



**VACUUM OVENS**  
**Microprocessor Controller**

Models: **TVO-1, TVO-2, TVO-5**

Installation and Operation Manual  
Rev 03.07

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# TABLE OF CONTENTS

<b>SECTION 1.0</b>	RECEIVING AND INSPECTION
<b>SECTION 2.0</b>	GRAPHIC SYMBOLS/PRECAUTIONS
<b>SECTION 3.0</b>	INSTALLATION
<b>SECTION 4.0</b>	CONTROL PANEL OVERVIEW
<b>SECTION 5.0</b>	OPERATION
<b>SECTION 6.0</b>	MAINTENANCE
<b>SECTION 7.0</b>	VACUUM REFERENCE TABLE
<b>SECTION 8.0</b>	TROUBLESHOOTING
<b>SECTION 9.0</b>	OPTIONAL FEATURES
<b>SECTION 10.0</b>	PARTS LIST
<b>SECTION 11.0</b>	UNIT SPECIFICATIONS
<b>SECTION 12.0</b>	WIRE DIAGRAM
<b>SECTION 13.0</b>	WARRANTY



## SECTION 1

# RECEIVING AND INSPECTION









This is a general-purpose vacuum oven for professional, industrial or educational use. It is suitable for a working environment where the preparation/testing of materials is done at approximately atmospheric pressure, and no flammable, volatile or combustible materials are being heated. This oven is not intended for hazardous or household locations or use.

**Your satisfaction and safety require a complete understanding of this unit. Read the instructions thoroughly and be sure all operators are given adequate training before attempting to put the unit in service. This equipment must be used only for its intended application; ANY ALTERATIONS OR MODIFICATIONS WILL VOID YOUR WARRANTY.**

- 1.1 Inspection:** The carrier accepts responsibility for safe delivery and is liable for loss or damage. On delivery, inspect for visible exterior damage, note and describe on the freight bill any damage found, and enter your claim on the form supplied by the carrier.
- 1.2 Return Shipment:** Save the shipping crate until you are sure all is well. If for any reason you must return the unit, first contact your customer representative for authorization. Supply nameplate data, including model number and serial number.
- 1.3 Accessories:** Verify that all of the equipment indicated on the packing slip is included with the unit. Carefully check all packaging before discarding. The oven is equipped with shelves. Vacuum pump and connection kits are sold separately and may ship separately.

**SECTION 2****GRAPHIC SYMBOLS / PRECAUTIONS**

Your oven is provided with a display of graphic symbols to help in identifying the use and function of the available adjustable components.

- 2.1  This symbol indicates that you should consult your manual for further description of a control or user item.
- 2.2  Indicates “**AC Power**”.
- 2.3  Indicates “**Temperature**”
- 2.4  Indicates “**Over Temperature Protection**”
- 2.5  Indicates “**Vacuum**”
- 2.6  Indicates “**Earth Ground**”
- 2.7  Indicates “**Potential Shock Hazard**”
- 2.8  Indicates “**Unit should be recycled**” (Not disposed of in land-fill)



**2.9 Precautions:**

**2.9.1 THIS IS NOT AN EXPOLOSION PROOF OVEN.**

2.9.2 Do not place or use explosive, combustible, or flammable materials in the oven.

2.9.3 Do not use sealed containers in the oven chamber.

2.9.4 Disconnect the unit from electrical power source before attempting to make any repairs, cleaning or component replacements.

2.9.5 If a mercury thermometer is used and breakage should occur, all spilled mercury must be completely removed from the chamber.

**2.9.6 This oven IS NOT suitable for use in Class I, II, or III locations as defined by the National Electrical Code NFPA 70, U.S.A.**

2.9.7 **Door Gasket Precaution:** Although the max temp of the oven is rated between 260C to 300C, the door gaskets will degrade rapidly if the oven is run at such high temperatures. Under vacuum, water actually boils at temperatures as low as 20C, and the boiling process starts as soon as the vacuum pump starts. It should not be necessary to run the oven to such extreme temperatures and risk compromising the gasket material.

<b>Gasket Material</b>	<b>Color</b>	<b>Application</b>	<b>Max Temp</b>
Silicone (standard)	Red/Orange/Black/Grey	High Temp	230C
Flouro-Silicone (Optional)	Black	Acid Resistant	200C
Buna (Optional)	Black	Solvent Resistant	125C

**Refer to Section 10 Parts List, for a complete Vacuum Gasket Selection Guide**



## SECTION 3

# INSTALLATION

Local city, county or other ordinances may govern the use of this equipment. If you have any questions about local requirements, please contact the appropriate local agency.

Under normal circumstances this unit is intended for use indoors, at room temperatures between 5° and 40°C, at no greater than 80% Relative Humidity (at 25°C) and with a supply voltage that does not vary by more than 10%. Customer service should be contacted for operating conditions outside of these limits.

- 3.1 Power Source:** The electrical supply circuit to the vacuum oven must conform to all national and local electrical codes. Consult the oven's data plate for the voltage, cycle, and amperage requirements before making connection. VOLTAGE SHOULD NOT VARY MORE THAN 10% FROM THE DATA PLATE RATING. This unit is intended for 50/60 Hz operation. A separate circuit is strongly recommended to prevent possible loss of product due to overloading or failure of other equipment on the same circuit.
- 3.2 Location:** When selecting a site for the oven, consider all conditions that may affect performance, such as extreme heat from radiators, stoves, other ovens, autoclaves, etc. Avoid direct sun, fast-moving air currents, heating/cooling ducts, and high traffic areas. To ensure proper air circulation around the unit, allow a minimum of 30 cm between the oven and any walls or partitions that might obstruct free airflow.
- 3.3 Lifting / Handling:** This unit is heavy and care should be taken to use appropriate lifting devices sufficiently rated for this load. Please see section 11, Unit Specifications for weight information. Units should only be lifted from their bottom surfaces. Doors, handles and knobs are not adequate for lifting or stabilization. The unit must be completely restrained from tipping during lifting or transport. All moving parts, such as shelves and trays should be removed and doors need to be positively locked in the closed position during transfer to prevent shifting and damage.
- 3.4 Leveling Feet:** The oven comes with 4 each leveling feet for installation. These are bagged separately. In this bag you will also find two inserts for the vacuum and vent connections on the back of the oven. Refer to Section 3.8 for connection details.

- 3.5 Cleaning:** The oven interior was cleaned at the factory, but not sterilized. Remove shelves and shelf slides, if installed, and clean with a disinfectant that is appropriate for your application. **WARNING:** Never clean the unit with alcohol or flammable cleaners with the unit connected to the electrical supply. Always disconnect the unit from the electrical service when cleaning and assure all volatile or flammable cleaners are evaporated and dry before reattaching the unit to the power supply.

