Rev 05/01/12

CASCADE™ TEK

VACUUM OVENS

MODELS: TVO-1, TVO-2, TVO-5
INSTALLATION and OPERATION MANUAL

CONTACT US

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CONGRATULATIONS!

Congratulations on selecting a Cascade TEK vacuum oven. We have put together this manual to make sure you get the most from your oven.

Our Lawyers Say: *This is a general-purpose vacuum oven for professional, industrial or educational use. It is suitable for a working environment where no flammable, volatile or combustible materials are being heated. This oven is not intended for hazardous or household 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.*

Your City Inspector Says: *Local city, county or other ordinances may govern the use of your vacuum oven. If you have any questions about local installation requirements, please contact the appropriate local agency.*

Our Design Engineers Say: *Your oven is intended for use indoors, at temperatures between 25°C and 40°C, at no greater than 80% Relative Humidity. Extreme external temperatures or humidity levels can affect the oven's ability to control temperature.*

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A. SET UP

A.1

IMMEDIATELY INSPECT THE CRATE & OVEN FOR FREIGHT DAMAGE: The carrier has responsibility for safe delivery and is liable for loss or damage. Describe on the freight bill any damage found, and enter your claim on the form supplied by the carrier. Photos are always helpful in making sure your freight claim is handled expeditiously.

A.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 Cascade TEK for authorization. Supply nameplate data, including model number and serial number.

A.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. In some models, shelves are wrapped to the side of the oven to prevent interior damage. Vacuum pump and connection kits are packaged separately and may ship separately. See **Section 4: Parts List.**

A.4

Location, Location, Location: Consider conditions that may affect the oven's ability to accurately control temperatures. 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.

A.5

Easy Tiger! Ovens are heavy and should only be lifted from their bottom surfaces. Doors, handles and knobs are not adequate for lifting or stabilization. Shelves should be removed and doors need to be positively locked closed during transfer to prevent shifting and damage.

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A.6

Remove Pallet. The oven is secured to its pallet with 4 washer/bolts. Remove with a 1/2” wrench.

NOTE: You are about to install leveling feet in those same 4 holes on the bottom of the oven.

A.7

Install Leveling Feet: Each oven comes with 4 leveling feet. These need to be installed in the 4 threaded inserts on the bottom of the oven.

A.8

Cleaning: The oven interior was cleaned at the factory, but not sterilized. Clean with a disinfectant that is appropriate for your application. Remove any protective vinyl film on the shelf surface.

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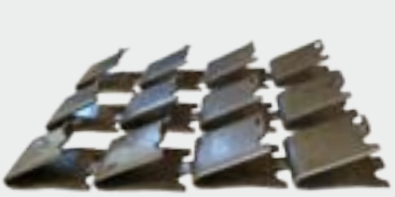
A.9

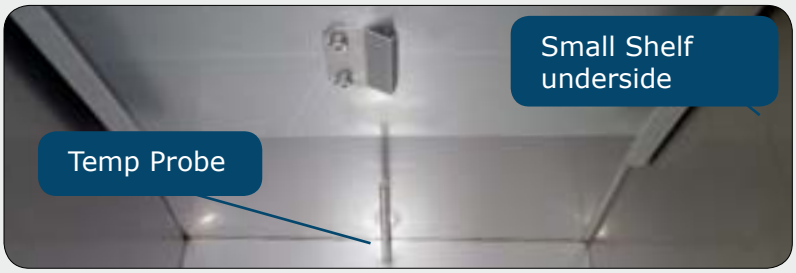
Adjustable Shelves with Clips (Model TVO-5):

1. Place shelves in the chamber at the desired location with the included shelf clips.



Stackable shelves (Model TVO-1 & TVO-2):

1. Locate the smaller shelf with the clip/bracket on the underside. This is to be placed on the bottom of the oven.
2. Locate the Temp Probe inside the oven (back wall). Slide the underside of the clip onto the probe.



