TERRA UNIVERSAL.COM
Critical Environment Solutions

Installation and Operating Guide *Document No. 1800-79*

Smart Glovebox™

Smart Glovebox™

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Safety Notice

A thorough familiarity with all operating guidelines is essential to safe operation of the product. Failure to observe safety precautions could result in poor performance, damage to the system or other property, or serious bodily injury or death.

The following symbols are intended to call your attention to two levels of hazard involved in operation:

The information presented here is subject to change without notice.

CAUTION — **Cautions are used when failure to observe instructions could result in significant damage to equipment.**

WARNING — **Warnings are used when failure to observe instructions or precautions could result in injury or death.**

1.0 Introduction

This manual provides information on installing and operating your Terra Universal Smart Glovebox. These instructions apply to all standard models of Smart Glovebox. Details may vary slightly depending on the options selected and any necessary customization to fit the needs of the end user. Instructions that do not apply to your particular model can be ignored.

2.0 Description

The Smart Glovebox helps protect sensitive materials against moisture-related damage by automatically maintaining the internal humidity level you select.

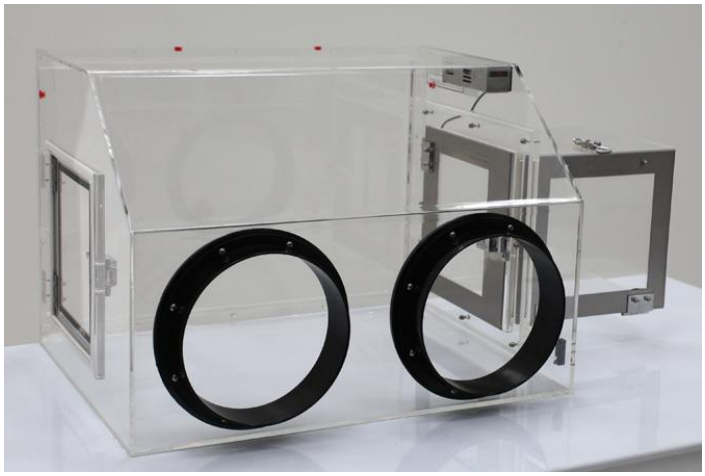

Figure 1: Acrylic Smart Glovebox shown with optional airlock.

It maintains dry conditions by controlling the flow of dry purge gas, generally nitrogen, into the glovebox chamber. A space-saving LED display continuously monitors the %RH (relative humidity) inside the chamber. After you enter a humidity set point, the Smart Glovebox turns the flow of nitrogen on and off to maintain the set point without wasting nitrogen.

This smart control system cuts nitrogen costs up to 78% when compared to flow meter gas delivery systems. Terra's Automatic RB (Relief/Bleed) Valve relieves system overpressures that could damage door seals.

Warning alarms monitor system function and alert operators of potentially damaging conditions. An "RH Hi" alarm indicates if the system remains in the high purge mode for too long, indicating a probable failure of the gas supply line.

3.0 Set-Up and Operation

WARNING **To prevent dangerously low oxygen levels and risk of asphyxiation, nitrogen-purged systems should only be installed in a well-ventilated area.**

CAUTION **The glovebox is rated for operation in an environment with temperatures between 32°F (0°C) and 104°F (40°C) and ambient humidity up to 92%.**

Follow these steps to prepare your Smart Glovebox for operation using the factory-set parameters summarized below. To change any of these values, refer to Section 4.0: Changing Set-Up Mode Parameters.

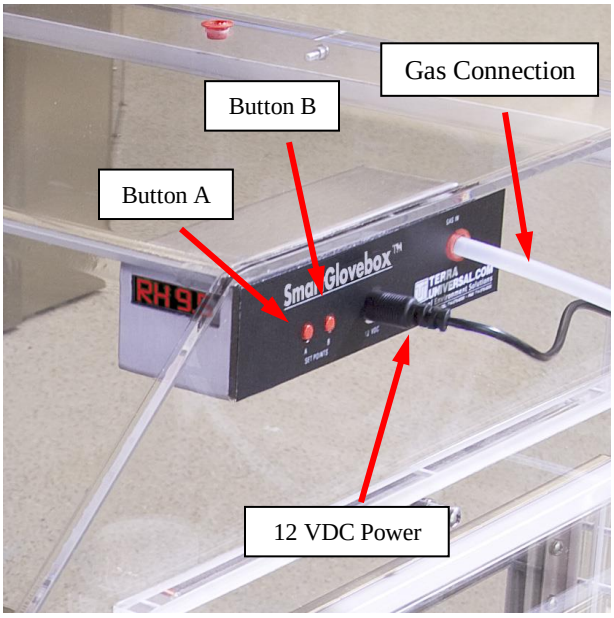

Figure 2: Smart Humidity Module mounted in an acrylic glovebox.

