXT		•	
Go to beginning of program.	SHF NXT	•	•	
Display an address.	SHF [Address] NXT	•	•	
Display next address.	NXT	•	•	
Clear display.	CLR [Clears previously entered command and present address is displayed]	•	•	
Display program.	[Instruction] NXT [Previous instruction] PRV	•	•	
Write instruction.	[Instruction] SHF [Data] ENT		•	
Edit instruction.	[Instruction] SHF [Data/Memory] ENT		•	
Insert instruction.	[Address or Instruction] SHF [Data] INS NXT		•	
Delete instruction.	Display the instruction to delete and press DEL PRV		•	
Insert End.	CLR SHF INS NXT		•	
Search for a specific instruction.	Display address by entering [Instruction] SHF [Data] SCH Display the instruction by pressing NXT	•	•	

Table 3-1 TI305 Programmer Functions (continued)

Function	Keystrokes	Mode RUN	PRG	LOAD
Search for a specific reference.	Display address by pressing NXT Display the reference number by pressing SHF [Memory reference] SCH Display next used reference by pressing SCH again	•	•	
	Use grammar check to locate vacant address	•	•	
Multiple status operation.	SHF [Memory reference] MON			
Monitors 16 bits from specified starting address.	Change range of display by pressing PRV or NXT	•		
Timer/counter accumulated value or data registers. Monitors one timer or counter accumulated value or data register.	SHF 6 [Memory reference] MON		•	
On/off status. If the instruction is displayed, the on/off coil display LED reflects the status of the contact or coil.		•		
Force discrete references*.	On = SET SHF [Memory reference] ENT Off = RST SHF [Memory reference] ENT	•		
Force timer/counter* accumulated value.	Display address and press SHF [Value] ENT	•		
Force data register value*.	R [Reg number] MON RST SHF [New value] ENT	•		
Check program grammar.	CLR SCH	•	•	
Cassette Operation				
Record data to cassette tape.	[File No.] WRITE NXT			
Load memory from cassette tape.	[File No.] READ PRV			
Verification of cassett tape.	[File No.] CHECK SCH			•

* Force operates for only one scan.

Note:
The I/O references in the Series TI305 controllers are numbered in octal, which is also known as base 8. I/O points are counted as usual from 0 to 7. Since 8 and 9 are not used, the next point after 7 is numbered 10. When the count reaches 17, the next point is 20. The point following 77 is numbered 100, and so on.

Clear Program Memory

To clear entire contents of logic memory, place the programmer in PRG mode and enter the following keystrokes:

CLR SHF 3 4 8 DEL NXT

After all memory has been cleared, the address/data display is **0.0.0.0.** and the ADR LED is on. To cancel the clear function, press CLR instead of NXT.

Display User Memory

When operating in the program or run mode, this function sequence allows you to select and display a specified memory address, and the logic content of that address.

Displaying Address 0
Press SHF NXT at any time.

Displaying A Specified Address
To display, for example, the logic in address 123, press SHF 1 2 3 NXT. The selected address, **0.1.2.3.**, is displayed.

Locating An Unused Address Or Grammar Check
Press CLR SCH to locate the first available location (end statement).

Changing From Address Display To Instruction Display
To change the address display to an instruction display, press NXT. The logic content of the memory is displayed.

Write/Edit An Instruction

To change memory data at a particular location:

1. Place the mode selector switch in the PRG position.
2. Press PRV or NXT until the instruction to be changed is displayed. Enter the new instruction; for example: AND SHF 4.
3. Press ENT. The new instruction replaces the previous instruction at that memory location, and the next address is displayed.

Insert An Instruction

To insert an instruction between two existing instructions, follow these steps:

1. Place the mode selector switch in the PRG position.
2. Press PRV or NXT to display the instruction before which the new instruction is to be inserted.
3. Enter the new instruction; for example: AND SHF 4.
4. Press INS. The address display shows a lower case **i** in the left digit of the display.
5. Press NXT to confirm the insert. The display shows the address of the next instruction.

Delete An Instruction

To delete an instruction, use these steps:

1. Place the mode selector switch in the PRG position.
2. Press PRV or NXT to display the instruction to be deleted.
3. Press DEL. The address display shows a lower case **d** in the left digit of the display.

Note:
To cancel the delete function, press CLR before performing step 4. The display returns to the instruction being considered for deletion.

4. Press PRV to confirm the delete function. The next address is displayed. The remaining instructions automatically back up one address location toward **0.0.0.0.** to fill the empty memory.

Monitoring I/O Status

You can monitor a total of 16 I/O references at any time, beginning with an address you select. Each reference is within a group of eight references. The I/O status of the group with the selected reference, and the next higher group of eight, is indicated by illuminated LEDs.

1. Place the mode selector switch in the RUN position.

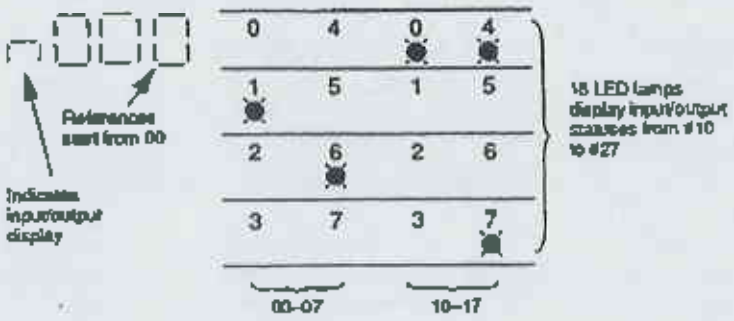


Figure 3-2 I/O Monitoring With LEDs

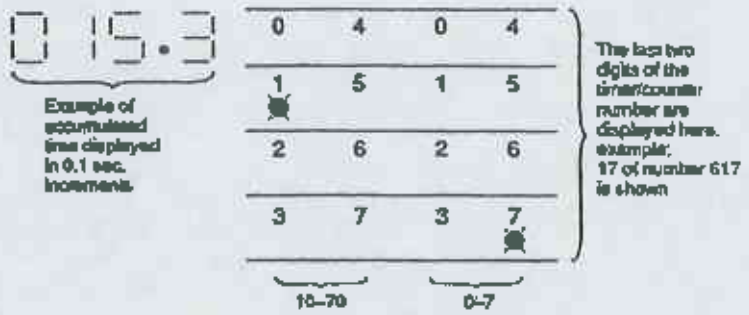


Figure 3-3 Timer/Counter Accumulated Value Display

2. Select the reference to be monitored. For example, to monitor input 6, press SHF 6.

3. Press MON. The display shows a character followed by the lowest reference in that group. From the example in step 2, the value **000** is displayed.

   The first eight LEDs represent the status of the group with the selected memory reference; the status of the next memory reference is indicated by the last eight LEDs. I/O monitoring with LEDs is shown in Figure 3-2.

4. You can use PRV and NXT to scroll forward or backward in increments of eight.

Monitoring Timer Or Counter Values

To monitor the accumulated value of a timer or counter:

1. Place the mode selector switch in the RUN position.

2. To specify the timer/counter number, press SHF and the identifier keys. For example, to monitor the operating value of timer 617, press:

   SHF 6 1 7 MON

The current accumulated value of the specified timer/counter is displayed in the address/data area, and the LEDs representing the last two digits of the timer or counter are illuminated. Accumulated time is displayed in 0.1 second increments. See Figure 3-3 for an example.

Monitoring Data Register Values

To monitor the value of a data register, place the mode selector switch in the RUN position. Specify the required data register. For example, to monitor the value of data register 400, press R 4 0 0 MON. The value of the data register is displayed in the address/data area.

Changing Timer/Counter Accumulator Values Or Data Specified Data Register Values

1. Monitor the specified timer/counter reference or the specified data register by typing the following keystrokes:

   data register
   CLR R 4 0 0 MON

   or

   timer/counter reference
   CLR R 6 0 0 MON

2. Change the value of the specified timer/counter reference or the specified data register by pressing:

   data register
   SHF New Value ENT

   or

   timer/counter reference
   SHF New Value ENT

Searching

The search operation allows you to locate logic instructions or reference numbers (contact points) for memory addresses. To search for an instruction, use the following procedure.

1. Place the mode selector switch in either the PRG or RUN position.

2. Enter the instruciton whose memory is to be searched. For example, press OUT SHF 2 0 SCH. The first memory address for the instruction is displayed. If the instruction is nonexistent, error code **E99** is displayed.

3. Press NXT to verify the instruction for the address displayed.

4. Pressing CLR causes the address to be displayed again.

5. If you continue to press SCH while the memory address is displayed, the controller searches for other addresses that have the same instruction. If searching is continued to the end of the program, it wraps around to memory address zero until an instruction-address match is detected.

To search for a particular reference (contact point), use the following procedure.

1. Place the mode selector switch in either the RUN or PRG position.

2. Enter the contact point. For example, to find the memory address for contact point 10:

   Press SHF 1 0 SCH. The memory address for the contact point is displayed. If the contact point is nonexistent, error code **E99** is displayed.