WATCH: Dan Installs Shelves on a TVO-1 or TVO-2

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B. FACILITIES

Standard TVO Vacuum ovens require the following facility connections:

B.1

Electrical Power of the Vacuum Ovens:

Vacuum Model	Voltage	Cycle	Amperage
TVO-1	120V	50/60 Hz	9 Amps
TVO-2	120V	50/60 Hz	13 Amps
TVO-5	120V	50/60 Hz	13 Amps

NOTE: *Consult the oven data plate for the voltage, cycle, and amperage requirements before making power connection.*

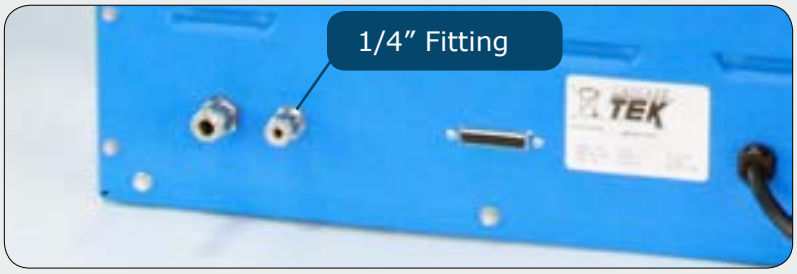
B.2

Electrical Power of the Vacuum Pumps:

Consult the pump data plate for the voltage, cycle, and amperage requirements before making power connection.

B.3

Inert Gas Connection (Rear): This is the vent port. This fitting will allow for connection to nitrogen, argon, or facilitate venting to atmosphere. 15 PSI inlet connection.



B.4

Your Electrician Should Know: A separate circuit for the oven and the pump is strongly recommended to prevent possible loss of product due to overloading or failure of other equipment on a shared circuit.

Electrical supply circuit to the vacuum oven and pump must conform to all national and local electrical codes.

VOLTAGE SHOULD NOT VARY MORE THAN 10% FROM THE DATA PLATE RATING.

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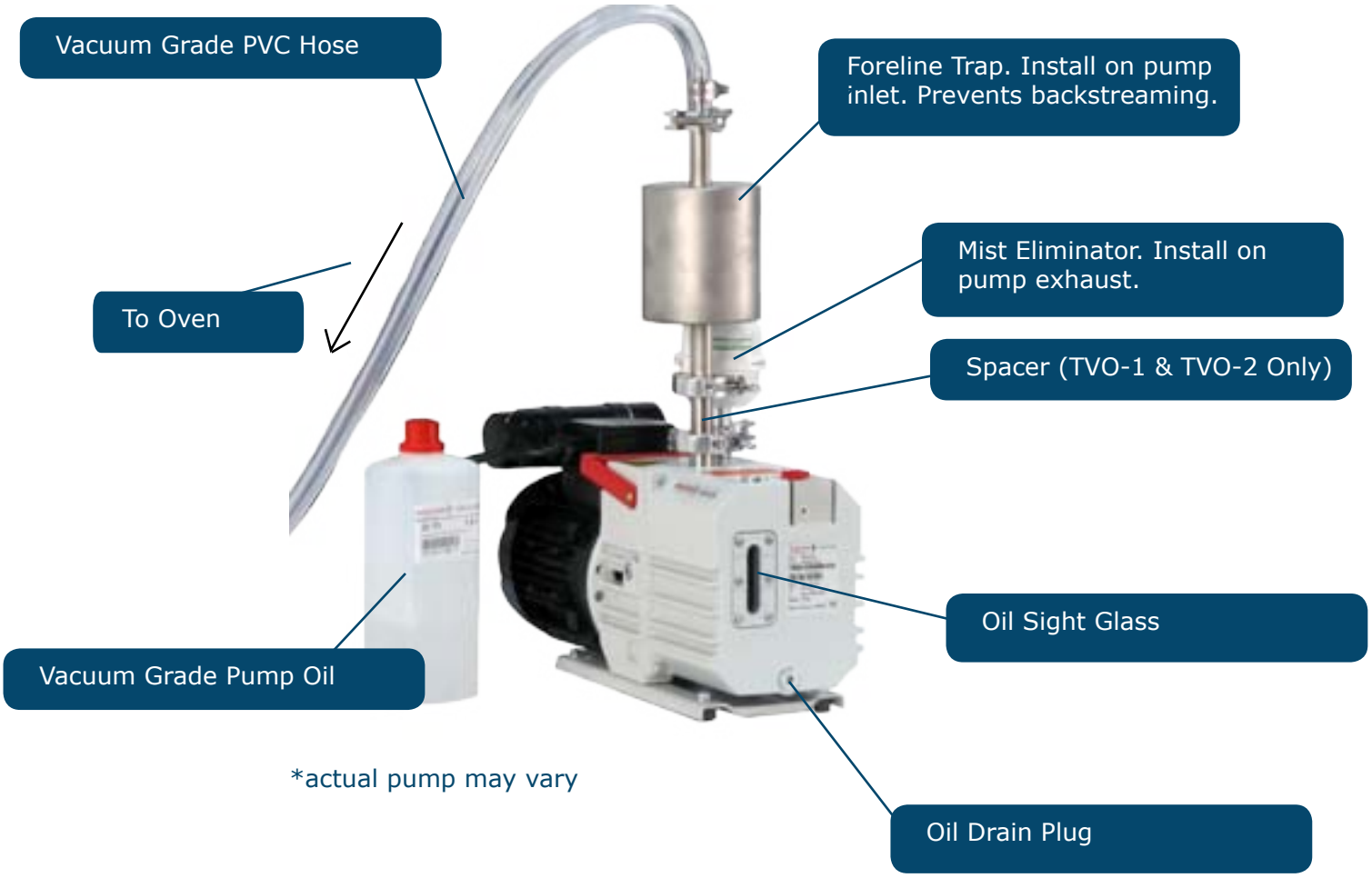
C. VACUUM PUMP