Relative Humidity Offset (default = 0): allows the user to offset the relative humidity readings to match %RH values displayed by a test instrument. This is effectively a calibration procedure.

High Relative Humidity Alarm (default = 60 seconds): allows the user to change the time delay between when the measured relative humidity level climbs above the set point value and when the "RH High" alarm is displayed.

Identification Parameter (default = 0): not used with the Smart Glovebox.

Purge-Off Delay (default = 30 seconds): allows the user to change the delay between the time when the system regains the humidity set point and the high-flow purge is de-activated. This delay ensures that ample purge is provided to remove moisture and contaminants from the chamber. The longer the delay, the more nitrogen is consumed each time a humidity fluctuation triggers the nitrogen purge.

WARNING **To prevent hazardous overpressures, the external gas supply to the glovebox must be regulated at a maximum pressure of 15 psi, and the glovebox must not be operated without the factory-installed Automatic RB (Relief/Bleed) Valve.**

1. Connect a ¼" N2 (or other process gas) supply line externally regulated at 10 – 15 PSI. See photo for fitting location. Higher pressure may result in glove "blowback," making insertion of hands into the glove difficult. At very high inlet pressure, the internal pressure can cause damage or even rupture of the chamber.

2. Connect the 12VDC power supply to a standard 110VAC/60Hz power outlet.

3. **RH Set Point (Factory Setting: 10% RH) –** The RH set point is established during normal run mode. With the power ON, press and release Button A to view current set point. Then press Button A again to increase the set point, or Button B to decrease it. Refer to photo above.

After a four-second delay, during which time no buttons are pressed, the unit will store the new set point and return to normal operation, displaying the current RH level.

Recommended Minimum Settings: Although the RH level can be specified anywhere between 0 and 99.5% RH, the practical set point range is from room ambient (highest setting) down to the RH of the supply gas (lowest setting).

Because the unit is accurate to ± 2%RH, your set point should be at least 2% above zero (recommended minimum setting is 4%). Otherwise, the system could attempt to attain a negative reading and remain on high purge mode all the time.

At initial setup, or following transfer of materials in or out of the glovebox chamber, sustained purging may be required to reach the set point humidity level. During this period, the internal pressure may cause glove blowback. To prevent this condition, the operator should open the internal air lock access door before starting the nitrogen flow. This will allow gas release through the external air lock access door, as well as through the Automatic RB Valve. It also ensures moisture removal from the air lock chamber.

Once the setpoint %RH is achieved, close the internal access door. The Smart Glovebox will now maintain the setpoint humidity level inside the main chamber.

4.0 Changing Set-Up Mode Parameters

Refer to the descriptions above for each of the set-up mode parameters. Before proceeding, make sure that the Smart Glovebox is connected to a ¼" nitrogen (or other process gas) supply line externally regulated at 10 – 15 PSI.

A. <u>Relative Humidity Offset (default = 0)</u>

1. To change parameter settings, you must first enter the Set Up Mode. To do so, disconnect the 12VDC plug from the side of the unit.

2. While pressing and holding both red buttons (labeled "A" and "B"), reconnect the 12VDC plug to the power.

3. Release the "A" button only. The LED will show "**RH**" to indicate the Relative Humidity Offset Parameter.

4. Release the "B" button. The display should read "0," the factory setting. Press the "A" button to increase this value. The settable range is -10 to +10. When the upper range limit is reached, displayed values will cycle to the lower range limit.