**NOTICE: REMOVE the protective film on the shelves prior to use.**

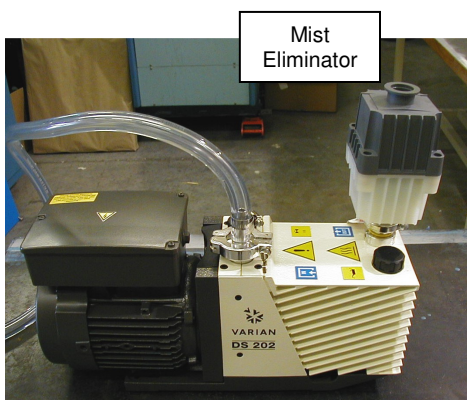
- 3.6 Shelf Placement:**  
**Shelves with brackets (TVO-5):** Place shelves in the oven along the side mounting brackets.

**Stackable shelves (TVO-1, TVO-2):** The smaller shelf with the bracket is to be placed on the bottom. The bracket is for the temp probe. The bottom shelf fits just over the top of the probe. The remaining shelves stack on top of the bottom shelf. Additional shelves can be ordered directly from Cascade TEK.

- 3.7 Connecting Vacuum Pump:** The Vacuum pump for the TVO Vacuum Ovens are sold separately. The Vacuum pump will require its own power source, typically 120V or 220V. If you have a pump that you intend to use for this application, all maintenance and instructional information should be obtained by the pump manufacturer and adhered to.

“Vacuum Interconnect Kit” is an available accessory. It contains the vacuum fittings, mist eliminator (for oil pump exhaust) and clamps to connect a pump to the TVO Ovens. This kit is sold as a convenience. It does not imply that the kit will accommodate any vacuum pump, as individual operating requirements may vary.

**Typical Oil Pump Connection: (Sold As Options)**

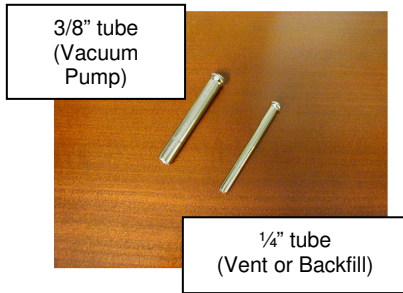
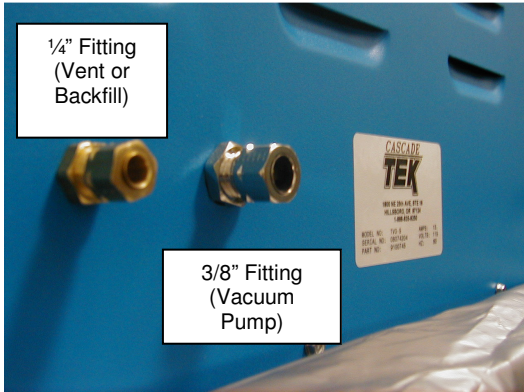


*Pictured:* Mist Eliminator mounted on top of Vacuum Pump. (Oil pump exhaust)

*Not Pictured:* Foreline Trap. **CAUTION:** If vacuum pump is off while vacuum valve is open, oil may backstream into the oven workspace. Install a foreline trap to prevent oil from contaminating the oven interior. Consult Vacuum Pump Manual for installation details.



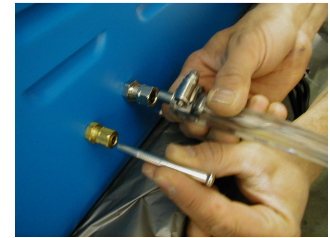
### 3.8 Vacuum Connections From Oven:



Locate the fittings at the rear of the oven as pictured. Locate the 1/4" and 3/8" diameter Vacuum tube(s) packaged inside the oven. These tubes are barbed at the end for easy connection. Insert the vacuum tubes into the fittings. Carefully tighten. The 3/8" barbed vacuum tube also inserts into the vacuum pump hose (see picture).

The larger 3/8" connection corresponds to the **large valve** on the front instrument panel and is recommended for the vacuum line.

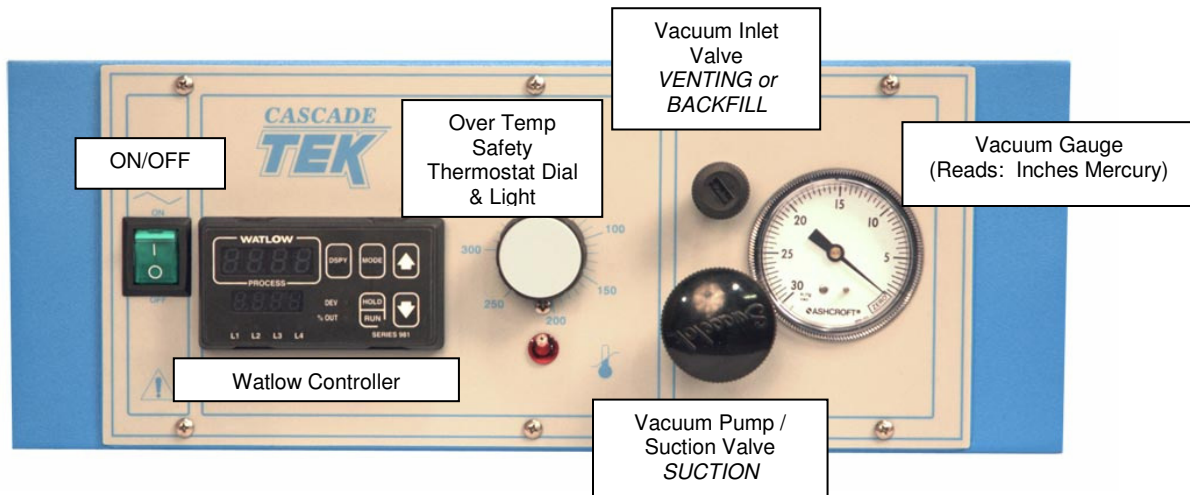
The 1/4" connection corresponds to the **smaller valve** on the front instrument panel and is recommended for venting. If you do not plan to back fill the oven with nitrogen, no hose is needed for the vent line. See Section 5.9 for backfill information.





## SECTION 4

# CONTROL PANEL OVERVIEW



- 4.1 Main Power Switch (On / Off):** The main power (I/O) switch is marked with the POWER symbol and controls power to the unit. It must be in the “I”, or ON position before any systems are operational.