Read the vacuum pump manufacturer's manual for details, maintenance and warnings. Cascade TEK sells vacuum pump connection kits.

C.1 CONNECTION KIT - OIL PUMP



*actual pump may vary

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C.2 SET UP OIL PUMP

You will need:

- Funnel or steady hand to pour pump oil into pump
- Strong knees and arms to position pump
- Cascade TEK Oil Pump Connection Kit

STEP 1	Remove vacuum pump from box.
STEP 2	Locate bottle of oil. This oil must be poured into the vacuum pump.
STEP 3	Attach mist eliminator to pump exhaust. (Use centering ring and clamp).
STEP 4	Attach foreline trap to pump inlet. (Use centering ring and clamp). If you have a TVO-1 or TVO-2: First install the spacer to pump inlet, then install the foreline trap.
STEP 5	Attach the end of the vacuum hose with the metal fitting to the foreline trap using a centering ring and clamp.
STEP 6	Plug pump into 120V outlet.

WATCH: How To Set Up An Oil Pump.

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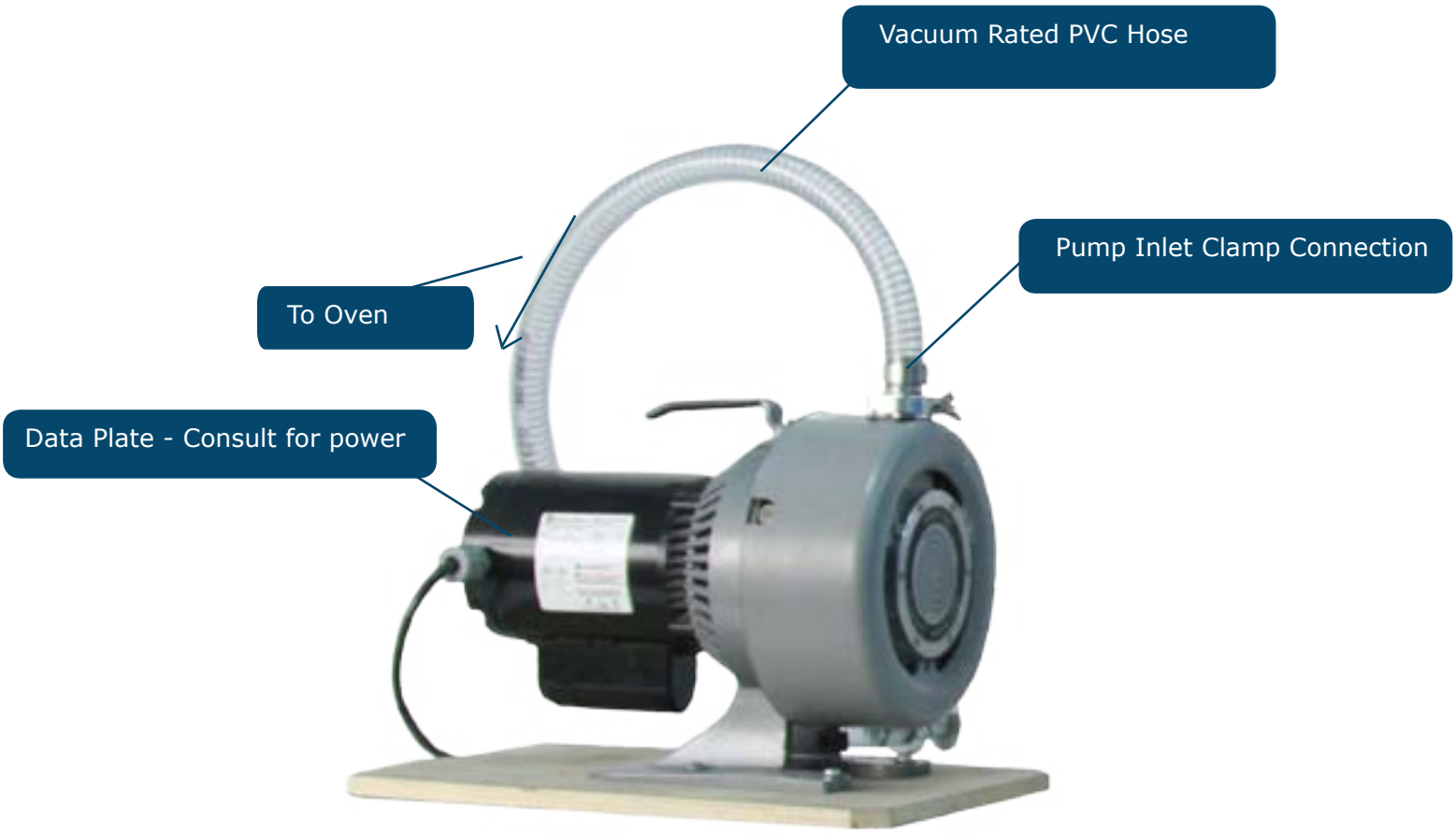
C.3 CONNECTION KIT - DRY PUMP