B. RH Hi Alarm (Default = 180 seconds)

1. To advance to the RH High Alarm parameter, press and hold the "B" button. The display should read "**RH**".

2. Release the "B" button. The display should indicate "60", the factory setting in seconds. Press the "A" button to increase this value. The settable range is from 0 – 255; when the value reaches 255 it will cycle to "0" and continue climbing. Release when the desired alarm delay appears

C. Identification Parameter (default = 0)

1. Press and hold the "B" button again to view the Identification Parameter, which is not used with Smart Gloveboxes.

D. Purge-Off Delay (default = 30 seconds)

1. To advance to the Purge-Off Delay parameter, press and hold the "B" button. The display should read "**purgG**".

2. Release the "B" button. The display should indicate "30", the factory setting in seconds. Press the "A" button to increase this value. The settable range is from 0 – 255; when the value reaches 255 it will cycle to 0 and continue climbing. Release when the desired alarm delay appears.

3. Press and hold the "B" button. The display will show "**done**" to indicate the end of the parameter set up mode.

4. Release the "B" button to return to Operation Mode. The display will read the current measured relative humidity level inside the chamber. The values that have been established will be stored and reloaded each time the Smart Glovebox is powered up.

5.0 Cleaning and Maintenance

NOTE

Due to the wide range of applications for Terra's Smart Glovebox, the cleaning instructions included in this section are general in nature. Users must develop an appropriate cleaning protocol for their glovebox based on its construction and the chemical/biological substances that will be introduced into the glovebox.

CAUTION

When choosing a cleaning agent, refer to the chemical compatibility at the end of this section to avoid damaging the glovebox surfaces.

- **Do not clean acrylic with alcohol or other strong cleaning agents.**
- **Do not expose static-dissipative PVC to extreme heat or direct sunlight.**
- **A stainless steel shield (sold separately) is required on the bottom of each static-dissipative PVC glovebox chamber to prevent scratching.**

Plastic Smart Glovebox Cleaning

Acrylic and static-dissipative PVC gloveboxes can be periodically cleaned with clean, lukewarm water or a mild, non-abrasive detergent. Use a clean, non-shedding cloth (polyester wipers are recommended) and wipe surfaces in slow, unidirectional motions, folding the soiled surface of the cloth portion to trap contaminant's after each pass. Avoid circular motions when cleaning. Use only light pressure.

Polypropylene and polycarbonate are more resilient to chemicals and are compatible with a wider range of cleaning agents. Refer to the chemical compatibility chart at the end of this section to determine an appropriate detergent.

If the outside of the glovebox is exceptionally dirty or gritty, rinse the surface first by lightly swabbing a saturated cloth over the surface and allowing surfactants to drain away. Avoid rubbing dirt or grit into the surface. Turn the cloth often and replace with a clean cloth frequently. Dry the surface by blotting gently with a clean, dry cloth.

If you clean the inside of the glovebox with water, you should dry the inside surface thoroughly and then purge the cabinet with nitrogen for at least 30 minutes before reintroducing moisture-sensitive stored materials.

Stainless Steel Smart Glovebox Cleaning

Stainless steel should always be cleaned with alcohol (or similar cleaning agent) and a suitable wiper (e.g. nonshedding). Follow the same wiping procedures as outlined above for plastic Smart Gloveboxes.

Special Care Instructions for Static-Dissipative PVC Plating

Although static-dissipative PVC has greater tensile strength the acrylic, it is not as rigid, and so it tends to bow if not supported adequately. For this reason, you should not stack static-dissipative PVC gloveboxes or place heavy objects on top of them.

These gloveboxes should also be kept away from temperature extremes; avoid prolonged exposure to temperatures over 80 degrees Fahrenheit. Always avoid scratching the surfaces.

Smart Glovebox™

This chart is intended as a general guide for various materials and chemicals. It shows some of the materials used in Terra's products and chemicals likely to be used with them. Testing is strongly recommended for extreme conditions of use, such as prolonged exposure or immersion, high temperatures and high concentrations. The acids, caustics and salts in this chart are assumed to be in solution. Materials may react differently to the pure substances (glacial acetic acid, for example).

Explanation for symbols:

- ❍ = **No noticeable effect.**
- ◗ = **Minor effect or slight change in appearance or properties. Test before repeated exposure.**
- ✶ = **No noticeable effect at low concentration and room temperature. Moderate to severe effect at high concentration and/or high temperature. Test before using.**
- ● = **Severe effect or degradation, exposure not recommended.**

Hazards (Only the primary ones are shown. For example, chlorine is not shown as an asphyxiant because its toxicity will kill you first).