*Note:* The Vacuum Pump must be powered separately and turned on or off independently. It is recommended to keep the vacuum pump on during the vacuum process.

- 4.2 Watlow Controller (Main Temperature Control):** This is a microprocessor based temperature/time controller with ramp and soak capabilities. The Watlow controller has digital displays and front panel controls for inputting set point temperature, calibration and program configurations. Detailed instructions are in the **Watlow Manual** included with your instruction packet. Additional details available in Section 5.14 “Quick Start” Example.
- 4.3 Over-Temperature Safety Thermostat:** This control is marked with a graduated dial. It is independent of the Main Controller and guards against a failure where the oven temperature exceeds the Main Controller set point. See Section 5.11 on how to set this thermostat.

- 4.4 Over-Temperature Safety Light:** This pilot lamp is directly below the Over-Temperature Safety Thermostat. The light will come on when the Safety Thermostat has been activated and taken control of the oven temperature. Under normal operating conditions this pilot lamp may blink during heat up, but should **never** be on.
- 4.5 Vacuum Gauge:** This bourdon tube vacuum gauge shows the chamber vacuum level in measurements of "Hg (Inches Mercury). See Section 5.8 for details.
- 4.6 Vacuum Pump/Suction Valve:** The LARGE Valve located just below the smaller vacuum inlet valve. It controls the vacuum of the chamber when opened counterclockwise and the pump is operating. This knob opens the suction line that should be connected to the 3/8" tube at the rear of the vacuum oven. See Section 5.7 for details.

**CAUTION:** If vacuum pump is off while vacuum valve is open, oil may backstream into the oven workspace. It is recommended to keep the vacuum pump on during the process.

**Note:** *Disregard this connection if you intend to use the 1" vacuum/accessory port located in the rear center of the oven for your main vacuum connection.*

- 4.7 Vacuum Inlet/Vent Valve:** The SMALL Valve located to the left of the vacuum gauge. This knob allows for venting the oven or to use an inert gas backfill. When turned clockwise, this valve releases vacuum in the chamber, returning it to atmospheric pressure. This valve must be closed (clockwise) when evacuating the chamber. The connection for this valve is at the back of the oven at the smaller 1/4" fitting. See Section 5.9 for details.

## SECTION 5

# OPERATION

A vacuum oven is one of the most challenging temperature controlled devices to understand. In an atmosphere void of ambient conditions (under vacuum), it is possible to dry samples at much lower temperatures than with a conventional oven. For example, under vacuum, water can boil at room temperatures! Because drying under vacuum occurs at lower temperatures, please also refer to Section 2.9 on maximum gasket temperatures.

Vacuum ovens transfer heat through contact or conduction heating. Since there is no air in the vessel under vacuum, the heating elements heat the walls and radiate thru the chamber.

- 5.1 **Power Supply:** The oven power requirements are listed on the data plate. THE POWER SUPPLY SHOULD NOT VARY MORE THAN  $\pm 10\%$  from this rating.
- 5.2 It is important to use vacuum rated tubing for all the vacuum hookups. Other types of tubing may collapse and prevent complete evacuation. All plumbing connections to the pump must be solid and tight to eliminate possible leakage.
- 5.3 When placing objects or samples within the chamber, be mindful of the sensing probes mounted on the back wall. Any pressure against them can cause breakage and replacement will be necessary.
- 5.4 The door should be closed and latched by swinging the latching arm into place until it grabs and the door is snug against the body.
- 5.5 **Vacuum Pump Connection to Power Supply:** Insure that the electrical power supply is properly configured and rated for the vacuum pump.
- 5.6 **Flip the POWER switch to the ON position.** The digital temperature display will indicate a temperature value. It should light up if properly connected to the power supply.
- 5.7 **Apply Vacuum to the Chamber:** Close the VENT valve by turning it fully clockwise (right). Turn the Vacuum pump ON and open the **Vacuum Pump/Suction Valve** (LARGE Valve) by turning it fully counterclockwise (left).

**Note:** *Ultimate vacuum levels may take some time. This is especially true if the contents in the chamber have oil or moisture in them. Absolute vacuum for most applications is equal to 0 torr, or 30" Hg. The time needed to fully evacuate the oven depends on many factors: pump and vacuum line size and what you put in the chamber. Remember, the process of boiling off water begins as soon as the vacuum pump starts.*

- 5.8 Full Vacuum:** Watch the vacuum gauge display, and when "ultimate" vacuum is achieved, the needle on the dial will be at or near 30" Hg. Leave the vacuum pump on during the entire process.

**CAUTION:** If vacuum pump is off, while vacuum valve is open, oil may backstream into the oven workspace.

- 5.9 Oven Venting or Backfilling:** Utilize the Vacuum Inlet/Vent Valve (SMALL Valve) located to the left of the vacuum gauge. This knob allows for venting the oven to atmosphere or to introduce an inert gas backfill. When turned clockwise, this valve releases the vacuum in the chamber, returning it to atmospheric pressure. This valve must be closed (counter-clockwise) when evacuating the chamber. The connection for this valve is at the back of the oven (smaller 1/4" fitting).

**CAUTION:** If vacuum pump is off, while vacuum valve is open, oil may backstream into the oven workspace. Install a foreline trap to prevent oil from contaminating the oven interior. Consult Vacuum Pump Manual for installation details.

**NOTE:** Venting to atmosphere with ambient, room air is not possible if a backfill connection is made to the 1/4" fitting (Allowing the introduction of GN2 rather than air as a backfill). An additional valve allowing the oven to vent must be added to the line connections.

**Backfill Method:** A vacuum is drawn and the valve is then closed. Gas is connected to the vent line. The vent line and the vacuum line are opened, displacing atmosphere inside the vessel with inert gas. When the prescribed amount of gas is in the chamber, the vent and vacuum valve are closed, preserving the gaseous atmosphere in a stationary condition. Small penetrations located inside the oven cavity allow for the introduction of gas.

**Purge Method:** Pull desired vacuum level, then open both the vent and vacuum valve slightly – while leaving the pump running continuously. With the combined pumping and gassing action, gas is drawn through the chamber in a constant motion.

- 5.10 Set Main Temperature Controller:** Please refer to the *Watlow Controller Manual* supplied with your oven for programming and more detailed information regarding the controller. Two important points of reference are the sections pertaining to **KEY FUNCTIONS** and **SIMPLE SET POINT OPERATION**. The Watlow controller is capable of storing and running up to 24 steps of ramp and soaks temperature profiles.