Read the vacuum pump manufacturer's manual for details, maintenance, and warnings. Cascade TEK sells vacuum pump connection kits.



*actual pump may vary

WATCH: Intro to the Dry Scroll Pump

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C.4 SET UP DRY PUMP

You will need:

- Cascade TEK Dry Pump Connection Kit
- Strong knees and arms to position pump

STEP 1	Remove pump from box. No brainer.
STEP 2	Attach vacuum hose to pump inlet. Attach the end of hose with the metal fitting to the pump inlet using clamp and centering ring.
STEP 3	Plug pump into 120V outlet.

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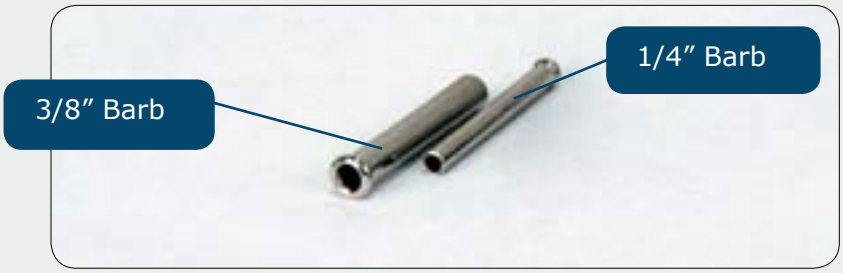
D. CONNECTING VACUUM PUMP TO OVEN

You will need:

- 2 wrenches to insert and tighten the barbed stems into the 1/4" and 3/8" rear fittings
- Flat Screwdriver to tighten the crimp clamp around vacuum hose
- 1/4" and 3/8" barbed inserts included with your oven



WATCH: Connecting a Vacuum Pump to a Cascade TEK Vacuum Oven

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SECTION 1: INSTALLATION

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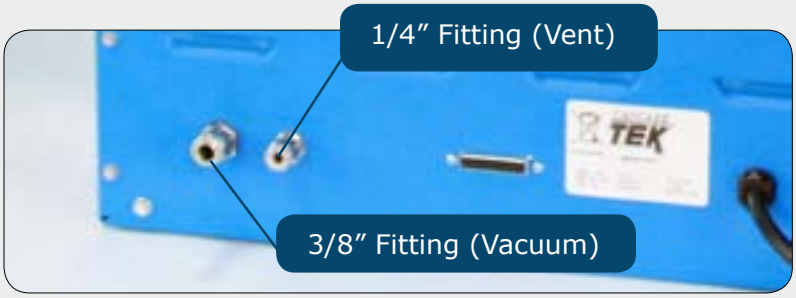
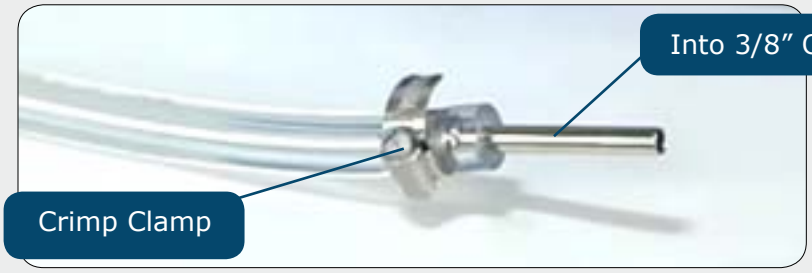
STEP 1

Insert the 3/8” barb into to 3/8” fitting on the back of the oven. Utilize the two wrenches to tighten.