3. Press NXT to display the contact point number for the address location displayed.

4. If you continue to press SCH while the memory address is displayed, the controller searches for other addresses that have the same contact point.

   If searching is continued to the end of the program, it wraps around to memory address zero until a contact point-address march is detected.

Monitoring A Program

Checking Status Of I/O Designators

To check the status of the I/O designators:

1. Place the mode selector switch in the RUN position.

2. Select reference to be monitored by pressing SHF and the beginning memory reference number and pressing MON. The display shows a character followed by the lowest reference in that group. The references are divided into groups of 10 (octal system), but there are only eight references in each group. For example, 0–7, 10–17, etc.

   The instruction/numeric LEDs show the status of 16 references. The first eight LEDs represent the status of the group with the selected reference; the second set of eight LEDs are for the next higher group.

3. Pressing NXT increases the displayed reference group by 10. Pressing PRV decreases the displayed reference group by 10.

4. Pressing the CLR clears the monitor display.

Example of monitoring reference 105, press:

SHF 1 0 5 MON

The Address/Data area displays 100. The instruction/numeric LEDs tells you the status of references 100 through 107, and 110 through 117. If the LED display is as shown in Figure 3-4, you can determine that references 101, 106, 110, 114, and 117 are on.

Checking T/C Accumulated Value

To check the timer/counter accumulated value:

1. Place the mode selector switch in the RUN position.

2. Enter the desired timer/counter number and press MON. The current accumulated value of the selected timer/counter is displayed in the Address/Data area, and the LEDs representing the last two digits of the timer or counter is illuminated in the instruction/numeric area. Accumulated time is displayed in seconds to within 0.1 seconds.

3. Pressing CLR clears the monitor display.

To see an example of checking timer 617 with an accumulated value of 15.3 seconds:

Press SHF 6 1 7 MON.

Figure 3-5 shows the Address/Data display and instruction/numeric LED display for this example situation.

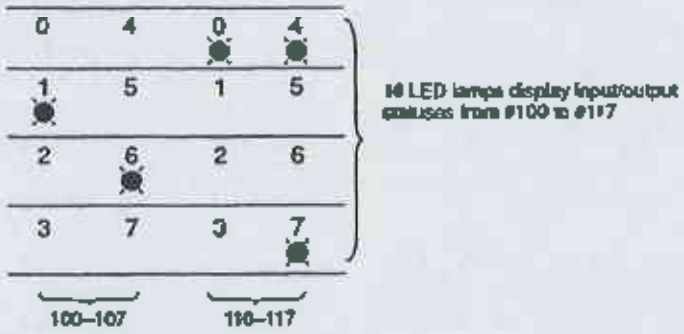


Figure 3-4 Example Of Monitoring I/O Reference Status

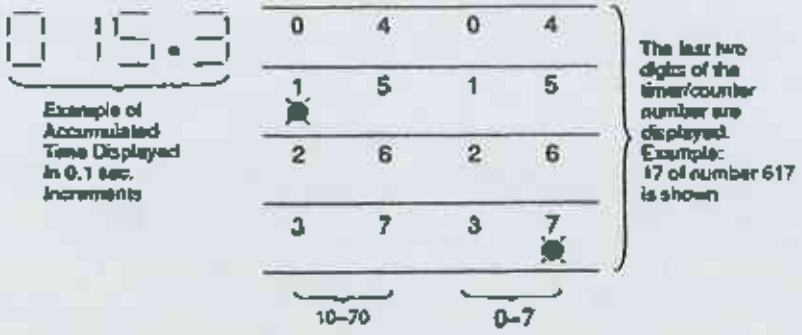


Figure 3-5 Example Of Monitoring T/C Accumulated Value

Changing Timer/Counter Accumulator Values Or Specified Data Register Values

To change timer/counter values or specified data register values:

1. Monitor the specified timer/counter reference or the specified data register by typing the following keystrokes:

   data register
   CLR R 4 0 0 MON

   or

   timer/counter reference
   CLR R 6 0 0 MON

2. Change the value of the specified timer/counter reference or the specified data register by pressing:

   data register
   SHF New Value ENT

   or

   timer/counter reference
   SHF New Value ENT

PROGRAMMING ERROR MESSAGES

Incorrect programmer operation and cassette recorder operation (recording/playing) are detected and displayed on the programmer.

Invalid Operation Detected	Display Code
Incorrect program syntax.	E01
Reference number out of range.	E01
Program memory is full.	E11
Program verification error with cassette.	E25
Cassette volume not adjusted correctly.	E28
Instruction being searched for does not exist.	E99

Program Syntax Error	Display Code
The reference number or a slot containing an input module was used as an output.	E02
Stack overflow: More than eight levels of logic have been programmed. Check the use of AND STR/ORSTR/MCS/MCR.	E03
Duplicate output or timer/counter number.	E05
MCS/MCR PAIRS do not match.	E06
An input contact is missing from before a CNT or SR instruction.	E07
Missing TMR or CNT preset or shift register range.	E08
The rung does not terminate in an OUT or box instruction.	E09
Program memory is full.	E11
Program memory parity error.	E21

A program syntax check can be made either in the RUN mode or PRG mode.

Additional TI315 Errors	Display Code
Maximum number of high speed counter preset points exceeded.	E13
Lost communication between TI315 and I/O expansion.	E30
Communications framing error between TI315 and I/O expansion.	E31
Communications parity error between TI315 and I/O expansion.	E32
I/O expansion does not respond to TI315.	E33

CASSETTE RECORDER OPERATION

IMPORTANT

It is wise to make a tape copy of the program existing in memory before erasing it to load the new program.

Introduction

The programs used for TURBO programmable controllers may be stored on standard audio cassette tapes. It is wise to keep a tape copy of the program handy in the event that the CPU either becomes defective, or somehow loses its memory.

Items Required For Tape Operation

Hand Held Programmer
This includes the key for the hand held programmer, along with the audio cable which is gray with a red tracer.

Audio Cassette Recorder
This is a standard size cassette tape recorder which has a microphone jack, earphone jack, and a volume control. Optionally, this should have a digital counter.

Standard Audio Cassette Tape (Type I)
The "micro cassette" tapes generally do not have the audio quality required and should not be used.

Common Problem

The most common problem incurred during tape operation is confusion over the proper key to depress on the hand held programmer. The shifted function keys on the programmer are shown in Figure 5-1. The shifted function always corresponds to the key directly below it.

Tape Operation

Save/Record A Program Onto Tape (WRITE)

1. Install the Programmer onto the CPU. Verify that the programmable controller has AC power.

2. Turn the mode switch on the Programmer to the LOAD position.

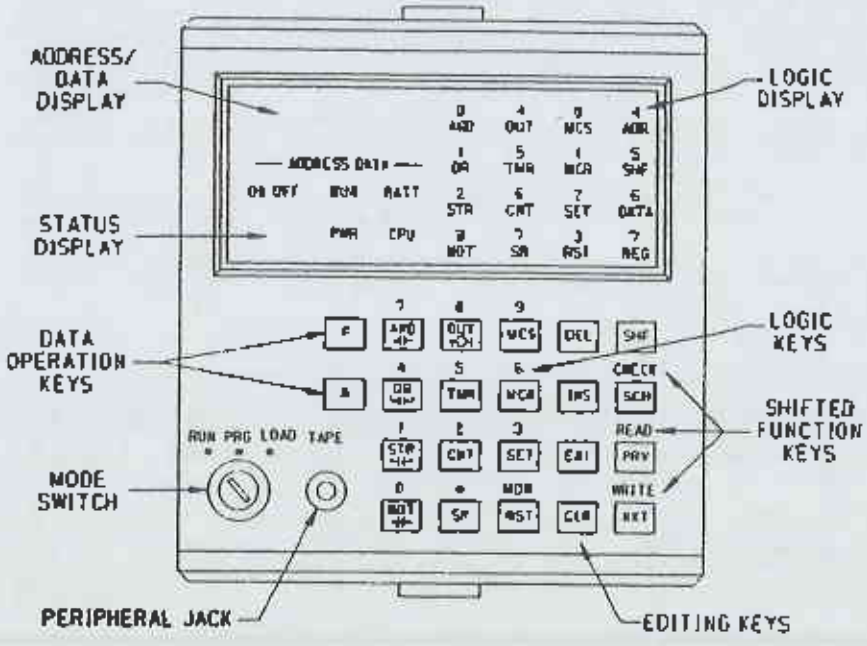


Figure 5-1 Programmer Features

3. Connect the Programmer (TAPE port) to the tape recorder (MICROPHONE input) with the audio cable (gray with red tracer). Refer to Figure 5-2.

4. Rewind the tape to the beginning or to the desired record position if multiple programs are to be places on one tape. Programs require approximately 1.5 to 4 minutes of tape per program. Note counter position.

5. For identification of a program, if desired, enter a four digit number (0000-9999) on the Programmer. When tape is accessed later to load the CPU, this number can be used to identify the correct program prior to altering CPU data. If a program number is not as expected, the operator can terminate the load operation and get the correct tape without loss of the existing program or delay incurred by loading a wrong program. THIS IDENTIFICATION NUMBER IS OPTIONAL.