To enter the desired set point temperature press either the Up or Down arrow pad until the desired temperature appears in the lower digital display window of the controller.

**Note:** *The controller is configured in °C.*

The upper digital window displays the process temperature (the temperature inside the oven.) Five to ten seconds after you change the temperature set point the controller will initiate the change. If heat is called for, the LED next to L1 will light. This is the main heater circuit. When this light is on, the oven is calling for heat.

See Section 5.14 for a “Quick Start” Example.

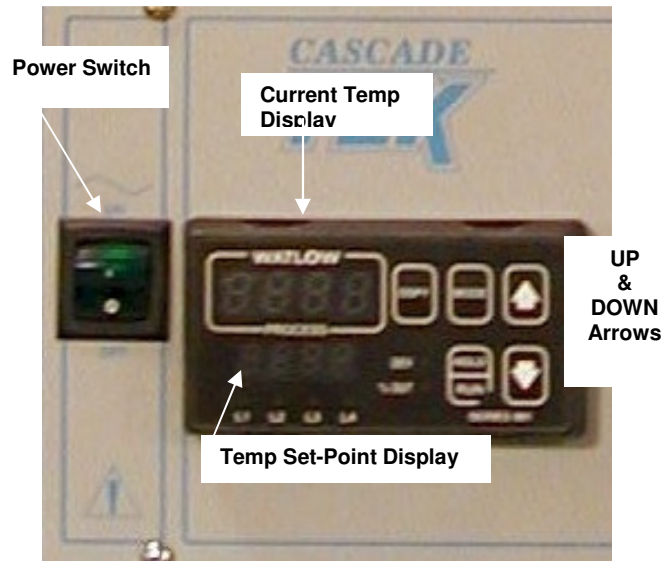
**Note:** *Slight vapor or smoke may occur in the initial heat-up. This is a normal occurrence when the oven is first brought up to temperature and protective coatings on the elements become hot.*

- 5.11 Set Over-Temperature Safety Thermostat (OTP):** The OTP should be initially set to its maximum position (all the way to the right) to allow the unit to stabilize.
- 5.12** Once the oven is stable at the desired set point, turn the OTP knob left (counterclockwise) until the OTP light turns ON.
- 5.13** Next, turn the OTP knob back to the right (clockwise) just until the OTP light turns OFF and continue turning the OTP knob to the right another hash mark. This sets the Safety Thermostat at a temperature approximately 10°C above the Main Temperature set point. Note that the OTP Safety is in series with the output from the control relay, and the OTP light will be blinking when the Main Temperature Controller is calling for heat.

**Note:** *The scale on the dial is for reference only and does not correlate to the temperature reading of the main controller.*

### 5.14 Quick Start Controller Operation Example

1. Turn on the power switch (located at the left of the instrument panel) It should glow with a green light if it is connected to the power correctly.
2. The “Process” window (upper window on your Watlow 981 controller) will display the current chamber temperature.
3. The lower window of your controller will indicate the current temperature set point.
4. To increase the set point, press the UP arrow key until the desired set point is displayed in the lower controller window.
5. To decrease the set point, press the down arrow key until the desired set point is displayed in the lower controller window.
6. The oven will heat to your selected set point and remain there until changed. Note: The set point will not change even if the power is turned on and off.
7. Please refer to the enclosed Controller manual for complete instructions.





### SIMPLIFIED 981 INSTRUCTIONS

THE 981 IS A MICROPROCESSOR BASED RAMP AND SOAK, PROGRAMMABLE TEMPERATURE CONTROLLER. IT IS CAPABLE OF BEING PROGRAMMED WITH UP TO FOUR PROFILES. A RAMP IS A CONTROLLED CHANGE IN TEMPERATURE OVER A SPECIFIED PERIOD OF TIME. A SOAK IS A HOLD AT PARTICULAR TEMPERATURE FOR A SPECIFIED PERIOD OF TIME WITH UP TO SIX STEPS EACH. PROFILES CAN BE LINKED FOR PROGRAMS NEEDING MORE STEPS UP TO A TOTAL OF 21 RAMPS OR SOAKS.

### SINGLE TEMPERATURE OPERATION

NORMALLY, AN AVERAGE USER ONLY WANTS TO OPERATE THE OVEN AT ONE TEMPERATURE. WHEN THE OVEN IS TURNED ON THE CONTROLLER WILL SHOW THE TEMPERATURE WITHIN THE OVEN ON THE TOP DISPLAY. THE BOTTOM DISPLAY WILL SHOW THE SETPOINT. THE CONTROLLER WILL MAINTAIN THE TEMPERATURE WITHIN THE OVEN TO WHATEVER THE LOWER DISPLAY IS SET FOR. TO CHANGE THE SETPOINT PRESS THE UP OR DOWN KEYS UNTIL THE DESIRED TEMPERATURE IS DISPLAYED IN THE LOWER DISPLAY.

### TIMED OPERATION

SOMETIMES A USER WILL WANT TO OPERATE THE OVEN AT A GIVEN TEMPERATURE FOR A SPECIFIED PERIOD OF TIME AND THEN COOL OFF. TO DO THIS, A SMALL PROGRAM MUST BE PUT INTO THE CONTROLLER.

BEFORE ATTEMPTING TO PROGRAM THE CONTROLLER IT IS HELPFUL TO LEARN A SMALL AMOUNT ABOUT HOW THE CONTROLLER IS PROGRAMMED.

THE CONTROLLER HAS THREE MAIN MENUS. (SEE THE USERS MANUAL FOR IN DEPTH INFORMATION). THESE ARE THE SETUP MENU, FACTORY MENUS, AND THE OPERATION MENU.

THE SETUP MAIN MENU HAS FOUR SUB MENUS, INPUT, OUTPUT, GLOBAL AND COM. THESE ARE ALL PREPROGRAMMED AT THE FACTORY AND SHOULD NEED NO ADJUSTMENT UNDER MOST CIRCUMSTANCES. THE FACTORY MENU SHOULD NEVER BE ACCESSED OR CHANGED BY ANYONE OTHER THAN AN AUTHORIZED FACTORY REPRESENTATIVE.

THE OPERATION MENU HAS THREE SUB MENUS. SYSTEM, P.I.D. AND PROGRAM. THE SYSTEM AND THE P.I.D. MENUS ARE FACTORY PRESET AND SHOULD NOT NEED ANY ADJUSTMENT UNDER NORMAL CIRCUMSTANCES. THE THIRD SUB MENU UNDER THE OPERATION MENU IS PROGRAM AND THIS IS WHERE YOU PROGRAM YOUR RAMP AND SOAK PROFILES.



