



# SAFE HANDLING OF A2L REFRIGERANT R-454B



## Safety Manual

### Disclaimer

Proper installation and servicing of the Total Green Mfg. Heat Pump is essential to its reliable performance. All Total Green Mfg. systems must be installed and serviced by a qualified HVAC contractor. Equipment sizing, selection and installation are the sole responsibility of the installing contractor.

Installations of equipment on an existing copper earth loop design that does not match a current Total Green Mfg. earth loop design is not permitted, will void all warranties on the equipment, and is the sole responsibility of the installing contractor. Installation must be made in accordance with the instructions set forth in this manual. Failure to provide installation by a qualified HVAC contractor in a manner consistent with this manual will void and nullify the limited warranty coverage for the system.

Total Green Mfg. shall not be liable for any defect, unsatisfactory performance, damage or loss, whether direct or consequential, relative to the design, manufacture, construction, application or installation of any field specified components.

All commissioning and registration paper work must be filled out at start up and returned to Total Green Mfg. for full warranty coverage.

**Please Note:** Electrical data given in this manual is subject to change without notice.  
Please refer to the equipment data label for the most up to date specifications.

**This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety.**

**Children should be supervised to ensure that they do not play with the appliance.**



### WARNING

#### LIVE ELECTRICAL COMPONENTS!

Failure to follow this Warning could result in property damage, severe personal injury, or death. Follow all electrical safety precautions when exposed to live electrical components. It may be necessary to work with live electrical components during installation, testing, servicing, and troubleshooting of this product.

The high voltage power supply must agree with the equipment nameplate.

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges, or any other adverse environmental effects.

Power wiring must comply with national, state, and local codes.

Follow instructions on unit wiring diagram located on the bottom side of the unit lid.



This equipment is designed for use with R-454B refrigerant that has an A2L classification. Only personnel trained in the proper handling of A2L refrigerants using compatible A2L service and installation tools should carry out services and installation of this equipment. This equipment ships without refrigerant with a dry nitrogen holding charge. Installing and service personnel are solely responsible for the proper servicing and charging of this equipment as set forth in this, and all Total Green Mfg. service and installation manuals.



THIS UNIT REQUIRES SERVICE EQUIPMENT  
COMPATIBLE WITH R-454B REFRIGERANT



**Refrigerant  
Safety Group  
A2L**

#### ⚠ WARNING

RISK OF FIRE.  
FLAMMABLE REFRIGERANT USED.  
TO BE REPAIRED ONLY BY TRAINED  
SERVICE PERSONNEL.  
DO NOT PUNCTURE REFRIGERANT  
TUBING.

#### ⚠ WARNING

RISK OF FIRE.  
DISPOSE OF PROPERLY IN  
ACCORDANCE WITH FEDERAL  
OR LOCAL REGULATIONS.  
FLAMMABLE REFRIGERANT USED.

#### ⚠ WARNING

RISK OF FIRE.  
AUXILIARY DEVICES WHICH MAY  
BE IGNITION SOURCES SHALL  
NOT BE INSTALLED IN THE  
DUCTWORK, OTHER THAN  
AUXILIARY DEVICES LISTED FOR  
USE WITH THE SPECIFIC  
APPLIANCE. SEE INSTRUCTIONS.

#### ⚠ AVERTISSEMENT

RISQUE D'INCENDIE.  
REFRIGERANT UTILISÉ INFLAMMABLE.  
SEUL UN PERSONNEL D'ENTRETIEN  
FORMÉ PEUT RÉPARER CE PRODUIT.  
NE PAS PERFORER LE TUBE  
REFRIGÉRANT.

#### ⚠ AVERTISSEMENT

RISQUE D'INCENDIE.  
ELIMINER CORRECTMENT ET  
CONFORMÉMENT AUX  
RÈGLEMENTATIONS FÉDÉRALES  
OU LOCALES. REFRIGERANT UTILISÉ  
INFLAMMABLE.