6. Adjust the volume setting on the tape recorder to approximately 75% of the maximum setting. If a tone control is available, adjust it to 75% of the maximum setting.

7. Begin the tape recorder operation by depressing the RECORD PLAY buttons.

8. Depress the WRITE key on the Programmer. The record operation will now begin.

9. The ON/OFF light on the Programmer will come on.

10. When the record is complete, the Programmer will display End in the Address/Data display and the ON/OFF LED will be off. Stop the recorder and note the counter position so that the amount of tape used for that program can be determined.

11. Depress the CLR (Clear) key on the Programmer to end the record operation.

12. It is recommended that the tape be rewound to where the recording began and that the "Check A Program" (described later) be performed to ensure data integrity.

Load A Program Onto CPU (READ)

1. Prior to loading a program onto the CPU, the existing program must be cleared from the CPU memory. To do this, turn the mode switch to the PRG mode and press the following key sequence:

   CLR SHF 348 DEL NXT NXT

   The program has now been cleared from the CPU.

2. Install the Programmer onto the CPU. Verify that the programmable controller has AC power.

3. Turn the mode switch on the Programmer to the LOAD position.

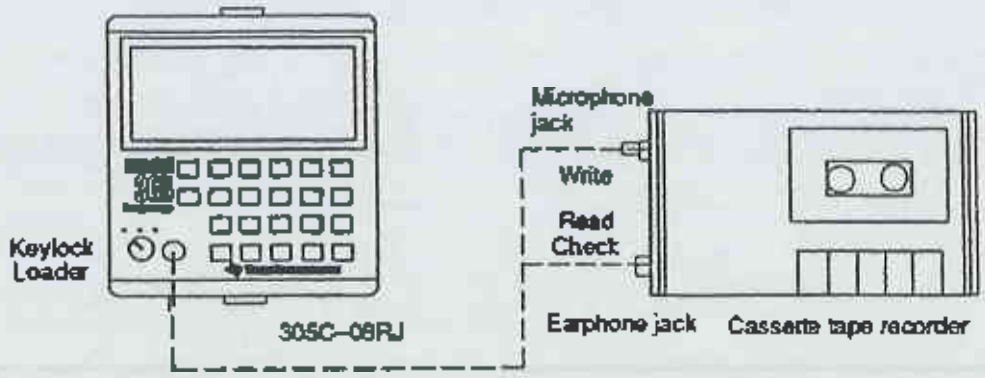


Figure 5-2 Writing From Controller To Tape

4. Connect the Programmer (TAPE port) to the tape recorder (EARPHONE input) with the audio cable (gray with red tracer).

5. Rewind the tape to the beginning of a previously recorded program. Enter the program identification number (if applicable).

6. Adjust the volume setting on the tape recorder to approximately 75% of the maximum setting. If a tone control is available, adjust it to 75% of the maximum setting.

7. Depress the READ key on the Programmer.

8. Begin the tape recorder operation by depressing the PLAY button.

9. The Address/Data screen of the Programmer will flash an E28 briefly.

10. The LED corresponding to the 7/REG on the lower right hand side of the Programmer will light up for approximately 10 to 15 seconds.

11. The Address/Data screen of the Programmer will display an F when the program has been found. If the CPU detects a program number different from the one entered in step 5, the Address/Data screen of the programmer will display PASS.

12. When the load is complete with no errors, the Programmer will display END in the Address/Data display. Stop the recorder and note the counter position so that the amount of tape used for that program can be determined.

13. Depress the CLR (Clear) key on the Programmer to end the record operation.

Check A Program With The Tape Copy (CHECK)

1. Install the Programmer onto the CPU. Verify that the programmable controller has AC power.

2. Turn the mode switch on the Programmer to the LOAD position.

3. Connect the Programmer (TAPE port) to the tape recorder (EARPHONE input) with the audio cable (gray with red tracer).

4. Rewind the tape to the beginning of a previously recorded program. Enter the program identification number (if previously recorded).

5. Adjust the volume setting on the tape recorder to approximately 75% of the maximum setting. If a tone control is available, adjust it to 75% of the maximum setting.

6. Depress the CHECK key on the Programmer.

7. Begin the tape recorder operation by depressing the PLAY button.

8. The Address/Data screen of the Programmer will flash an E28 briefly.

9. The LED corresponding to the 7/REG on the lower right hand side of the Programmer will light up for approximately 10 to 15 seconds.

10. The Address/Data screen of the Programmer will display an F when the program has been found. If the CPU detects a mismatch between the contents of the tape and the CPU logic, the Address/Data screen of the programmer will display E25. A steady E28 indicates that the play level of the recorder is wrong. The CHECK operation should be stopped, the volume/tone re-adjusted, and the operation restarted.

11. When the check is complete with no errors, the Programmer will display END in the Address/Data display. Stop the recorder and note the counter position so that the amount of tape used for that program can be determined.

12. Depress the CLR (Clear) key on the Programmer to end the record operation.

TI305 QUICK REFERENCE GUIDE

Memory Functions	TI325/TI330 Mem Ref	Dec	TI315 Mem Ref	Dec
I/O Points	000-157	112	000-137	96
	700-767	56		
Control relays				
Non-retentive	160-337	112	140-277	96
Retentive	340-373	28	300-372	59
Shift registers	400-577*	128	140-372	155
Timers/counters	600-677	64	600-623	20
Sequencers	600-677	64	600-623	20
Data registers	400-577*	64	N/A	

Programming Error Messages

E01	Programming error
E02	Data/memory reference error
E03	Stack overflow
E05	Output or TMR/CNT duplicated
E06	MCS/MCR mismatch
E07	CNT or SR missing element
E08	TMR, CNT, or SR missing value
E09	Rung not complete
E11	Memory full (RAM)
E21	Memory parity error
E25	Tape/CPU verify error
E28	Records volume level incorrect
E99	Instruction being searched not in program memory

External TMR/CNT Memory Reference Ranges

TI325/TI330 = 647-677
TI315 = 600-623

Shift and Data Register References

* Shift register references 400-577 are discrete references. Data register references 400-577 are byte references (TI325/TI330 only).

Special Function Relays

Set retentive control relays	373[2]
First scan reset	374
0.1 second clock	375
Disable all outputs	376
Battery status	377
Set 0.01 second timer	770[1]
External diagnostic coil	771[1]

Data Operation Relays

Accumulator is <	772[1]
Accumulator is =	773[1]
Accumulator is >	774[1]
Accumulator carry/borrow	775[1]
Accumulator is zero	776[1]
Accumulator overflow	777[1]

[1] Valid in TI325/TI330 models only.
[2] Valid in TI315 model only.

Programmer Functions

Clear memory	CLR	SHF	3	4	8	DEL	NXT		
Display address	CLR								
Display instruction	NXT								
Goto address	SHF	—	—	—	NXT				
Edit instruction	—	—	—	SHF	—	—	—	ENT	
Insert instruction	—	—	—	SHF	—	—	—	INS	NXT
Delete instruction		Display instruction =			DEL	PRV			
Insert end	CLR	SHF	INS	NXT					
Search	—	—	—	SHF	—	—	—	SCH	
Monitor	SHF	—	—	—	RST				
Force ON	SET	SHF	—	—	—	ENT			
Force OFF	RST	SHF	—	—	—	ENT			
Syntax check	CLR	SCH							

Data Instructions

F50 (D*STR)	–	Load 2 bytes into accumulator
F51 (D*STR1)	–	Load 1 byte into accumulator
F52 (D*STR2)	–	Load high bits into accumulator
F53 (D*STR3)	–	Load low 4 bits into accumulator
F55 (D*STR5)	–	Load 16/mdl into accumulator
F60 (D*OUT)	–	Write accumulator to 2-byte reference
F61 (D*OUT1)	–	Write accumulator (low byte) to 1-byte reference
F62 (D*OUT)	–	Write accumulator (low 4 bits) to 1-byte reference (high 4 bits)
F63 (D*OUT3)	–	Write accumulator (low 4 bits) to 1-byte reference (low 4 bits)
F65 (D*OUT5)	–	Write accumulator to 16/mdl (out)
F70 (CMP)	–	Compare 2-byte reference/4-digit constant to accumulator
F71 (ADD)	–	Add 2-byte reference/4-digit constant to accumulator
F72 (SUB)	–	Subtract 2-byte reference/4-digit constant from accumulator
F73 (MUL)	–	Multiply 2-byte reference/4-digit constant by accumulator

F74 (DIV)	–	Divide accumulator by 2-byte reference 4-digit constant
F75 (D*AND)	–	Bit AND 2-byte reference/4-digit constant with accumulator
F76 (D*OR)	–	Bit OR 2-byte reference/4-digit constant with accumulator
F80 (SR)	–	Accumulator shift right "n" times
F81 (SL)	–	Accumulator shift left "n" times
F82 (DEC)	–	Accumulator (low 4 bits) are decoded to a decimal number. A "1" is placed in the corresponding bit in the accumulator (1-15)
F83 (ENC)	–	Accumulator (1 bit on) is encoded to a 4-bit code representing the decimal number 1-15
F84 (INV)	–	Logically invert accumulator
F85 (BIN)	–	Convert BCD to binary
F86 (BCD)	–	Convert binary to BCD
F20 (FAULT)	–	Display BCD number on programmer display

Notes: All Math instructions use BCD format.
Results of Math instructions are stored in the accumulator.
Multiply and Divide instructions store the result in 4 bytes.
The accumulator and data registers 576 and 577 are used to store the result.