THE PROGRAM SUB MENU IS USED TO INPUT TIME AND TEMPERATURE STEPS INTO THE CONTROLLER. THE FIVE TYPES OF STEPS THAT CAN BE PROGRAMMED ARE SETPOINT, SOAK, JUMP LOOP AND END. A SETPOINT STEP INPUTS THE TEMPERATURE DESIRED AND THE TIME TAKEN TO GET TO THAT TEMPERATURE. A SOAK STEP ONLY INPUTS THE AMOUNT OF TIME THAT THE TEMPERATURE IN THE PREVIOUS STEP IS MAINTAINED. A JUMP LOOP TELLS THE CONTROLLER TO JUMP TO ANOTHER STEP. A LINK FILE JUMPS TO ANOTHER PROFILE AND END STEP ENDS THE PROGRAM.

IN PROGRAMMING, EACH STEP IS A SERIES OF COMMANDS. FOR A SETPOINT STEP THE COMMANDS ARE SP(SETPOINT), HOUR(HOURS), MIN(MINUETS), SEC(SECONDS), ENT3(EVENT THREE THE POWER EXHAUST OUTLET). THE SETPOINT IS THE TEMPERATURE THAT YOU WANT THE OVEN TO GO TO. THE HOURS, MINUTES AND SECONDS IS THE TIME YOU WANT THE OVEN TO TAKE TO REACH SETPOINT. IF YOU WANT THE OVEN TO REACH SETPOINT AS FAST AS POSSIBLE THEN SET THESE TIMES TO ZERO. THE EVENT THREE IS WHETHER THE POWER EXHAUST OUTLET IS TURNED ON OR OFF.

A SOAK STEP HAS FIVE COMMANDS. THERE ARE TREE COMMANDS FOR TIME; HOUR, MIN AND SEC. THESE WOULD BE SET FOR THE AMOUNT OF TIME THAT YOU WANT THE OVEN TO RUN AT THE OPERATING TEMPERATURE. THE FOURTH COMMAND IS ENT1 THE POWER EXHAUST OUTLET. THE FIFTH COMMAND IS WPR WHETHER OR NOT THE CONTROL SHOULD WAIT UNTIL A PARTICULAR PROCESS VALUE IS REACHED.

A JUMP LOOP STEP HAS ONLY THREE COMMANDS JF(JUMP FILE), JS(JUMP START) AND JC(JUMP COUNT)

THE LINK FILE STEP HAS ONLY ONE COMMAND LFIL FILE TO LINK TO AN END STEP HAS ONLY ONE COMMAND END.

AN EXAMPLE OF A SIMPLE PROGRAM WOULD BE ONE IN WHICH YOU WANT THE OVEN AT 90 TO 100 DEGREES, MAINTAIN 100 DEGREES FOR 5 1/2 HOURS AND THEN COOL DOWN TO ROOM TEMPERATURE. THIS WOULD BE FOUR STEP PROGRAM. THE FIRST STEP WOULD BE A SETPOINT STEP. THE SETPOINT WOULD BE 100 DEGREES. THE TIME WOULD BE PROGRAMMED AS ZERO SINCE YOU WANT THE OVEN TO GET 100 AS FAST AS POSSIBLE. THE SECOND STEP WOULD BE A SOAK STEP. THE SOAK TIME WOULD BE 5 HRS. AND 30 MIN. THE THIRD STEP WOULD BE A SETPOINT STEP WITH THE SETPOINT SET TO ZERO AND THE TIME SET TO ZERO. THE FINAL STEP WOULD BE AN END STEP.

## SECTION 6

# MAINTENANCE

**WARNING:** Always disconnect the unit from the electrical service when cleaning and assure all volatile or flammable cleaners are evaporated and dry before reattaching the unit to the power supply.

- 6.1 Cleaning:** Cleaning the oven on a regular basis improves vacuum performance. To prepare the oven for cleaning, remove the shelves, shelf slides and door gasket. All of these components are autoclavable, or clean as described below. Be careful not to disturb the sensors located on the back wall; any undue pressure may cause breakage and replacement will be necessary. Disinfect with a solution that is suitable for your application. Any oily residue or moisture in the chamber should be removed after each operation to ensure maximum performance.

Using a lint free rag, wash the oven chamber and all parts with isopropyl or ethyl alcohol and dry thoroughly. DO NOT use chlorine based bleaches or abrasives as this may damage stainless steel surfaces. DO NOT use spray cleaners that might leak through openings and cracks and get on electrical parts or that may contain solvents that will harm the coatings.

When cleaning the gasket, handle it carefully not to impair the positive seal.

- 6.2 Vacuum pump maintenance:** Refer to the operation manual supplied with your vacuum pump for detailed descriptions of recommended maintenance routines. Oil levels, and the exhaust filter are typical areas for attention. Contact your vacuum pump supplier if you do not have an operation manual.
- 6.3 AIR IT OUT!** It is a good idea to leave the door ajar when not in use. This will facilitate drying of the chamber walls and tubing. When the door is closed, it will retain moisture. This moisture, combined with corrosive chemicals may deteriorate the chamber and tubing of the unit.