- **A** = **Asphyxiant (gases and vapors only)**
- **C** = **Corrosive**
- **F** = **Flammable**
- **O** = **Oxidizer**
- **T** = **Toxic**

			METALS					PLASTICS								
	–HAZARDS–		Aluminum	Brass	Bronze	Copper	304 Stainless Steel	316 Stainless Steel	ABS	Acrylic (plexiglass)	CPVC	Noryl	Nylon	Polycarbonate	Polyethylene	Polypropylene
ACIDS	Acetic	C	◗	●	◗	◗	●	✶	●	✶	✶	❍	●	✶	●	
	Aqua Regia	C	●	●	●	●	●	●	●		◗	●	●	●	●	
	Chromic	C	●	●	●	●	◗	◗	◗	◗	✶	✶	●	✶	✶	
	Hydrochloric	C	●	●	●	●	●	●	✶	❍	✶	❍	●	✶	✶	
	Hydrofluoric	C	●		◗	◗	◗	◗	●	◗	●	✶	●	●	✶	
	Nitric	C	●	●	❍	●	❍	❍	●	✶	✶	✶	●	✶	✶	
	Phosphoric	C	◗	●	◗	●	●	●	●		✶	❍	●	❍	✶	
	Sulfuric	C	●		◗	●	●	●	✶	✶	✶	❍	●	✶	✶	
CAUSTICS	Ammonium Hydroxide	C	◗	●	●	●	❍	❍	◗	❍	✶	❍	❍	●	✶	
	Potassium Hydroxide	C	●	●	●	◗	◗	❍	◗		❍	❍	◗	●	❍	
	Sodium Hydroxide	C	●	●	◗	●	◗	◗	◗	❍	✶	❍	✶	✶	✶	
GASES	Air	O	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	
	Ammonia	C,F,T	❍	●	●	●	❍	❍	◗		✶	◗	❍	●	●	
	Argon	A	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	
	Carbon Dioxide	A	❍	❍	❍	❍	❍	❍	◗		✶	❍	❍	❍	✶	
	Carbon Monoxide	F,T	❍	❍	❍	❍	❍	❍			✶	❍	❍		✶	
	Chlorine	C,T	●	●	●	●	❍	❍			●	●	●	❍	●	
	Flourine	C,O,T	✶	✶	◗	✶	❍	❍	❍		✶		●	◗	●	
	Helium	A	❍	❍	❍	❍	❍	❍	❍	❍	✶	❍	❍	❍	❍	
	Hydrogen	A,F	❍	❍	❍	❍	❍	❍			✶	❍	❍	❍	◗	
	Hydrogen Sulfide	C,F,T	❍	❍			❍	❍	◗		✶		●	◗	✶	
	Methane	A,F	❍	❍	❍	❍	❍	❍			✶	●	❍		❍	
	Nitrogen	A	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	
	Nitrous Oxide	O	❍	❍	❍	❍	❍	❍			✶		◗		❍	
	Ozone	O	◗		◗	❍	◗	❍	❍		❍	❍	●	●	❍	
	Propane	A,F	❍	❍	❍	❍	❍	❍			❍	❍	❍	◗	❍	
OXIDANTS	Hydrogen Peroxide	O	❍	●	◗	●	◗	❍	❍	❍	✶	❍	●	❍	❍	
	Sodium Hypochlorite	O	●	●	◗		✶	✶	◗	❍	✶	❍	●	◗	✶	
SALTS	Ammonium Nitrate		◗	●	●	●	❍	❍	❍		✶	❍	●	❍	✶	
	Ammonium Persulfate		●	●	●	●	●	◗	❍		✶	❍	●		✶	
	Sodium Carbonate		●	◗	❍	❍	❍	❍	✶	❍	✶	❍	❍	❍	❍	
SOLVENTS	Acetone	F	❍	❍	❍	❍	❍	❍	●	●	●	●	❍	●	●	
	Carbon Tetrachloride	T	●	❍	❍		◗	◗	●	◗	●	●	●	●	●	
	DI Water		❍	❍		◗	❍	❍	❍	❍	❍	❍	❍	❍	❍	
	Ethyl Alcohol	F	◗	❍	❍	❍	❍	❍	❍	◗	◗	❍	❍	◗	✶	
	Ethylene Glycol		❍	◗	❍	❍	◗	◗	◗		✶	❍	❍	❍	◗	
	Glycerine		❍	◗	❍	❍	❍	❍	◗		✶	❍	❍	❍	◗	
	Isopropyl Alcohol	F	◗		❍	◗	◗	◗		◗	◗	❍	●	❍	✶	
	Kerosene	F	❍	❍	❍	◗	❍	❍	◗	❍	✶	●	❍	✶	✶	
	Methyl Alcohol	F,T	❍	❍	❍	◗	❍	❍	●	◗	✶	❍	❍	◗	✶	
	Methyl Ethyl Ketone	F	◗	❍	❍	❍	❍	◗	●		●	●	◗	●	●	
	Toluene	F	❍	❍	❍	❍	❍	❍	●	●	●	●	❍	●	●	
	Trichloroethane	A	●		❍		◗	◗				●	◗	●	❍	