TI325/TI330 CPU Jumper And Dipswitch Settings

TI325	Memory Specifications		
Switch	Standard Equipment RAM (701 words)	Expansion RAM (1.723 words)	EPROM (1.723 words)
Dipswitch 2	ON 2	ON 2	OFF 2
Jumper 1			
Jumper 2			

TI330	Memory Specifications	
Switch	3.7k RAM	3.7k EPROM
Dipswitch 2	ON 2	OFF 2
Jumper 1		
Jumper 2		
Jumper 3		

Dipswitch Functions

Dipswitch 1	On Off	Retain coils Clear coils
Dipswitch 2	On Off	CMOS memory PROM memory

MODEL 335/340 CPU

Note:
All TURBO models shipped after October 1993 contain a model 335 or 340 CPU with an EEPROM chip which contains the user program. TURBO has enabled the EEPROM and retentive control relays by using the following CPU configuration (refer to Table 7-1 and Table 7-2):

1. Dip switches 1 and 2 ON.
2. All other dip swiches OFF.
3. Jumper in the middle (2) position.

The 335/340 CPU is equipped with standard RAM memory for user program storage. You can install an optional EEPROM or EPROM. The user program stored in the standard RAM memory will not be destroyed even if the EEPROM or EPROM is installed, as long as it is backed up by battery. To help ensure equipment compatibility, use only the EEPROM/EPROM model supplied by your distributor.

Program Storage In EEPROM

The 335/340 CPU offers the option for saving your RLL program in a non-volatile form using an Electrically Erasable Programmable Read-Only Memory (EEPROM, Industry #28C64; Siemens, PPX:2587681-8029, quantity 1) integrated circuit. A separate programming device is not necessary. Once programmed, an EEPROM can be removed and used in any 335/340 CPU as required. If desired, you can disable the 335/340 CPU from writing to the EEPROM.

You can edit the EEPROM with TISOFT or the HHP. While editing a program in the PRG mode, the editing result is temporarily stored in RAM. After finishing the program edit, perform either of the following operations to transfer the edit to EEPROM:

- Syntax check
- Mode change from PRG to RUN

For the operations listed below, the 335/340 CPU automatically writes to the EEPROM after the operation is performed.

- All clear of the entire user program. The program in the EEPROM is cleared, but the program in the RAM is not cleared.
- On-line change of TMR/CNT preset value while in RUN mode.
- Downloading of user program through cassette interface or TISOFT.

Installing EEPROM

Follow instructions in this section to install an EEPROM in your 335/340 CPU.

Note:
If you are installing an EEPROM and intend to keep the user program currently in RAM memory, ensure that a good backup battery is installed and enabled. Controller power must be turned OFF and, without a functioning backup battery, your program may be lost when power is restored.

1. Turn off all user-supplied power to the Series 305 base.
2. Remove the 335/340 CPU from the base assembly.
3. Insert the EEPROM, aligning the notches on the EEPROM and the socket. Refer to Figure 7-1.
4. Check that all pins are seated properly in the socket.
5. Set Switch 2, Position 1 and the jumper according to Table 7-1. If you intend to write to the EEPROM, ensure that jumper is in position 2. If you do not intend to write to the EPPROM and want to disable this feature, ensure the jumper is in position 1.
6. Re-install the CPU in the base and turn the base power on.

Mode After Power-Up

If no HHP or DCU is connected to the parallel port, a 335/340 CPU configured for EEPROM operation will attempt to power up in the RUN mode. If an HHP is connected and online, with or without a DCU, the HHP keyswitch determines the operating mode. If a DCU is connected, but no HHP is online, the power-up mode is determined by a switch setting of the DCU. Refer to the Series 305 Data Communications Manual (PPX:305-8102) for details.

CR340-373 can be retentive or non-retentive. Retentive memory will retain the last state through a power cycle. Set switch 2, position 2 in the ON position to make CR340-373 retentive; OFF for non-retentive. Refer to Table 7-2.

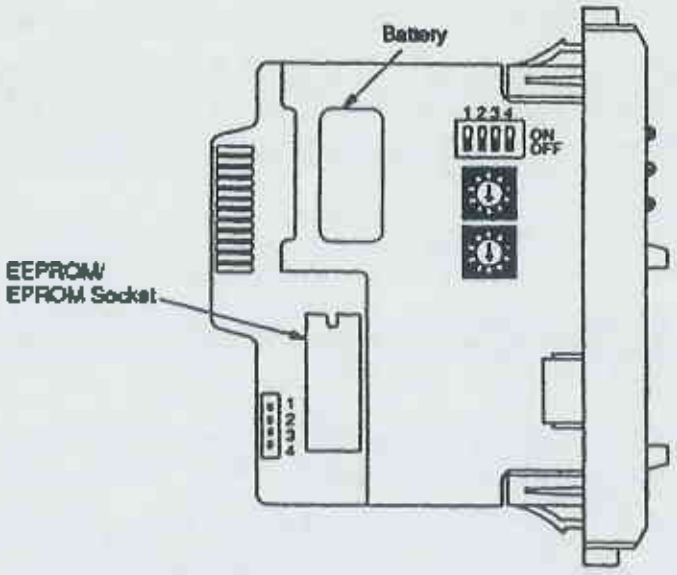


Figure 7-1 EPROM/EEPROM Socket Location

Table 7-1 Selecting Memory Type

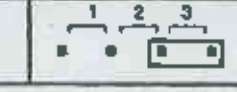
	RAM	EEPROM	EEPROM Write Protected	EPROM
Memory IC Socket	Empty	28C64 Installed	28C64 Installed	27C256 Installed
Switch 2				
Jumper Pin				

Table 7-2 Selecting Retentive Control Relays

CR 340-373	Retentive	Non-Retentive
Switch 2		

APPENDIX & NOTES

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

APPENDIX A: RECIRCULATED AMMONIA OPERATION

General Operating Sequence

Icemaking Mode

Liquid ammonia is pumped to the top of each plate bank. Liquid enters the evaporator plates through orificed headers. Water is circulated over the outside of the vertical evaporator plates. The water is "on" anytime the unit is running (i.e. the water flow is not cut off during defrost).

As the refrigerant leaves the plates, the liquid-vapor mixture is collected in the wet suction header. A branch wet suction line is piped into each suction header. This line tees off to the gas powered suction check valves. The gas power check is wide open during the icemaking mode. The wet suction branch line is connected to the wet suction main going back to a surge drum (by others). The vapor is separated from the liquid in the surge drum and returned to the refrigeration high side via the dry suction lines.

Liquid refrigerant is maintained at a level of approximately 3" in the bottom of the surge drum to ensure an adequate liquid supply to the recirculation pump(s) at all times.

During the above cycle, ice is formed on both sides of the evaporator plates. At the end of a preset cycle time, the programmable controller will initiate a defrost cycle. Cycle time can vary depending on the application, but in general, with a 0°F evaporator temperature, will be approximately 20 minutes to produce 1/8"-1/4" thickness. Ice thickness should be kept to a minimum to ensure maximum overall system efficiency. (One of the distinct advantages of a Turbo ice harvesting system is that a clean surface is available after each harvest cycle to ensure maximum heat transfer.)

Each bank of plates is defrosted separately and defrosts are equally spaced (i.e. the time between the harvest of section #1 is the same as the time between sections #2 and #3, and between #3 and #1). The defrost sequence is as follows:

1. The hot gas solenoid valve is energized to feed hot gas into the header. Higher pressure in the hot gas line causes the check valve in the liquid line to close.

2. At the same time, the pilot coil, on the electric wide open upstream pressure regulator in the suction line, is deenergized. With the coil deenergized, the regulator will modulate to maintain a preset upstream pressure. During defrost, a back pressure of approximately 65 psig is maintained in the evaporator plates in defrost.

3. As the pressure in the plates increases, the temperature also increases and the ice separates from the plates and drops into the harvest conveyor located below the plates. Liquid in the plates flows out of the plate through the suction header and regulator into the wet suction return line.

4. After a preset defrost time, the programmable controller deenergizes the hot gas solenoid valve and energizes the coil on the suction line pressure regulator (electric wide open) to return the evaporator to the icemaking mode.

5. The above sequence is repeated for each bank of plates in the unit, and the sequence repeats until either the unit is turned off or a remote contact (bin full, etc.) opens to terminate operation.

Note:
Installations with multiple ice generators should interconnect the controls to harvest only one section at a time.