## SECTION 7

### EQUIVALENCE TABLE FOR PRESSURE / VACUUM MEASUREMENTS

Millitorr Micron	torr/ mmHg	mbar	psi	inches Hg absolute	inches Hg gauge	atmosphere	% vacuum	altitude (feet)	torr/mmHg
760,000	760	1013	14.696	29.92	0	1	0	0	760
750,000	750	1000	14.5	29.5	0.42	0.987	1.3	5,000	632.21
735,000	735.6	981	14.2	28.9	1.02	0.968	1.9	10,000	522.73
700,000	700	934	13.5	27.6	2.32	0.921	7.9	15,000	428.75
600,000	600	800	11.6	23.6	6.32	0.789	21	20,000	349.25
500,000	500	667	9.7	19.7	10.22	0.658	34	25,000	281.94
400,000	400	533	7.7	15.7	14.22	0.526	57	30,000	225.55
380,000	380	507	7.3	15	14.92	0.5	50	35,000	178.71
300,000	300	400	5.8	11.8	18.12	0.395	61	40,000	140.82
200,000	200	267	3.9	7.85	22.07	0.264	74	45,000	110.87
100,000	100	133.3	1.93	3.94	25.98	0.132	87	50,000	87.33
90,000	90	120	1.74	3.54	26.38	0.118	88	55,000	68.76
80,000	80	106.8	1.55	3.15	26.77	0.105	89.5	60,000	54.15
70,000	70	98.4	1.35	2.76	27.16	0.0921	90.8	65,000	42.65
60,000	60	80	1.16	2.36	27.56	0.0789	92.1	70,000	33.58
1,700	51.7	68.8	1	2.03	27.89	0.068	93.03	75,000	26.47
50,000	50	66.7	0.97	1.97	27.95	0.0658	93.5	80,000	20.83
40,000	40	63.3	0.77	1.57	28.35	0.0526	94.8	90,000	16.41
30,000	30	40	0.58	1.18	28.74	0.0395	96.1	95,000	12.92
25,400	25.4	38.8	0.4912	1	28.92	0.034	96.6	100,000	10.18
20,000	20	26.7	0.39	0.785	29.14	0.0264	97.4	110,000	8.02
10,000	10	13.33	0.193	0.394	29.53	0.0132	98.7	120,000	5.136
7,500	7.6	10.13	0.147	0.299	29.62	0.01	99	130,000	3.343
1,000	1	1.33	0.01934	0.03937	29.88	0.00132	99.9	140,000	2.269
750	0.75	1	0.0145	0.0295	29.89	0.000987	99.9	150,000	1.276
100	0.1	0.133	0.00193	0.00394	29.916	0.000132	99.99	160,000	1.128
10	0.01	0.0133	0.000193	0.000394	29.9196	0.0000132	99.999	170,000	0.8268
1	0.001	0.00133	0.0000193	0.0000394	29.91996	0.0000013	99.9999	180,000	0.6154
0.1	0.0001	0.000133	0.00000193	0.00000394	29.91999	0.0000001	99.99999	190,000	0.4592
								200,000	0.3432
								250,000	0.04557

## SECTION 8

# TROUBLESHOOTING

## TEMPERATURE

### Temperature too high

- 1/ Controller set too high-see section 5.10
- 2/ Controller failed on – call Customer Service.
- 3/ Wiring error – call Customer Service.

### Display reads "HI" or "400"+

Probe is unplugged, is broken or wire to sensor is broken – trace wire from display to probe; move wire and watch display to see intermittent problems

### Temperature too low

- 1/ OTP limit set too low – see section 5.11
- 2/ Controller set too low – see section 5.10
- 3/ Unit not recovered from door opening – wait for display to stop changing.
- 4/ Unit not recovered from power failure or being turned off –
- 5/ Heater Element failure – compare current draw to data plate.
- 6/ Controller failure – call Customer Service.
- 7/ OTP limit failure – confirm with front panel lights that Safety Thermostat is operating correctly. See Section 5.11
- 8/ Wiring problem – check all functions and compare wiring to schematic in section 11.0 - especially around any areas recently worked on.
- 9/ Loose connection – check control panel for loose connections.

### Display reads "LO"

- 1/ Bad probe or disconnected – call Customer Service.
- 2/ If ambient temperature is lower than range of unit – compare set points and ambient temperature to rated specifications in section 11.0.

### Unit will not heat over a temperature that is below set point

- 1/ Confirm that set point is set high enough –turn Safety Thermostat all the way clockwise and see if OTP light comes on.
- 2/ Check connections to sensor.

### Unit will not heat up at all

**If the L1 light is on, that means the controller is calling for heat. If no heat is being generated, the relay has failed and the heaters are not getting energized.**

- 1/ Check amperage – amperage should be virtually at maximum rated (data plate) amperage.
- 2/ Do all controller functions work?
- 3/ Is the Safety Thermostat set high enough? – for diagnostics, should be fully clockwise with the OTP light never on.
- 4/ Has the fuse/circuit breaker blown?



**Indicated chamber temperature  
unstable**

- 1/ Sensor miss-located, damaged or wires may be damaged - check mounts for control and OTP sensors, then trace wires or tubing between sensors and controls.
- 2/ Calibration sensitivity – call Customer Service.
- 3/ High limit set too low – check if OTP light is on continuously; turn controller knob completely clockwise to see if problem solved then follow instructions in section 5.11 for correct setting.
- 4/ Electrical noise – remove nearby sources of RFI including motors, arcing relays or radio transmitters
- 5/ Bad connection on temperature sensor or faulty sensor – check connectors for continuity and mechanical soundness while watching display for erratic behavior; check sensor and wiring for mechanical damage.
- 6/ Bad connections or faulty solid state relay – check connectors for mechanical soundness and look for corrosion around terminals or signs of arcing or other visible deterioration.
- 7/ If set point is below 60 degrees, temperature can be unstable. See unit specifications for individual ranges.

**Display and reference  
thermometer don't match**

- 1/ Calibration error – See Controller Manual
- 2/ Temperature sensor failure
- 3/ Controller failure
- 4/ Allow at least two hours to stabilize.
- 5/ Verify that reference thermometer is certified.

**Can't adjust set points or  
calibration**

- 1/ Turn entire unit off and on to reset.

**Calibrated at one temperature, but  
not at another**

This can be a normal condition when operating temperature varies widely. For maximum accuracy, calibration should be done at or as close to the set point temperature.

## MECHANICAL/VACUUM

**Door not sealing/Can't hold  
Vacuum**

- 1/ Door misalignment during shipping/handling. Lay unit on it's back and with a screwdriver, loosen and then re-tighten the door hinges.
- 3/ Check physical condition of gasket for tears or punctures.

## OTHER

**Controller on at all times -  
"locked-up"**

- 1/ Adjust set point to room temperature. If the unit is still heating, replace the solid state relay.
- 2/Turn unit off and on to reset.

**Controller timer resets on its own**

- 1/ Confirm that power from wall is consistent and within specifications.

**Front panel displays are all off**

- 1/ Check connections to the temperature display control board and assure that all are tight and in the correct orientation.
- 2/ Check for wire damage.

**Unit or wall fuse/circuit breaker is  
blown**

- 1/ Check wall power source.
- 2/ Compare current draw and compare to specs on data plate.
- 3/ See what other loads are on the wall circuit.

**Unit will not turn on**

- 1/ Check wall power source.
- 2/ Check fuse/circuit breaker on unit or in wall.
- 3/ See if unit is on, e.g., fan or heater, and just controller is off.
- 4/ Check all wiring connections, especially around the on/off switch.

**Contamination in chamber  
Oil in Chamber**

- 1/ See cleaning procedure in Section 3.5
- 2/ Develop and follow standard operating procedure for specific application; include definition of cleaning technique and maintenance schedule.
- 3/ Oil from the vacuum pump has "back-streamed" into the vessel. Avoid this in the future by closing the vacuum valve after pulling full vacuum. It is recommended to keep the vacuum pump on during the process. See Section 5.8 for details.