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		PLASTICS (Cont.)								RUBBER & SYNTHETICS (ELASTOMERS)										
		Polymethylpentene (TPX)	Polypropylene	Polystyrene	PPS (Ryton)	PVC, Static Dissipative PVC	Styrene Acrylonitrile (SAN) PVDF (Kynar)	Teflon, PTFE		Buna N	EPDM	Hypalon	Natural Rubber	Neoprene	Nitrile	PVA (Polyvinyl Alcohol)	Tygon	Silicone	Viton
ACIDS	Acetic	✶	✶	❍	✶	✶	❍	✶	❍	❍	◗	❍	✶	✶	✶	◗	●	●	◗	✶
	Aqua Regia		●		●	●		❍		❍	●	◗	◗	●	✶	✶	●	●	●	✶
	Chromic	✶	✶	●	❍	✶		❍	✶	❍	●	◗	◗	●	●	◗	●	◗	◗	✶
	Hydrochloric	✶	✶	✶	●	✶	❍	✶	❍	❍	◗	✶	✶	❍	✶	◗	●	●	●	✶
	Hydrofluoric	✶	❍	✶	❍	✶	✶	✶		❍	●	●	◗	✶	●	❍	●	●	●	✶
	Nitric	✶	✶	●	●	✶	❍	✶	◗	❍	●	✶	✶	●	●	✶	●	●	●	✶
	Phosphoric	❍	◗	❍	●	◗	❍	✶		❍	●	◗	◗	◗	✶	✶	●	●	●	✶
	Sulfuric	❍	✶	✶	✶	✶	✶	✶	❍	❍	✶	✶	✶	✶	✶	●	●	●	●	✶
CAUSTICS	Ammonium Hydroxide	❍	❍		❍	✶	❍	✶	❍	❍	❍	❍	❍	✶	✶	❍	●	❍	❍	●
	Potassium Hydroxide		❍		✶	✶	❍	✶		❍	◗	❍	❍	❍	❍	❍	●	◗	◗	◗
	Sodium Hydroxide	❍	◗	❍	◗	✶	❍	✶		❍	✶	◗	❍	❍	✶	❍	●	◗	❍	✶
GASES	Air	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
	Ammonia	❍	◗		✶	❍	❍	✶		❍	◗	❍	●	●	❍	❍		❍	◗	●
	Argon	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
	Carbon Dioxide	❍	◗	❍	❍	✶	❍	✶		❍	✶	✶	✶	✶	✶	✶			✶	✶
	Carbon Monoxide		◗		❍	✶	❍	✶		❍	❍	❍	◗	●	✶	✶			❍	✶
	Chlorine	●	●		●	●	●	✶		❍	◗	❍	●	●	●			◗	●	✶
	Flourine		●		❍	●	●	✶		●	●	❍		◗	●				●	✶
	Helium	❍	◗	❍	❍	✶	❍	✶	❍	❍	❍	❍	❍	❍	✶	❍	❍	❍	❍	❍
	Hydrogen		◗		✶	✶	❍	◗		❍	❍		❍	✶	✶			❍	◗	✶
	Hydrogen Sulfide		◗		◗	✶		✶		❍	●	◗	◗	◗	●			●	◗	✶
	Methane		◗		❍	✶		✶		❍	❍	●	◗	●	✶				●	✶
	Nitrogen	❍	❍		❍	❍	❍	●		❍	❍	❍	❍	❍	✶	❍		❍	❍	✶
	Nitrous Oxide		●		❍	✶		❍		❍	❍				●					✶
	Ozone		◗			◗		❍		❍	●	❍	❍	●	◗				❍	✶
	Propane		◗		❍	✶	❍	✶		❍	❍	●		●	✶				●	✶
OXIDANTS	Hydrogen Peroxide	✶	✶	❍	●	●	✶	✶		❍	●	✶	●	◗	●	❍	●	◗	✶	✶
	Sodium Hypochlorite	❍	✶	❍	●	✶	❍	✶	❍	❍	◗	◗	✶	◗	✶		●	◗	◗	✶
SALTS	Ammonium Nitrate	❍	✶	❍	❍	✶	❍	✶	❍	❍	❍	❍	❍	◗	◗	❍	●	❍	◗	✶
	Ammonium Persulfate		✶		❍	✶	❍	✶	❍	❍	❍	◗	❍	❍	✶	❍	●	❍	●	✶
	Sodium Carbonate	❍	✶	❍	✶	✶	❍	✶	❍	❍	❍	❍	❍	❍	✶		●	◗	❍	✶
SOLVENTS	Acetone		❍	●	✶	●	●	●	●	❍	●	❍	◗	◗	✶	✶	●	●	◗	●
	Carbon Tetrachloride	●	●	●	❍	●	●	✶		❍	◗	◗	●	●	✶	✶	❍		●	✶
	DI Water		❍		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		●	❍	❍	❍
	Ethyl Alcohol		✶		❍	◗	❍	❍	◗	❍	◗	❍	❍	❍	✶	❍	●	◗	◗	✶
	Ethylene Glycol	❍	◗	❍	✶	✶	❍	✶		❍	❍	❍	❍	❍	✶	❍	◗	◗	❍	✶
	Glycerine		◗	❍	✶	✶	❍	✶	❍	❍	❍	❍	❍	❍	✶	❍	◗	❍	❍	✶
	Isopropyl Alcohol		✶			◗	❍	✶		❍	◗	❍	❍	❍	✶	❍	●	❍	❍	✶
	Kerosene		●		✶	◗	❍	✶		❍	❍	●	●	●	●	❍	◗	●	●	✶
	Methyl Alcohol		✶		❍	◗	❍	✶	●	❍	◗	❍	❍	❍	✶	❍	●	❍	◗	✶
	Methyl Ethyl Ketone	◗	✶	●	✶	●	●	●	●	❍	●	❍	●	✶	●	●	◗	●	●	●
	Toluene	●	●	●	✶	●	●	✶	●	❍	●	●	●	●	✶	✶	◗	●	●	✶
	Trichloroethane		◗			●	❍	❍	❍	❍	●	●	●	●	✶	✶	◗		●	❍