Hot Gas Supply Line

A strainer is installed in the hot gas supply line upstream of a pressure sensing (Mercoid) switch. A pressure gauge is also mounted in parallel to the pressure switch.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

During defrost, the hot gas solenoid valve to the section in defrost opens, allowing hot gas to enter the evaporator. Because of the volume of the evaporator plates and the 32°F water flowing over the plates, the discharge pressure will drop during defrost. In most cases, this will not cause a problem; however, in cases where the system is operated at a relatively low condensing temperature (below 85°F SDT/ 150 PSIG), a positive defrost cannot be assured with the standard defrost time. Therefore, when the high pressure (Mercoid) switch mounted on the hot gas line senses a pressure below 150 PSIG, a set of normally closed contacts close. (Above 150 PSIG, the normally closed contacts are open). When the contacts close during defrost, the input to the programmable controller initiates an extended defrost sequence. That is, the normal defrost time will elapse and then a second time span will elapse. The setting of both, the normal defrost time and the extended defrost time, will vary depending on the installation. In general, normal defrost time is 40-60 seconds and the extended defrost time adds 15-45 seconds to the defrost time.

During the refrigeration cycle, the input of the high pressure (Mercoid) switch has no effect on the operation of the system. System discharge pressure can be run below 150 PSIG without affecting the overall operation of the equipment.

Table A-1 Control Devices (Input/Output of Controller)

CONTROL DEVICE	NO.	OPERATES	LOCATION	CONTROLLED BY	STATUS		COMMENTS
					ICEMAKING	DEFROST	
SOLENOID COIL-UPSTREAM PRESSURE REGULATOR (ELECTRIC WIDE OPEN)	1 PER SECTION	SUCTION SOLENOID	BRANCH SUCTION LINES	PROGRAMMABLE CONTROLLER	ON (ELECTRIC WIDE OPEN)	OFF (BACK PRESSURE REGULATOR)	FIELD ADJUSTMENT OF BACK PRESSURE SETTING REQUIRED.
HOT GAS SOLENOID VALVE (HGSV)	1 PER SECTION	FLOW OF HOT GAS TO EVAP PLATES DURING DEFROST	HOT GAS BRANCH LINE (EVAP)	PROGRAMMABLE CONTROLLER	OFF	ON (ENERGIZES 10 SECONDS BEFORE HARVEST INITIATES)	ENERGIZED ONLY DURING DEFROST. SOLENOID OPENS TO FEED HOT GAS TO SECTION IN DEFROST.
HIGH PRESSURE MERCOID SWITCH (DPS)	1	SENSES HOT GAS PRESSURE. EXTENDS DEFROST TIME IF PRESSURE DROPS BELOW 170 PSIG	HOT GAS SUPPLY MAIN TO EVAP	MERCOID SWITCH (NC CONTACTS)	—	NC CONTACT OPENS IF PRESSURE IS ABOVE 150 PSIG NC CONTACT CLOSES IF PRESSURE IS BELOW 150 PSIG	DURING OPERATION AT LOW CONDENSING PRESSURES, STANDARD DEFROST TIME MAY BE TOO SHORT TO COMPLETE HARVEST CYCLE. PRESSURE SWITCH SENSES LOW PRESSURE AND AUTOMATICALLY EXTENDS DEFROST THROUGH PROGRAMMABLE CONTROLLER.
LIQUID LINE SOLENOID VALVE (LSV) - BY OTHERS	1	FLOW OF LIQUID REFRIGERANT TO EVAPORATORS	MAIN LIQUID LINE TO EVAP	PROGRAMMABLE CONTROLLER	ON	ON	SOLENOID COIL IS DE-ENERGIZED TO CLOSE LIQUID SOLENOID WHEN UNIT IS OFF.
HAND EXPANSION VALVE—LIQUID LINE	1 PER SECTION	CONTROLS FLOW OF LIQUID REFRIGERANT TO EVAP	BRANCH LIQUID LINE	MANUAL ADJUSTMENT	—	—	FIELD ADJUSTMENT REQUIRED TO BALANCE LIQUID FLOW TO EACH EVAPORATOR.

TSTG-917

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

APPENDIX B: WATER FLOW CONTROL

Icemaking and Chilling Mode

By control of the water flow to the evaporator plates, the TIG can operate as either an ice generator or as a chiller. In the icemaking mode, water is recirculated over the plates and a periodic defrost sequence is used to harvest the ice. For chilling, the recirculating pump is turned off and process water flows over the plates and is drained to a remote sump.

A dual pressure regulator is used to maintain a suction suitable for icemaking at the low set point, and a higher suction when energized to prevent the formation of ice. The regulator is located in the main suction line leaving the unit (field installed).

To accomplish selection of the icemaking or chilling mode, a two-position selector switch (ICS) is located on the control panel door. In the left position, the signal to the programmable controller initiates the "ice" making sequence. For chilling, the selector switch is placed in the "chill" position.

Operating Sequence

Icemaking Mode

1. Selector switch in "ice" position.
2. Recirculating water pump (WP) is turned on.
3. Make-up water solenoid valve (MWS) is energized to supply make-up water to the sump.
4. The coil on the dual pressure regulator in the suction line is deenergized to provide a suction pressure low enough to produce ice.
5. Process water solenoids (WS-1 & WS-2) remain closed.
6. Water is continuously circulated from the sump, over the plates, and back to the sump.
7. As the water flowing over the plates is converted to ice, the water level in the sump drops. A mechanical float opens to maintain the water level in the tank.
8. After a preset refrigeration time, the programmable controller initiates a defrost sequence of each evaporator section. (See operating section for description of defrost sequence).
9. The unit will operate in the mode until:
   a. the master control switch (MCS) is turned "off".
   b. all manual defrost switches (MDS1, MDS2, MDS3, etc.) are in the "off" position.

   See operating section for termination of operation by the emergency stop button (ES), water pump, or harvest screw failure.

Chilling Mode

1. Selector switch in "chill" position.
2. Recirculating water pump (WP) is "off".
3. Make-up water solenoid valve (MWS) is deenergized (i.e. water will not be added to the sump through the make-up water float valve).
4. The process water supply solenoid valve (WS-1) is energized, and opens to supply water to the evaporator plates.
5. The drain solenoid valve (WS-2) is energized to open the drain line from the chiller sump to a remote chilled water storage sump.
6. Dual set point regulator is energized to raise the evaporator suction to a higher pressure (i.e. no ice is produced).
7. The unit will operate in this mode until:
   a. the master control switch (MCS) is turned "off".
   b. all manual defrost switches (MDS1, MDS2, MDS3, etc.) are in the "off" position.

Read Safety Section before this section. Failure to carefully follow these instructions could result in permanent injury or loss of life.

Note:
Even though a defrost sequence is not used in the chill mode, the MDS switches must be in the "on" position.

See operating section for termination of operation by the emergency stop button (ES). The water pump or harvest screw failure safeties will not terminate operation in the chill mode.

Change from Icemaking to Chilling

The mode of operation may be changed from icemaking to chilling, or from chilling to icemaking while running.

Icemaking to Chilling

When the "ICS" switch is changed from "ice" to "chill" position while operating, the defrost sequence is immediately eliminated. With the higher temperature water on the plates and higher suction, the ice on the plates will be melted off. The harvest screw remains off in the chill mode and any ice that drops into the harvest screw will also be melted away.

Chilling to Icemaking

When the "ICS" switch is changed from "chill" to "ice" while operating, the process water solenoids immediately close, and the recirculating pump starts. The normal icemaking sequence including harvest begins.

TURBO®

Service Bulletin
October 1993

Turbo Refrigerating Company
P.O. Box 396
Denton, Texas 76202-0396
817/387-4301

Water Distribution System Flat Bottom Pans

Product Lines

- TIG/TIGAR Industrial Models
- HP and IGC Thermal Storage Models

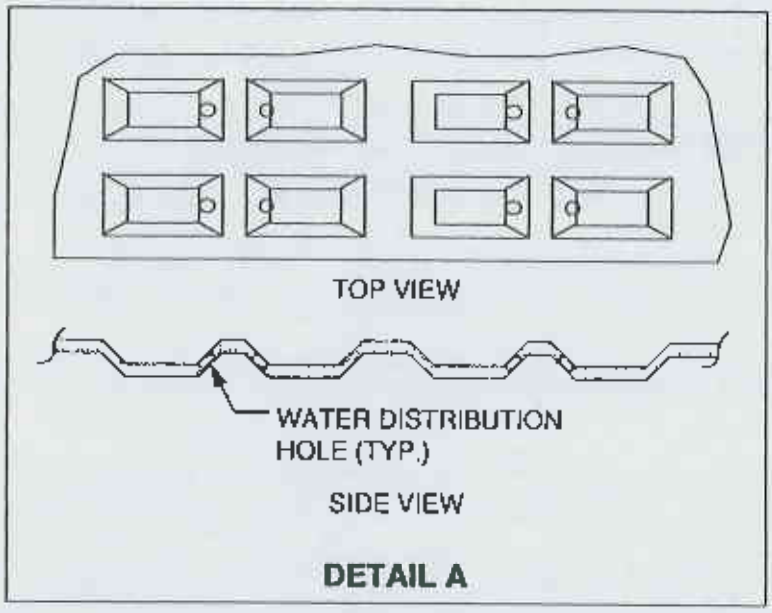
V-Bottom Water Distribution System

Prior to the development and testing of the flat bottom pans, a V-bottom water distribution system has been utilized. Refer to Figure 1. This system consisted of a stainless steel V-bottom water distribution pan and PVC water distribution header for each bank of evaporator plates. This system provided water distribution to each evaporator plate in the plate bank and filtration of debris from the circulating water system. Due to the "corrugated" construction of the pan, cleaning debris that collected in the pan was difficult. Due to the wide range of flow rates and water levels in the pans, splashing was a possibility if the pans were not clean. Splashing contributes to freeze-up problems if not corrected and frequent cleaning was often required in debris prone systems.