STEP 2

Insert the blank end of the vacuum hose into the 3/8” barb sticking out the back of the oven. Use screwdriver to tighten the crimp clamp.



STEP 3

Insert the 1/4” barb into the 1/4” fitting on the back of the oven. Utilize the two wrenches to tighten. This barb will be available for a nitrogen or argon/gas connection, should you choose to backfill or vent with inert gas. 15 PSI inlet pressure.

STEP 4

Power Source: The vacuum pump will require its own power source, typically 120V or 220V. Consult pump data plate.

WATCH: Connections on Cascade TEK Vacuum Ovens.

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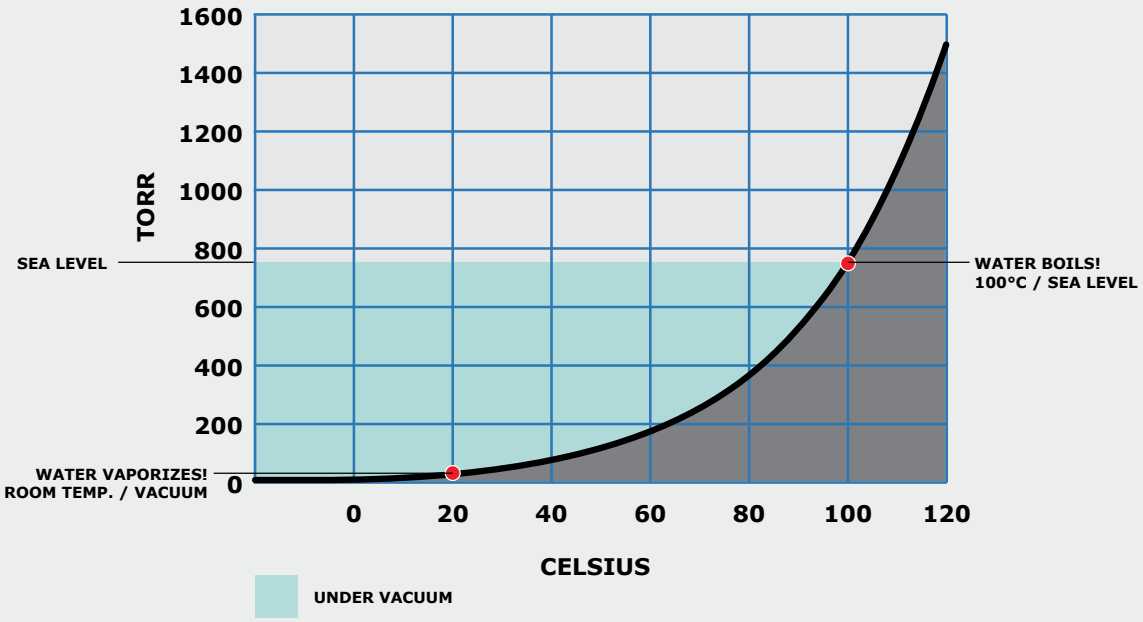
A. HOW VACUUM WORKS

Editors Note: *There will not be a test on this theory of operation. But it's good to know and may impress at your next geek fest.*

It's best to think of a vacuum oven as a pressure device, rather than a temperature controlled oven. Primarily, it is the change in pressure that is doing the drying, not the heat from the oven. The heat helps, you should use it, but that explanation is for the advanced course.

How does a change in pressure dry? Molecules have a "vapor pressure" – meaning, there is a pressure level at which a molecule will change from a solid molecule (think drop of water) to a vapor. In a vacuum oven you are reaching the vapor pressure of a molecule to change it from a solid to a gas. Then the pumping speed of the vacuum pump removes the vapor from the oven. Viola!

Here is an example of the vapor pressure of water:



Sea level is 760 Torr. (Ways to measure vacuum on **Page 16**.)
The chart shows that water will turn to a vapor (meaning boil) at about 100°C. This is common knowledge to us folks at sea level.

What would it take to boil water at say, room temp… approximately 20°C? The chart illustrates that at around 20°C, water molecules will turn to a vapor simply by changing the pressure from 760 Torr down to less than 50 Torr.

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VACUUM REFERENCE TABLE

There are many ways to measure vacuum. The TVO Vacuum ovens use a bourdon tube gauge that reads in Inches of Mercury (Hg). When the needle pegs 30", you are at "ultimate vacuum". This should happen fairly quickly. If the needle does not peg 30" quickly - the pump is dealing with a large gas load, or there is a leak in the connections between the oven and the pump.