6.0 Repair and Replacement

Replacing Glovebox Doors
Under normal operating conditions, with a safely regulated inlet line pressure (15 psi max.), TUI gloveboxes should operate for years.

If your glovebox should experience warping, you should first attempt to determine the cause. Does your system incorporate an Automatic RB Valve? Is the pressure of incoming nitrogen set too high?

Call Terra Universal for any required replacement doors (we will need the model number, which is printed on a label affixed to the lower right side of every standard TUI glovebox). To replace a door, simply remove the screws that hold the door in place and reinstall the new door. The back panel is similarly secured by a number of screws; make sure that you do not over-tighten these, or the acrylic will crack!

Testing and Replacing Humidity Sensor
If a discrepancy is observed between the displayed %RH and that of an independent humidity calibrator, the humidity scale can be compensated accordingly (see "Set-Up" instructions above).

The NitroWatch humidity sensor requires no calibration. The sensor should be tested periodically and replaced as necessary (about every 5 years under normal use).

Mounting the Gloves to the Glove Box
Normally, the gloves are installed in the glove box prior to shipping. To replace them, follow these instructions:

1. Insert the gove into the glove box, allowing 2" of sleeve to extend beyond the front edge of the mounting flange.

2. Fold the outside edge of the sleeve over the flange, so that roughly 2" of the sleeve cuff is stretched along the outside perimeter of the flange.