Flat Bottom Pan System

The new flat bottom pan design eliminates these problems. Refer to Figure 2. A stainless steel water distribution pan and PVC water distribution header are still the standard materials used, but the new design has provided improvements in several areas:

- Cleaning is much easier due to the flat design of the pan.
- A cleanable media material pad has been added to filter out debris before it gets to the holes in the water distribution pan which makes maintenance and cleaning easier.
- The media pad reduces the possibility of splashing, thus reducing the mist that can cause freeze-ups.
- USDA approval is pending on the media pad.
- Cleaning is as simple as removing the media pad and washing it out. The media pad is cleanable and reusable. If you want to shorten your cleaning time even more, keep a spare media pad available for each pan. Pull the dirty media pad out and insert the clean media pad. Clean the dirty media pad and store for the next clean up. Replacement media pads will be about $15 each (list price).
- Since the area in the media pad is many times the cross sectional area of the holes in the pans, frequency of cleaning is much less. In severe cases, it may change from weekly cleaning to every four months or longer.
- The media pad is treated to prevent the growth of bacteria even with the longer interval between cleaning. *Note:* In USDA applications, regular cleaning is recommended.
- The PVC water distribution system and header reduce splash and are easily removed and dismantled for cleaning.
- The new design improves performance by increasing the wetted surface area of the evaporator plate while decreasing misting and splash. Both contribute to increased reliability.



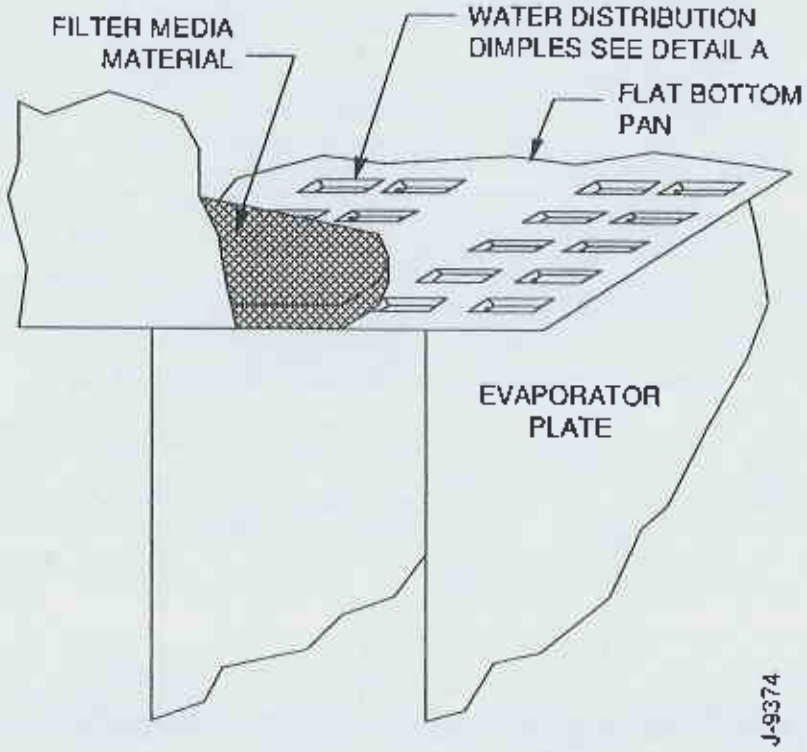


Figure 2 Typical Flat Bottom Pan Section With A Section Of Filter Media Pad

TURBO®

SERVICE BULLETIN
MARCH 1994

Flat Bottom Pan Water Distribution Header:
Flow Control Orifice Ring Assembly Installation and Adjustment Instructions

TURBO REFRIGERATING
P.O. Box 396
Denton, Texas 76202-0396
Ph: 817/387-4301
Fax: 817-382-0364

A flow control orifice assembly is installed in the inlet connection to each of the PVC spray headers providing water to the water distribution pan. Refer to Figure 1. As shipped, the orifice ring assembly is set for maximum flow (full open). Refer to Figure 2. During start-up of the system, adjustment of the orifice ring assembly may be required to obtain the desired flow to the water distribution pan without overflowing the pan.

REMOVING THE ORIFICE RING ASSEMBLY

1. Loosen the hose clamps on both ends of the radiator hose connecting the spray header to the main water distribution header.
2. Slide the hose down the PVC spray header inlet connection until the orifice ring assembly is accessible for removal.
3. Remove the orifice ring assembly.

ADJUSTING THE ORIFICE RING ASSEMBLY

1. Loosen the nut holding the three PVC rings together.
2. Rotate one (or two, if required) of the rings (clockwise or counterclockwise) to reduce the free opening through the assembly. To increase the flow, rotate the rings to increase the free area. Refer to Figure 2. To decrease the flow, rotate the rings to decrease the free area. Refer to Figure 3.
3. Tighten the nut to secure the setting of the orifice ring assembly.

INSTALLING THE ORIFICE RING ASSEMBLY

1. Replace the orifice ring assembly in the opening between the main water header and the spray header inlet connection.

   Note: Install the orifice ring assembly with either the nut or bolt head on the inlet side of the flow.
2. Slide the hose connection over the orifice ring assembly and on to the main water header connection stub.
3. Secure the two hose clamps on the main header side.
4. Push the PVC spray header inlet toward the main water header to ensure that the orifice ring assembly is wedged between the PVC connections (i.e., the orifice ring assembly cannot move between the two ends of the PVC pipe).
5. Secure the two hose clamps on the spray header inlet connection while holding pressure against the spray header inlet connection to ensure that the orifice ring assembly remains in place while tightening the clamps.

After completing adjustments, restart the system and observe the flow. If required, repeat the procedure until the desired flow is obtained. If you have any questions, contact:

TURBO REFRIGERATING
Service Department
Phone: 817-387-4301
Fax: 817-382-0364

T-0418

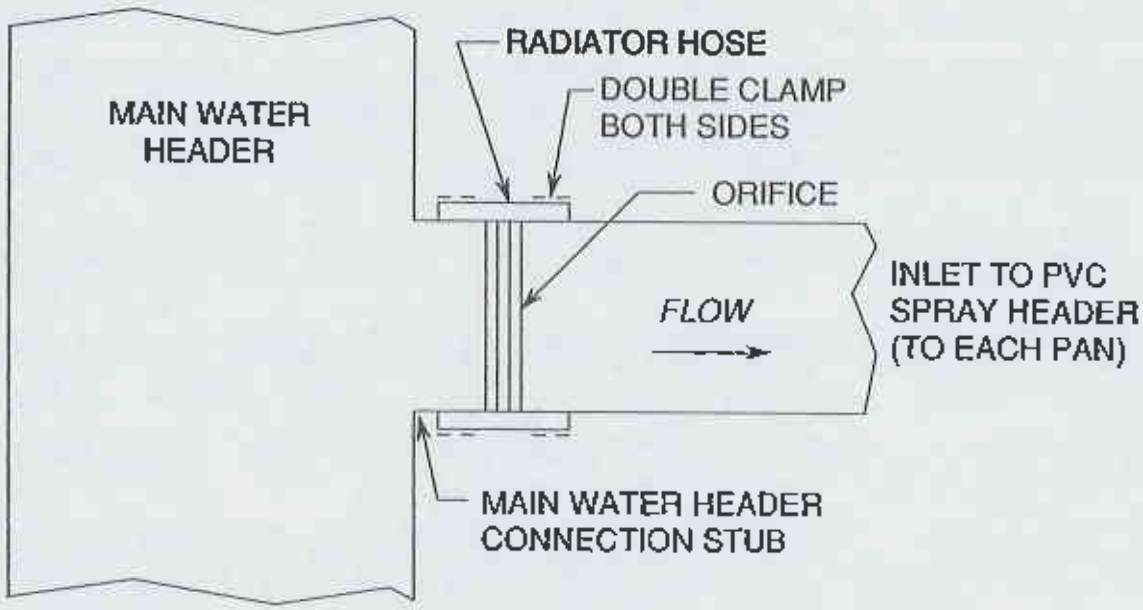


Figure 1
INSTALLATION LOCATION

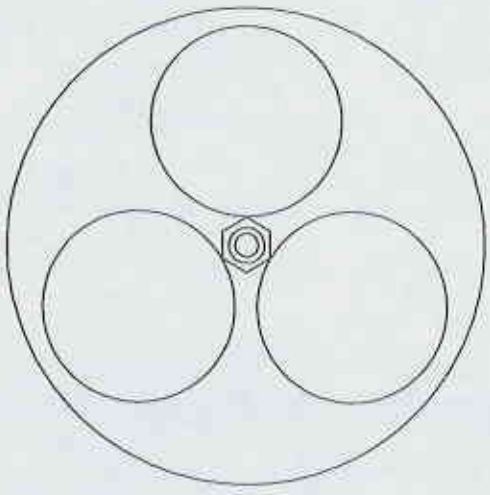


Figure 2
MAXIMUM FLOW
ADJUSTMENT

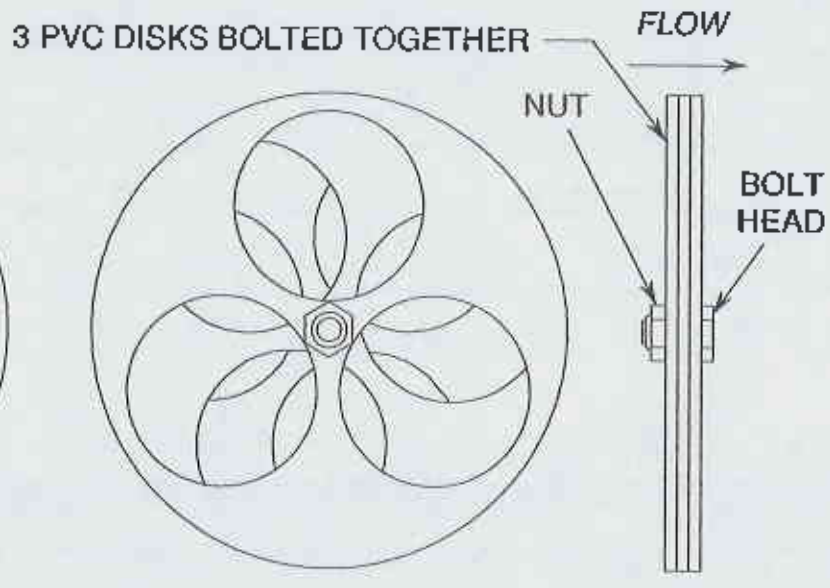


Figure 3
MINIMUM FLOW
ADJUSTMENT

TURBO®

TECHNICAL BULLETIN
AUGUST 1994

TURBO REFRIGERATING
P.O. Box 396
Denton, Texas 76202-0396
Ph: 817-387-4301
Fax: 817-382-0364

Vessel & Piping Insulation Guidelines

TURBO provides a variety of refrigerant vessels and refrigerant piping with insulation to control condensation and heat infiltration. TURBO uses a black, closed cell, rubber insulation material (similar to Armaflex®) secured to the vessel or piping with an adhesive.

No other material or jacketing is supplied over the insulation material because of:

- Variations in jacketing materials to match other jacketed piping or vessels in the installation.
- Possible damage during shipment or installation.

The insulation material provided by TURBO does not require jacketing on most installations, but jacketing is recommended:

- Where the insulation material is exposed to direct sunlight (outdoor installations).
- Where ultraviolet light will cause the insulation material to become brittle.
- Where the insulation material is exposed to cleaning agents or contact by personnel performing normal maintenance and service work on indoor or outdoor installations.

TURBO does not provide jacketing as a standard, but it can be provided as an option. Quotes can be obtained for individual requirements and will vary according to the type of jacketing requested (i.e., fiberglass, stainless steel, or aluminum). Alternate insulation materials (plaster, rigid or flexible foam, fiberglass, and other rubber products) can be quoted for special order. TURBO may choose not to provide some requested jacket or insulation materials due to application methods and/or incompatibility with other materials or fluids used in or around the equipment.

Insulation On Equipment Exterior Piping & Vessels:

- Equipment may be ordered without insulation on exterior piping or components.

Insulation On Equipment Interior Piping & Vessels:

- Insulation of certain piping or vessels inside the icemaker or ice generator is factory installed because insulation of such areas may not be practical in the field. Areas in which insulation is provided are listed below.
- Jacketing and alternate insulation materials for interior piping and vessels are available as options.

FACTORY INSULATED PIPING & VESSELS: AMMONIA SYSTEMS APPLICATIONS

CAR Models

- Evaporator refrigerant suction and liquid line piping
- Recirculating water suction and discharge lines in the lower section only (upper water piping is not insulated)

CAR-LR Models

- Evaporator refrigerant suction piping
- Built-in recirculator vessel and piping
- Recirculating water suction and discharge lines in the lower section only (upper water piping is not insulated)

TIGAR Models

- Evaporator refrigerant suction and liquid line piping
- Recirculating water suction and discharge lines in the lower section only (upper water piping is not insulated)
- High side skids refrigerant suction piping
- Refrigerant recirculation system (if supplied)

Packaged Chillers (units with factory installed high side and/or refrigerant recirculation units)

- External refrigerant piping
- Refrigerant recirculation vessel (if supplied)
- High side refrigerant suction piping
- Leaving water lines (entering water line is not insulated unless specified)
  Note: Surge drum (low pressure receiver) for flooded models that are shipped loose are uninsulated.

HP, IGC, & ATS Recirculated Thermal Storage Equipment

- Recirculation system (if supplied)
- Evaporator refrigerant piping
- High side refrigerant suction piping
- Surge drum on flooded models for packaged units (see note below)
  Note: Surge drum (low pressure receiver) for flooded models that are shipped loose are uninsulated.

Chillers (evaporator only)

- All piping and vessels are shipped uninsulated.

FACTORY INSULATED PIPING & VESSELS: R-22 SYSTEMS APPLICATIONS

CF Models

- Recirculating water suction and discharge lines in the lower section only (upper water piping is not insulated)

TIG Models

- Recirculating water suction and discharge lines in the lower section only (upper water piping is not insulated)

High Side Skids

- Refrigerant suction piping

Packaged Chillers (units packaged with high side or refrigerant recirculation units)

- External refrigerant piping
- Refrigerant recirculation vessel (if supplied)
- High side refrigerant suction piping (if supplied)
- Leaving water lines (entering water line is not insulated unless specified)
  Note: Surge drum with standard chillers (evaporator only) is shipped loose and uninsulated.

HP, IGC, & FTS Thermal Storage Equipment

- Suction accumulator/heat exchanger
- High side refrigerant suction piping
- Refrigerant recirculation system (if supplied)
- Hot gas line inside evaporator compartment

Chillers (evaporator only)

- All piping and vessels are shipped uninsulated.

ADDITIONAL INFORMATION

For information about available insulation options or special requirements, contact:

Sales Department
ATTN: Inside Sales
P.O. Box 396
Denton, Texas 76202
Phone: 817/387-4301
Fax: 817/382-0364

2. The oil pot contains a low watt density heater controlled by an OTT. The OTT has a sensor located in the bottom of the oil pot.

3. An electronic oil level controller is located in the control panel of the unit. A transducer is mounted in the side plate of the compressor crankcase to monitor the oil level in the crankcase. This transducer is denoted as ESG on the wiring diagrams. The transducer provides an input to the oil level controller. The controller compares the signal received from the transducer to the oil level setpoint, and energizes and de-energizes the oil level relay (OLR) as required.

4. The OLR-1 contact opens and closes the OFS to maintain the desired oil level in the compressor crankcase. As indicated previously, three conditions must be met for the OFS solenoid to open:

   a. Low oil level in the compressor crankcase.

   b. OTT-2 must make-on-rise to input a signal to the PLC. This initiates a time delay to allow the oil temperature to stabilize. The time delay between the opening of the OTT-2 and the enabling of the PLC output is typically 25 minutes.

   c. The PLC output to which the OFS circuit is connected is enabled (on).

5. During normal operation, oil is carried over to the refrigerant system and the level in the crankcase will decrease. The oil is collected in the accumulator and returned to the oil pot.

6. The purpose of the oil pot is to separate the refrigerant from the oil. As indicated above, an electric resistance heater is located in the oil pot to elevate the mixture temperature and boil off the refrigerant, leaving only oil for return to the compressor.

7. As the oil level in the compressor crankcase decreases, the transducer transmits a signal to the oil level controller. The controller compares this signal to the preset value and energizes the OLR relay. When the relay is energized, the normally open OLR-1 contact closes. If the oil in the pot has reached the minimum oil temperature of 85°F, the OTT-2 contacts will close (MOR). When the OTT-2 thermostat closes, power is supplied to the OFS circuit through the PLC output to which it is connected, and the OFS opens to meter oil into the crankcase until either the oil level is satisfied or the OTT thermostat closes, indicating a drop in temperature of the liquid in the oil pot.