EQUIVALENCE TABLE FOR PRESSURE / VACUUM MEASUREMENTS

	Millitorr / Micron	torr / mmHg	mbar	psi	inches Hg absolute	inches Hg gauge	atmo-sphere	% vacuum	altitude (feet)	torr / mmHg
Sea Level	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	106.6	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	0.07899	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	29.86	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
Expected Vacuum Range	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	0.00000132	99.999	170,000	0.8268
	1	0.001	0.00133	0.000193	0.0000394	29.91996	0.0000013	99.99999	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

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B. CONTROL PANEL OVERVIEW / SYMBOLS

POWER SWITCH - It must be in the "I" or "on" position to operate.

HIGH LIMIT CONTROL - This independent controller shuts down heaters if oven temp exceeds main temp controller set-point.

VENT VALVE - Allows for venting or inert gas backfill. When open, it releases vacuum, returning oven to site pressure. Must be closed under vacuum.

VACUUM GAUGE - Displays vacuum level in Hg (mercury).

TEMP CONTROLLER - Displays temperature, set-point, and profile status.

VACUUM VALVE - Turn vacuum valve counter-clockwise to open and allow vacuum pump to evacuate the oven.

WATCH THE TUTORIAL (Internet connection required)

Introduction to the TVO Vacuum Oven Control Panel.

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GRAPHIC SYMBOLS

Your oven may contain a variety of graphic symbols which should help in identifying the use and function of the available user adjustable components.

	ATTENTION! Consult your manual for further description.
	Indicates **"AC Power"**
	Indicates **"Degrees Celsius"** (Seen on Temperature Controllers)
	Indicates **"Over Temperature Safety"** (High Limit Controller)
	Indicates **"Earth Ground"**
	Indicates **"Potential Shock Hazard"** behind partition
	RECYCLE THIS UNIT! Do the right thing for the planet and your children. Do not dispose of in land-fill.

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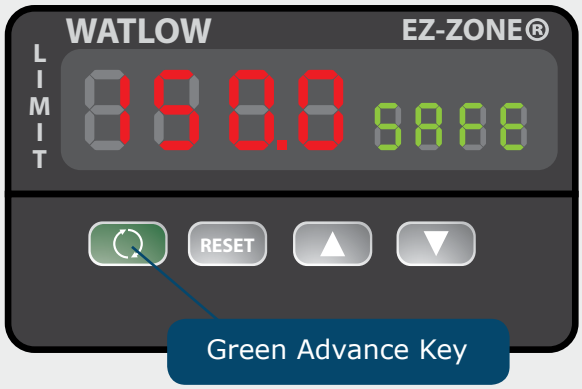
C. QUICK START GUIDE (SET-POINT TEMPERATURE)

STEP 1	Put stuff in, close door.
STEP 2	Close small vent valve (right = tight)
STEP 3	Open large vacuum valve (left = loose)
STEP 4	Turn oven on. Green switch lights up, so do controllers.
STEP 5	Turn vacuum pump on. Watch needle valve peg 30" Hg. (ultimate vacuum) fairly quickly.
STEP 6	**Set High Limit Controller.** 1. Press the Green Advance Key and scroll to LH5. (Lh.5 = Limit, high set-point). 2. Press the UP/DOWN arrows until the desired High Limit Temperature is seen on the large red digital display. 3. Press the reset button to activate High Limit Control.