3. The sleeve is held in place by a stainless steel clamp (TUI Cat. No. 1689-40). Position this clamp along the mounting flange so that about 1" of excess sleeve cuff protrudes on the inside edge of the flange (the edge closest to the front wall of the glove box). Carefully tighten the clamp just enough to hold the sleeve in place.

4. Fold back the excess sleeve cuff toward the front edge of the flange to cover the clamp. Repeat procedure for the other glove.

CAUTION

Over-tightening the clamp could crack or warp the flange and damage the glove box.

7.0 Warranty

Products Manufactured by Terra: Terra Universal, Inc., warrants products that it manufactures to be free from defects for a period of 12 months for parts and 90 days for labor, commencing from the date of shipment. Terra's sole responsibility is to repair or replace, at its option, any part of the product that proves defective or malfunctioning during this time limit. In some cases, components incorporated in Terra Universal products are covered by additional warranties from component manufacturers; obtain specific information from Terra sales representatives. This warranty is void if the equipment is abused or modified by the customer, is operated outside Terra's operating instructions or specifications, or is used in any application other than that for which it is specified. This warranty does not include routine maintenance or service procedures, breakage of quartz baths after 60 days, shipping damage, nor damage from misuse, intentional or unintentional abuse, neglect, natural disasters, or acts of God.

Products Manufactured by Others: Terra Universal, Inc., warrants that, to the best of its ability, Terra's representations of products that are manufactured by others reflect the manufacturer's representations, subject to change without notice. Sole warranty for these products is the original manufacturer's warranty that is passed forward to the purchaser and constitutes the customer's sole remedy for these products. Detailed warranties for distributed products are available through Terra sales representatives.

Freight Shortage or Damage: Upon receipt of any equipment from Terra Universal, Inc., customer shall immediately unpack and inspect for damage or shortage. The customer shall not accept a damaged package or a short shipment until the carrier makes a "damage or shortage" notation on both the carrier's and customer's copy of the freight bill or delivery receipt. Service title passes when the shipment is loaded, so customer is responsible for filing and collecting a freight claim. Any replacement products must be ordered and paid for separately. For Terra's "Policy and Procedures for Returning Goods," see Terra's Internet site: www.TerraUniversal.com.

Generally, customers can improve the chance of collecting on a freight claim by following these procedures: 1) formally requesting that the carrier inspect the shipment immediately upon suspecting damage or shortage to verify condition; 2) notifying the carrier upon discovery of concealed damage and requesting an inspection within 15 days of receipt, both in person or phone and following up via mail; 3) keeping the shipment as intact as possible, including retaining original packaging materials and keeping the product as close to the original receiving location as possible; 4) holding salvage for disposition by the carrier.

All Claims: Terra Universal expressly disclaims all other warranties, expressed or implied or implied by statute, including the warranties of merchantability or fitness for intended use. Terra Universal is not responsible for consequential or incidental damages arising out of the purchase or use of the products supplied by Terra Universal. Terra Universal is not liable for damage to facilities, other equipment, products, property or personnel of others, or of their agents, suppliers, or affiliated parties, which is caused or alleged to have been caused by products supplied by Terra Universal. In any event or series of events, Terra Universal's total liability for any and all damages whatsoever is limited to the lesser of the actual damages or the original invoice cost of the items alleged to have caused the damage. The customer's sole and exclusive remedy for any cause of action whatsoever is repair or replacement of the non-conforming products or refund of the actual purchase price, at the sole option of Terra Universal. All claims must be made in writing within 90 days of the date the product was shipped. Any claims not made within this time limit shall be deemed waived by the customer. Terra Universal is not responsible for any additional costs of repair caused by poor packaging or in-shipment damage during return.

Warranty Returns: All warranty returns must be authorized in advance by Terra Universal and approved under an RMA. Unless approved in advance for good reason, all returns must be in original condition, including all manuals, and must be packaged in original packaging materials. All returned goods are to be shipped to Terra Universal, freight prepaid at customer's expense. See Terra's "Policy and Procedure for Returned Goods."

Thank You for ordering from
Terra Universal!