#### ⚠ AVERTISSEMENT

RISQUE D'INCENDIE. LES DISPOSITIFS  
AUXILIAIRES QUI PEUVENT ÊTRE DES  
SOURCES D'INFLAMMATION NE  
DOIVENT PAS ÊTRE INSTALLÉS DANS  
LE RÉSEAU DE CONDUITS, À  
L'EXCEPTION DES DISPOSITIFS  
AUXILIAIRES ÉNUMÉRÉS  
POUR UNE UTILISATION  
AVEC L'APPAREIL SPÉCIFIQUE.  
VOIR LES INSTRUCTIONS.

## ⚠ NOTICE

**LEAK DETECTION SYSTEM  
INSTALLED.  
UNIT MUST BE POWERED  
EXCEPT FOR SERVICE.**

## ⚠ AVIS

**SYSTÈME DE DÉTECTION  
DE FUITE INSTALLÉ.  
L'APPAREIL DOIT ÊTRE  
ALIMENTÉ, SAUF POUR  
LA MAINTENANCE.**

## ⚠ WARNING

**RISK OF FIRE. AUXILIARY DEVICES  
WHICH MAY BE IGNITION SOURCES  
SHALL NOT BE INSTALLED IN THE  
DUCTWORK, OTHER THAN  
AUXILIARY DEVICES LISTED  
FOR USE WITH THE SPECIFIC  
APPLIANCE.  
SEE INSTRUCTIONS.**

## ⚠ AVERTISSEMENT

**RISQUE D'INCENDIE, LES  
DISPOSITIFS AUXILIAIRES QUI  
PEUVENT ÊTRE DES SOURCES  
D'INFLAMMATION NE DOIVENT  
PAS ÊTRE INSTALLÉS DANS LE  
RÉSEAU DE CONDUITS, À  
L'EXCEPTION DES DISPOSITIFS  
AUXILIAIRES ÉNUMÉRÉS POUR  
UNE UTILISATION AVEC  
L'APPAREIL SPÉCIFIQUE.  
VOIR LES INSTRUCTIONS.**

**ALL phases of this installation must comply with NATIONAL, STATE AND LOCAL CODES.**

**IMPORTANT:** This document is customer property and is to remain with this unit. Please return to service information packet upon completion of work.

1) INTRODUCTION.....Page 5  
2) INSTALLER GUIDE.....Pages 6 AND 7  
3) CHARGING PROCEEDURES.....Page 8  
4) RECOVERY.....Page 8  
5) DECOMISSIONING.....Page 9  
6) LEAK MITIGATION VENTING/EXHAUST TABLES.....Pages 10 and 11

Please note that illustrations in these manuals are for reference only and may not show all detail. Also, specifications are subject to change without notice. It is imperative that only the manuals shipped with the equipment be used for each installation.

## 1) INTRODUCTION

Total Green Mfg.'s Waterless® Geothermal equipment is designed for use with A2L class R-454B refrigerant. One of the most significant advantages of R-454B refrigerant is its eco-friendly nature. Compared to older refrigerants like R-22 and R-410A, R-454B has a significantly lower global warming potential (GWP), making it a more environmentally sustainable choice. Additionally, R-454B offers improved energy efficiency. This makes R-454B refrigerant a perfect choice with use in our Waterless® Geothermal equipment.

While R-454B offers numerous benefits, it's essential to exercise caution when handling this refrigerant. One key consideration is its flammability. R-454B is classified as an A2L refrigerant, which means it has a low risk of ignition but is not non-existent, which requires careful handling and installation by trained professionals. Additionally, regular maintenance by trained professionals is crucial to ensure the safe and efficient operation of systems using R-454B. By prioritizing safety and maintenance, end users can enjoy the benefits of R-454B without compromising on safety.

When installing Total Green Mfg. equipment, all local codes for installing an A2L based heating and cooling system are to be followed.

To assist in meeting any local code requirements when installing Waterless® Geothermal equipment, we have incorporated optional compressor unit ventilation panels to give installation flexibility, leak sensors in the compressor units as well as leak sensors to be installed in air handlers and cased coils and, a leak mitigation control system.