WATCH: Setting the High Limit on a Cascade TEK Vacuum Oven

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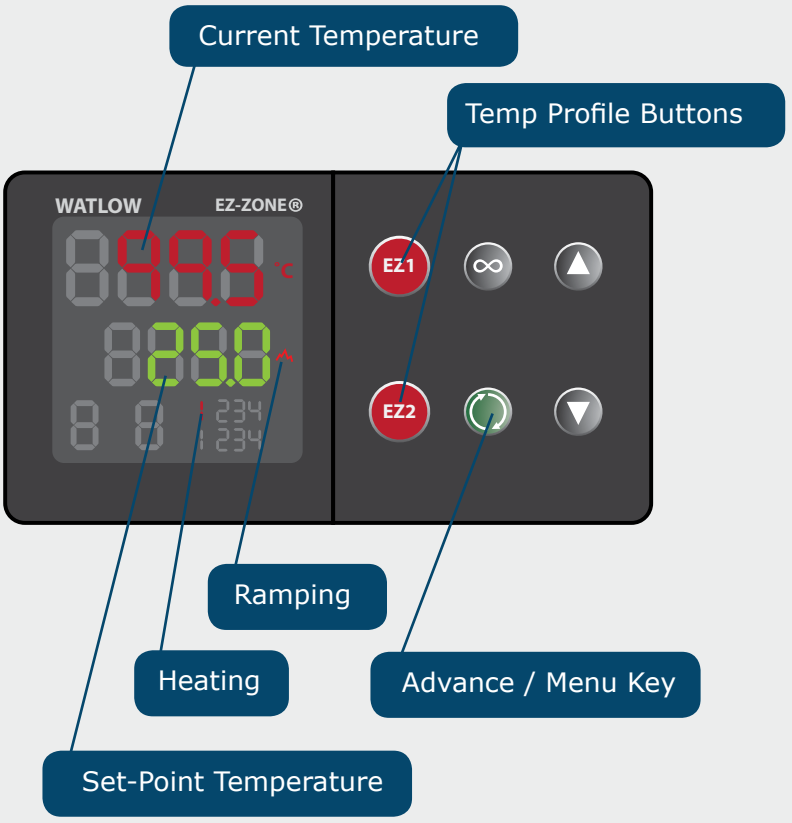
WATCH: Getting Started with your Cascade TEK Oven Controller

STEP 7

Single Temperature Set-Point Operation

1. Use UP/DOWN arrows to select desired set-point temperature. Red = the current temp inside the oven, Green = the temperature you desire.
2. Red "1" light is on to show power to the heaters.



STEP 8

Process runs. Vent is closed. Vacuum valve is open. Pump on.

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C.1 QUICK START GUIDE (END OF PROCESS)

STEP 1	Close the vacuum valve. Vacuum pump stays on.
STEP 2	Open the vent valve. Watch needle gauge reach 0" Hg.
STEP 3	Turn off main power, or press the down arrow on Temp Controller to lower temperature below ambient.
STEP 4	Open door and remove samples. ***CAUTION: They may be hot.***
STEP 5	Turn off the vacuum pump.

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D. NITTY GRITTY

PROGRAM CONTROLLER WITH SOFTWARE

Watlow's Configurator Software is an optional tool you can use to program your controller. The software presents pages and menus as they are in the controller's display, RUI and manuals:

- On-screen parameter help & copy parameter settings
- Save and download configuration files on the computer with all the information required to set up a controller
- Preserves settings for archiving, recovery or to simplify setting up another EZ-ZONE
- Enables files to be e-mailed or made available to users on a network or via the internet to aid them with set up

You will need:

- Cascade TEK's USB to RS-485 Cable Connection - available for purchase.

- EZ-ZONE Configurator software. Located on the disk: Controller Support Tools
- Directory: EZ-ZONE Configuration Software > Software > EZ ZONE > EZ-ZONE Configurator

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PROGRAM RAMP AND SOAK TEMP PROFILE

STEP 1

Make sure you have read **Section 1**, the oven and pump are setup and ready to go. Flip the POWER Switch to the ON position.

STEP 2

Set High Limit Control:

1. Press the Green Advance Key and scroll to LHS (Limit, High Set-Point).
2. Use the UP/DOWN arrows to select the temperature set-point.
3. Press the Reset button to initiate high limit control.

WATCH: Setting the High Limit on a Cascade TEK Vacuum Oven

STEP 3

Trust me. Watch this first:

WATCH: Programming a Simple Ramp and Soak Temperature Profile

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STEP 3 CONT.

Simple Profile: Single Set-Point and Time
(Example: 150°C for 1 hour)

1. Green Advance Key – hold for 3 seconds
2. See Profile 1 appear on display
3. Press Green Advance Key to StEP 1
4. Press Green Advance Key to Step Type StyP

Step 1 – Use UP and DOWN arrows until t1 (Time Step appears). This step tells the controller to achieve 150°C as quickly as possible. (Or how quickly to ramp to temp.)

1. t1 (Time Step)
2. Press Green Advance Key until you see tSP1
3. Press UP/DOWN arrows until 150°
4. Press Green Advance Key
5. Hour = 0 hour (0 Hours - Specify Time)
6. Press Green Advance Key
7. Min = 0 Min (0 Minutes - Specify Time)
8. Press Green Advance Key
9. SEC =0 SEC (0 Seconds - Specify Time)
10. Press Green Advance Key
11. Ent 1 = OFF
12. Press Green Advance Key
13. Ent 2 = OFF
14. Press Green Advance Key
15. Press Infinity Key which takes you to back to P1
16. Use UP arrow to select 2 (Step 2 in Profile 1)

Step 2

1. Press Green Advance Key until you see StyP (Step Type)
2. Press UP/DOWN arrows until WJPr (Wait For Process). This means we are waiting for the oven to get close to the set-point temp (145°C) before we actually start the process time.
3. Press Green Advance Key
4. WJP1 (Wait For Process 1)
5. Press UP/DOWN arrows to select 1
6. Press Green Advance Key
7. Press UP/DOWN arrow to about 5°C lower than your process temperature (145°C if you want 150°C)
8. Press Green Advance Key
9. Ent 1 = OFF
10. Press Green Advance Key
11. Ent 2 = OFF
12. Press Green Advance Key
13. Press Infinity Key which takes you to back to P1
14. Use the UP/DOWN arrows to select Step 3.