**Controller PID Settings:**

These are internal controller settings pre-set at the factory for optimum oven performance. Altering these settings can cause performance problems. Please contact customer service if settings have been altered.

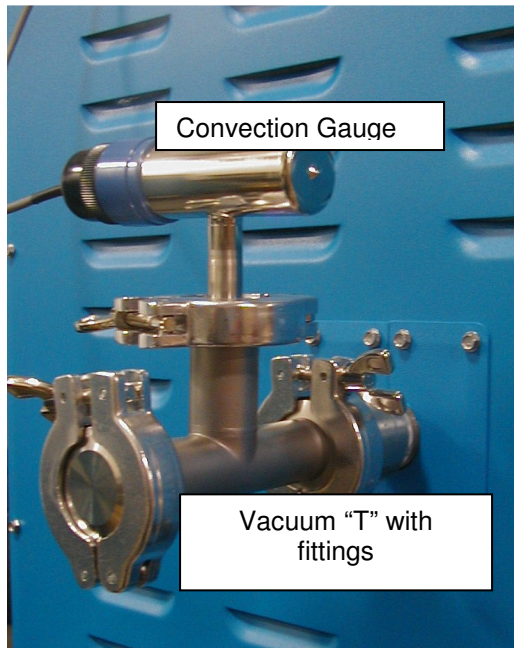
DISPLAY	MODE	SET TO	ALTERNATE
FOR	LOWER	UPPER	UPPER
PID	VACUUM	OVENS	ONLY
	PB1	15	15
	RE1	0.05	0.05
	RA1	2.72	2.72
	CT1	1	1



## SECTION 9

# OPTIONAL FEATURES

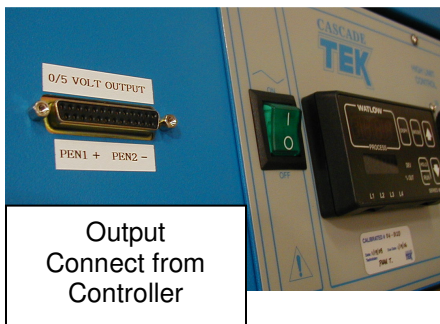
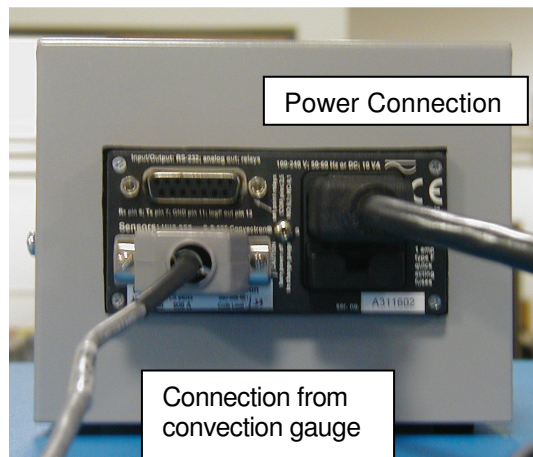
### Instructions For Installing Digital Vacuum Gauge



Attach KF25 "T" to NPT NW25 Flange as shown.

Attach convection gauge to the KF25 "T" as shown.

Refer to Digital Vacuum Gauge Manual





## SECTION 10

# PARTS LIST

### TVO-1

9570739 Element Assy., top / bottom  
5620506 Shelf - Top 2  
5620519 Shelf - Bottom 1

### TVO-2

9570742 Element Assy.  
5620518 Shelf - Top 2  
5620520 Shelf - Bottom 1

### TVO-5

9570765 Element Assy., top / bottom  
5620523 Shelf  
5220580 Shelf Sliders  
9570764 Element Assy., side

### PARTS FOR ALL VACUUM OVENS

9530535 Needle Valve Kit .250  
9530536 Needle Valve Kit .375  
100031 Vacuum Gauge  
1800516 Power Cord  
X1000771 Soft Touch Knob  
103351 Green I/O Switch  
200020 Red Pilot Light  
8000542 Terminal Block 18 Position  
100026 Over-Temperature Safety Thermostat  
101827 TC Probe Closed End  
1750540 Watlow 981 Controller  
102162 Solid State Relay  
200129 Adjustable Feet



# Gaskets for TVO Series Vacuum Ovens

TVO-1 (9x9)	Max Temp	Part Number
Silicone (Standard)	230C	10029
Buna-N (Solvent Resistant)	125C	10049
Flourasilicone (Acid Resistant)	200C	3450610
TVO-2 (12x12)		Part Number
Silicone (Standard)	230C	100037
Buna-N (Solvent Resistant)	125C	100038
Flourasilicone (Acid Resistant)	200C	3450611
TVO-5 (18x18)		Part Number
Silicone (Standard)	230C	310028
Buna-N (Solvent Resistant)	125C	891054
Flourasilicone (Acid Resistant)	200C	3450612

Replacement Gaskets can be ordered by calling Cascade TEK at 888-835-9250 / [info@cascadetek.com](mailto:info@cascadetek.com) or fax to 503-648-1798.

**Door Gasket Precaution:** Although the max temp of the oven is rated between 260C to 300C, the door gaskets will degrade rapidly if the oven is run at such high temperatures. Under vacuum, water actually boils at temperatures as low as 20C, and the boiling process starts as soon as the vacuum pump starts. It should not be necessary to run the oven to such extreme temperatures and risk compromising the gasket material.



## SECTION 11

# UNIT SPECIFICATIONS

### **TVO-1** 0.56 cubic foot Vacuum Oven

Interior Dimensions:	9" W x 9" H x 12" D
Exterior Dimension:	15 ¾" W x 21 ½" x 20" D
Temperature Range:	5° C above ambient to 300°C
Temperature Uniformity:	± 6°C @ 150°C
Vacuum Range:	Less than 10 microns
Vacuum Gauge:	0-30" hg
Controls:	Watlow Model 981 programmable microprocessor with ramp & soak capabilities. Independent over temp controller.
Heaters:	1000 watts
Power:	120V, 1ph, 50/60Hz, 9 amps
Shelves:	3
Full glass viewing door	
Port:	1" vacuum port in rear
Weight (uncrated):	68 lbs.