## 2) Installer Guide

1. All persons in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.
2. The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e., non-sparking, adequately sealed or intrinsically safe.
3. If any hot work is to be conducted on the refrigerant containing equipment or any associated parts, appropriate fire extinguishing equipment shall be available and on hand. Have a dry powder or CO2 fire extinguisher adjacent to the charging area.
4. No person carrying out work in relation to a refrigerant containing system which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere. Be aware that refrigerants may not contain an odor.
5. The following checks shall be applied to installations using flammable refrigerants:
  - a) Marking to the equipment continues to be visible and legible.
  - b) Markings and signs that are illegible shall be corrected.
  - c) Refrigerant piping or components are to be installed in a position where they are unlikely to be exposed to any substance which may corrode and/or damage refrigerant containing components.
  - d) Refrigerant piping shall be installed in a manner that protects them from potential damage.
  - e) Repairs to Electrical Components, where electrical components are being changed, shall be for the purpose and to the correct specification.
  - f) At all times the manufacturer's maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer's technical department for assistance.
  - g) Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately, but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment, so all parties are advised.
  - h) Safety checks shall include that capacitors are discharged. This shall be done in a safe manner to avoid possibility of sparking and that no live electrical components and wiring are exposed while charging, recovering or purging the system.
  - i) Assure there is continuity of earth bonding. Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental

effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

- j) Detection of Flammable Refrigerants under no circumstances shall potential sources of ignition be used in the searching for, or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.
  - k) The following leak detection methods are deemed acceptable for all refrigerant systems.
  - l) Electronic leak detectors may be used to detect refrigerant leaks but, in the case of flammable refrigerants, the sensitivity may not be adequate, or may need recalibration. (Detection equipment shall be calibrated in a refrigerant-free area.)
  - m) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed.
  - n) Assure that leak detection fluids are also suitable for use with most refrigerants, but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work.
  - o) If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak. Removal and Evacuation when breaking into the refrigerant circuit to make repairs - or for any other purpose - conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration.
  - p) Safely remove refrigerant following local and national regulations.
  - q) Purge the refrigerant circuit with inert gas (Dry Nitrogen).
  - r) Continue to flush or purge with inert gas (Dry Nitrogen) when using flame to open circuit.
- 6) The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes.
- 7) For appliances containing flammable refrigerants, the system shall be purged with dry nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times.
- 8) Compressed air or oxygen shall not be used for purging refrigerant systems. For appliances containing flammable refrigerants, refrigerants purging shall be achieved by breaking the vacuum in the system with dry nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum. This process shall be repeated until no refrigerant is within the system. When the final dry nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place.
- 9) The outlet of a vacuum pump shall not be close to any potential ignition sources, and ventilation shall be available.

### **3) Charging Procedures**

- a) Ensure that contamination of different refrigerants does not occur when using charging equipment.
- b) Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.
- c) Cylinders shall be kept in an appropriate position according to the instructions.
- d) Do not pierce or burn refrigerant cylinders or any other refrigerant containing component.
- e) Ensure that the refrigerating system is earth grounded prior to charging the system with refrigerant.
- f) Label the system when charging is complete (if not already).
- g) Extreme care shall be taken not to overfill the refrigerating system.
- h) Prior to recharging the system, the system shall be pressure tested with the appropriate purging gas.  
The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

### **4) Recovery**

- a) When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.
- b) When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed.
- c) Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i.e., special cylinders for the recovery of refrigerant).
- d) Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order.
- e) Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs. The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of the flammable refrigerant.
- f) If in doubt, the manufacturer should be consulted.
- g) In addition, a set of calibrated weighing scales shall be available and in good working order.
- h) Hoses shall be complete with leak free disconnect couplings and in good condition.
- i) The recovered refrigerant shall be processed according to local legislation in the correct recovery cylinder, and the relevant waste transfer note arranged.
- j) Do not mix refrigerants in recovery units and especially not in cylinders.
- k) If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that flammable refrigerant does not remain within the lubricant.
- l) The compressor body shall not be heated by an open flame or other ignition sources to accelerate this process.
- m) When oil is drained from a system, it shall be carried out safely.