8. When the thermostat reaches 95°F, the OTT-1 contact opens to turn off the oil pot heater (ORH). The stage offset is 105°F. With the first stage (OTT-1) setpoint set for 95°F, the second stage setpoint will be 80°F for control of the oil feed solenoid. With the 95°F setpoint and 5°F differential for the first stage, the heater will maintain the oil temperature between 90–95°F (the 5°F differential is set on "DIFF 1" adjustment knob). OTT-2 controls the oil return to the compressor. With the 105°F stage offset and the 5°F differential for stage 2, the controller will permit the oil to return with oil temperatures between 80 – 85°F (the 5°F differential is set on "DIFF 2" adjustment knob). Oil return will not be permitted to the compressor with oil temperatures below 80°F.

9. The oil level in the crankcase sight glass should be half full. In verifying the operation of the oil return system, this level should remain constant with minor variations in the level as the oil leaves the crankcase and is returned through the oil recovery system. Oil level in the sight glass should remain between 3/8–1/2 full during normal operation.

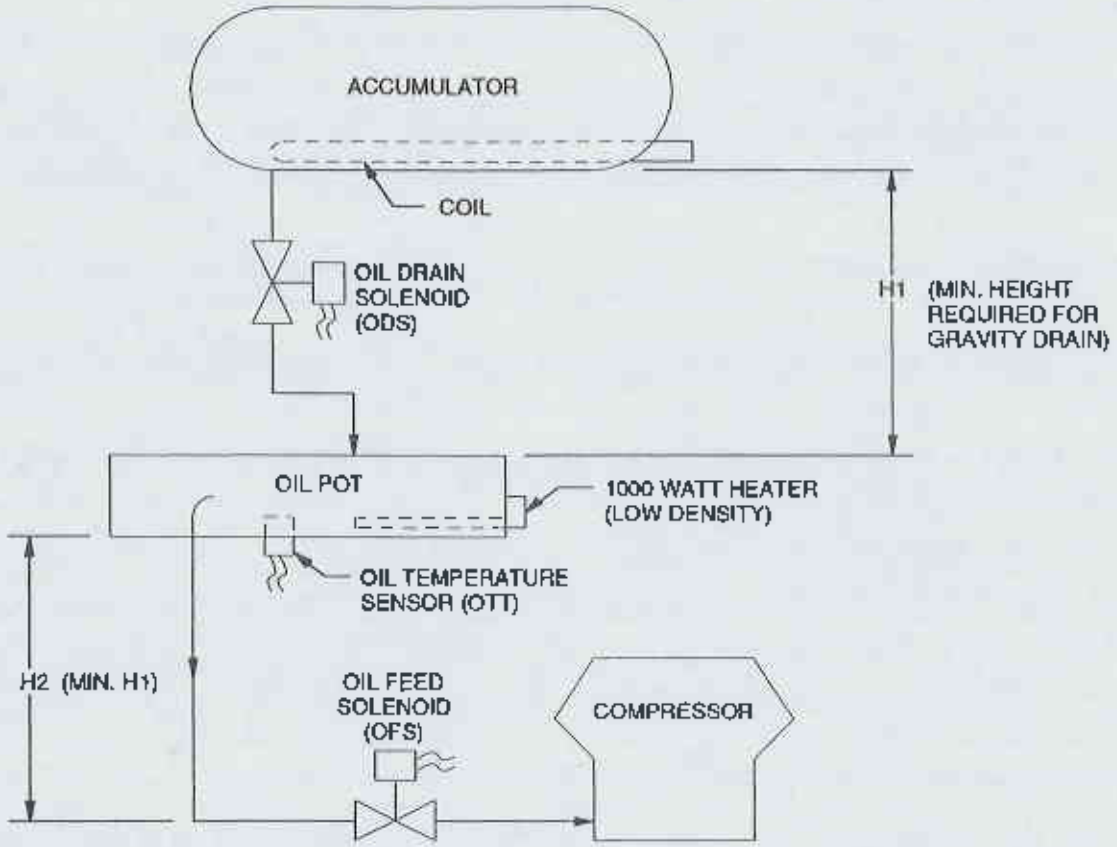


Figure 3 Piping Schematic

Technical Bulletin 9601A
November 1996
Supersedes 8/96 Bulletin 9601

MAINTENANCE REQUIREMENTS
PREVENTION OF HYDRAULIC SHOCK / EVAPORATOR PLATE LEAKS

TURBO REFRIGERATING
P. O. Box 396
Denton, Texas 76202
Phone: 817/387-4301
Fax: 817/382-0364

Products/Models Affected

All TIG ice generators.

Description of Situation

Hydraulic shock can cause premature failure of the evaporator plate(s) as well as loss of the refrigerant charge due to leaks. Reliable operation of the refrigeration system requires a proper refrigerant charge and control of the condensing pressure. If the refrigerant level is low and the condensing (discharge) pressure is high, the resulting increase in the differential pressure between evaporator plate suction and hot gas supply can increase the possibility of hydraulic shock at the outlet of evaporator plate when the defrost cycle is initiated. Proper operation and maintenance are required to avoid the problems referenced above.

The following design conditions should be used as guidelines to evaluate the operation of the system (R-22 systems):

Receiver Operating Level:	25-30%	
Suction Pressure:	24 PSIG (at the end of the icemaking cycle)	
Discharge Pressure:	Evaporative-Cooled	185 PSIG
	Water-Cooled	210 PSIG
	Air-Cooled	260 PSIG

All units are equipped with high pressure and low pressure cut-out switches to maintain correct pressure in the system during operation. Factory settings for the safety switches on TIG models are shown below. The setting of the safety switch should be verified and adjusted accordingly:

Model	Factory Recommended Setting
Evaporative & Water-cooled systems:	250 PSIG
Air-cooled systems:	275 PSIG

If the high pressure cut-out is improperly adjusted and exceeds the relief valve setting (350 PSIG), the relief valve will open and vent refrigerant before the high pressure safety cut-out can shut the unit off. In this case, the loss of the refrigerant will increase the probability of a low suction condition and hydraulic shock.

CAUTION: Never set the high pressure safety cut-out above the recommended setting to eliminate a safety trip. Determine the cause of the trip and take corrective action to avoid future problems and failures.

Corrective Action

Simple maintenance and service procedures can avoid the problem referenced above. A *Hot Gas Pressure Regulator Kit* is available to minimize the affect of the increased pressure differential caused by poor maintenance. Although the best results and most reliable operation is obtained by maintaining the equipment within the operating specifications above, the optional kit can be added to reduce the risk of plate failures during periodic operation under adverse conditions. On equipment that is within specifications, the pressure regulator can be used to improve the life expectancy of the evaporator plates for air-cooled systems or systems that operate at the higher pressures.

If you are concerned you may have a problem or want to evaluate the operation of your equipment, either contact TURBO for instructions and/or continue to read this bulletin for maintenance and trouble-shooting hints. Also reference the Operating & Maintenance manual for additional information.

Operation

The down stream pressure regulator is set to maintain the hot gas pressure at the evaporator plate inlet below 135 PSIG. The regulator is factory set and requires no field adjustment. The adjustment seal cap is sealed to prevent adjustment of the regulator.

Maintenance and Trouble-Shooting Hints

If you notice an increase in the discharge pressure check:

Water-cooled systems

1. The water regulating valve. Check the setting and operation of the valve.
2. Check for non-condensables in the system. This can be determined by monitoring the temperature of the discharge lines. If non-condensables are present, the temperature of the line will be very high (in excess of 180°F). At this temperature even brushing the line with your hand will be uncomfortable. Purge, evacuate, and recharge the unit to eliminate non-condensables from the system.
3. Determine if the condenser is fouled. A typical system should have approximately 85°F water entering the condenser and 95°F leaving. If the condenser is fouled, the water regulating valve can not supply enough water to overcome the poor heat transfer caused by the fouling. If fouling is the problem, the difference between the entering and leaving water will be low (3-5°F versus 8-10°F) indicating poor heat transfer between the refrigerant and the water.

In some cases, chemical cleaning of the condenser circuit will eliminate the fouling. Consult a local chemical supply or refrigeration company for a chemical cleaning agent recommended for cooling towers and condensers. Follow the directions and procedure

If you have additional questions or need information on the above referenced problem or any other question on the TIG ice generator, contact:

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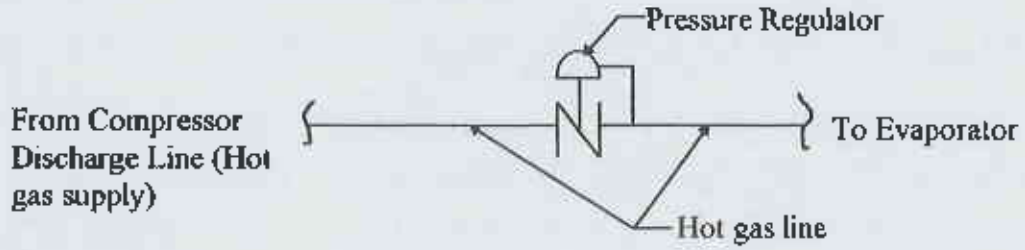

Figure 1. Typical Pressure Regulator Piping