### **TVO-2** 1.7 cubic foot Vacuum Oven

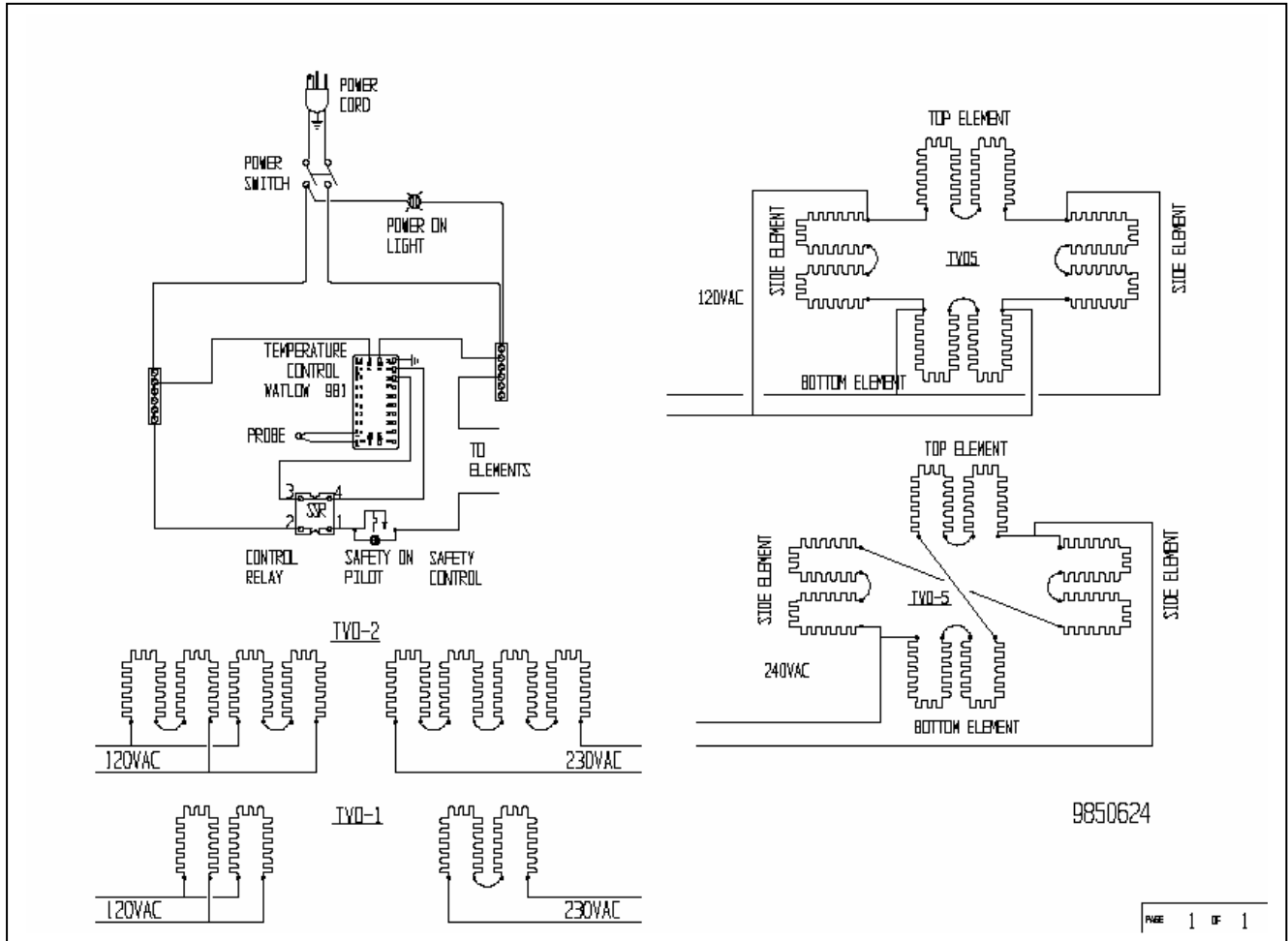
Interior Dimensions:	12" W x 12" H x 20" D
Exterior Dimension:	18 ¾" W x 24 ½" x 26.1/2" D
Temperature Range:	5° C above ambient to 300°C
Temperature Uniformity:	± 6°C @ 150°C
Vacuum Range:	Less than 10 microns
Vacuum Gauge:	0-30" hg
Controls:	Watlow Model 981 programmable microprocessor with ramp & soak capabilities. Independent over temp controller.
Heaters:	1500 watts
Power:	120V, 1ph, 50/60Hz 13 amps
Shelves:	3
Full glass viewing door	
Port:	1" vacuum port in rear
Weight (uncrated):	148 lbs.

### **TVO-5** 4.6 cubic foot Vacuum Oven

Interior Dimensions:	18¼" W x 18¼" H x 24" D
Exterior Dimension:	25" W x 30 ½" x 30 ½" D
Temperature Range:	5° C above ambient to 260°C
Temperature Uniformity:	± 10°C @ 150°C
Controls:	Watlow Model 981 Programmable Controller. Independent Overtemp protection
Heaters:	1500 watts
Vacuum Range:	Suitable to 10 microns. 0-30" Vacuum Gauge
Power:	220V, 1ph, 50/60Hz
Shelves:	3 / Full Glass Viewing Door
Weight (uncrated):	350 lbs. 1" Vacuum Port in Rear

SECTION 12

WIRING DIAGRAM (TVO-1, TVO-2, TVO-5)





## SECTION 13

# WARRANTY

### 13.0 North America

*Cascade TEK*, agrees to correct for the original user, either by repair (or at our election), replacement, any defect in material or workmanship which develops within twelve months after delivery to the original user. In the event of replacement, the replacement unit will be warranted for the original twelve (12) month period or ninety (90) days, whichever is longer.

If this product should require service, contact *Cascade TEK*, at (503) 648-1818 or toll free 888-835-9250. When return of the product is necessary, a return authorization number will be assigned and the product should be shipped, transportation charges pre-paid, to the service center. To insure prompt handling, the return authorization number should be placed on the outside of the package and a detailed explanation of the defect enclosed with the item.

This warranty shall not apply if accident, neglect, unreasonable use, improper service caused the defect or malfunction, or other causes not arising out of defects in material or workmanship.

There are no warranties, express or implied, including, but not limited to, those merchantability or fitness for a particular purpose, which extend beyond the description and period set forth herein.

*Cascade TEK's* sole obligation under this warranty is limited to the repair or replacement of a defective product. *Cascade TEK* shall not, in any event, be liable for any accidental or consequential damages of any kind resulting from use or possession of the product.

### 13.1 Export

The *Cascade TEK* warranty for all equipment delivered outside the continental US or Canada is 1 year on defective parts. The purchaser will be responsible for all labor costs for on-site repairs or parts installation. All replacement parts provided under warranty by *Cascade TEK* are shipped F.O.B. our plant.