## 5) **Decommissioning**

- a) Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its detail. It is recommended good practice that all refrigerants are recovered safely.
- b) It is essential that electrical power is available before the task is commenced.
- c) Become familiar with the equipment and its operation.
- d) Isolate system electrically.
- e) All personal protective equipment is available and being used correctly.
- f) The recovery process is supervised at all times by a competent person.
- g) Recovery equipment and cylinders conform to the appropriate standards.
- h) Make sure that the recovery cylinder is situated on the scale before recovery takes place.
- i) Start the recovery machine and operate in accordance with its instructions.
- j) Do not overfill cylinders (no more than 80 % volume liquid charge).
- k) Do not exceed the maximum working pressure of the cylinder, even temporarily.
- l) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
- m) Recovered refrigerant shall not be charged into another refrigerating system unless it has been cleaned and checked.
- n) Equipment shall be labelled stating that it has been decommissioned and emptied of refrigerant and that a label stating such shall be dated, signed and affixed to the equipment.

## 6) LEAK MITIGATION VENTING/EXHAUST TABLES

The installer must verify that the total space conditioned and blower air flow by the system is enough to safely dilute any leaked refrigerant in the event of a refrigerant leak. The minimum space conditioned and air flow by the appliance shall be according to Table below. The conditioned space includes any parts of the space connected via an air duct system. The altitude of installation is the altitude above sea level of the site where the equipment is installed.

### **Forced Air Units Only. Models WGxA, AD and AH Models**

| Unit Size     | Max Charge | Min. Conditioned Room Area | Minimum Mitigation Air Flow |
|---------------|------------|----------------------------|-----------------------------|
| (24) 2 tons   | 15 Lbs.    | 237 Sq. ft.                | 406 CFM                     |
| (30) 2.5 Tons | 17.5 Lbs.  | 276 Sq. ft.                | 474 CFM                     |
| (36) 3 Tons   | 20 Lbs.    | 315 Sq. ft.                | 542 CFM                     |
| (42) 3.5 Tons | 22.5 Lbs.  | 355 Sq. ft.                | 609 CFM                     |
| (48) 4 tons   | 25 Lbs.    | 394 Sq. ft.                | 677 CFM                     |
| (54) 4.5 Tons | 27.5 Lbs.  | 434 Sq. ft.                | 744 CFM                     |
| (60) 5 Tons   | 30 Lbs.    | 473 Sq. ft.                | 812 CFM                     |

### **Hydronic Units Only. WG1H. 100% heated and chilled water.**

| Unit Size     | Max Charge | Min. Conditioned Room Area | Minimum Mitigation Air Flow |
|---------------|------------|----------------------------|-----------------------------|
| (36) 3 Tons   | 17 Lbs.    | 268 Sq. ft.                | 460 CFM                     |
| (42) 3.5 Tons | 19 Lbs.    | 300 Sq. ft.                | 514 CFM                     |
| (48) 4 tons   | 21 Lbs.    | 331 Sq. ft.                | 569 CFM                     |
| (54) 4.5 Tons | 23 Lbs.    | 363 Sq. ft.                | 623 CFM                     |
| (60) 5 Tons   | 25 Lbs.    | 394 Sq. ft.                | 677 CFM                     |
| (66) 5.5 Tons | 30 Lbs.    | 473 Sq. ft.                | 812 CFM                     |

**Altitude Adjustment factors.** The above tables are based at sea level. When installing in areas where altitude is higher than 2000 ft. above sea level, use the following multiplier tables for both room area and mitigation CFM for minimum requirements.

| Height above Sea Level | Multiplier |
|------------------------|------------|
| 2000 to 3000 ft.       | 1.02       |
| 3000 to 4000 ft.       | 1.07       |
| 4000 to 5000 ft.       | 1.12       |
| 5000 to 6000 ft.       | 1.15       |
| 6000 to 7000 ft.       | 1.21       |
| 7000 to 8000 ft.       | 1.25       |
| 8000 to 9000 ft.       | 1.28       |
| 9000 to 10000 ft.      | 1.36       |