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STEP 3 CONT.

Step 3 - Soak Step (Step 3 in Profile 1)

1. Press Green Advance Key. To see Step Type (StYP)
2. Use UP/DOWN arrows until SoAk (Soak Step) appears. This step tells the controller how long to remain at 150°C
3. Press Green Advance Key
4. Hour = 1 hour (1 Hours - Specify Time)
5. Press Green Advance Key
6. Min = 0 MIn (0 Minutes - Specify Time)
7. Press Green Advance Key
8. EC = 0 SEC (0 Seconds - Specify Time)
9. Press Green Advance Key
10. Ent 1 = OFF
11. Press Green Advance Key
12. Ent 2 = OFF
13. Press Green Advance Key
14. Press Infinity Key which takes you to back to P1
15. Use UP arrow to select 4 (Step 4 in Profile 1)

Step 4 - (End of process, reduce temperature – oven does not actively cool)

1. Press Green Advance Key until you see Step Type (StYP)
2. Press UP/DOWN arrows until t1 (Time Step)
3. Press Green Advance Key
4. Press UP/DOWN arrows until 150°
5. Change 150° to 0°
6. Press Green Advance Key
7. Hour = 0 hour (0 Hours - Specify Time)
8. Press Green Advance Key
9. Min = 0 MIn (0 Minutes - Specify Time)
10. Press Green Advance Key
11. SEC = 0 SEC (0 Seconds - Specify Time)
12. Press Green Advance Key
13. Ent 1 = OFF
14. Press Green Advance Key
15. Ent 2 = OFF
16. Press Green Advance Key
17. Press Infinity Key, which takes you to back to P1
18. Use UP arrow to select 5 (Step 5 in Profile 1)

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STEP 3 CONT.

Step 5 - End Step (Step 5 in Profile 1)

1. Press Green Advance Key until you see StyP (Step Type)
2. Press UP/DOWN arrows until End (End Process).
3. Press Green Advance Key
4. Press UP/DOWN arrows until Hold (Hold Step). This will hold the oven temperature at the last set-point. (The temp that was called out in Step 4.)
5. Press Green Advance Key
6. Ent 1 = OFF
7. Press Green Advance Key
8. Ent 2 = OFF
9. Press Green Advance Key
10. Press Infinity Key, which takes you to back to P 1.
11. Press Infinity Key for 2 seconds to go back to home screen.

Start the Profile

1. Press EZ-1
   a. 3 things should happen right away
      i. The red "ramp" symbol will light up
      ii. The green application display should read 150°
      iii. The red "1" light will come on showing the oven is calling for heat. The oven should begin heating.

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STEP 4

Apply Vacuum to the Chamber:

1. Confirm that both valves are closed (turned fully to the right).
2. Turn on vacuum pump.
3. Open Vacuum Valve (Large) by turning it fully to the left.

CAUTION: *If vacuum pump is off and vacuum valve is open, oil may* ***backstream*** *into the oven workspace.* ***See here for explanation.***

STEP 5

Full Vacuum: Watch the gauge. You will see it move quickly towards full vacuum (30" Hg). You will want to leave the vacuum valve open and the vacuum pump on for the entire process. If you close the vacuum valve during the process and the display creeps up in pressure, it is most likely because your product is outgassing, not because there is a leak in the system.

Ambient Pressure

You may notice that the gauge hovers at a certain pressure for some time before it drops toward 30" Hg. This is a result of your product outgassing. Once the product is fully outgassed, the gauge will drop toward 30" Hg and hold there.

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.*

STEP 6

Oven Venting or Backfilling: The Vent Valve (SMALL Valve) located to the left of the vacuum gauge allows for venting the oven to atmosphere or to introduce an inert gas backfill. When opened, this valve releases the 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 (smaller 1/4" fitting).

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 static condition.

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 gasing action, gas is drawn through the chamber in a constant motion.

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A. 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.*

A.1

VACUUM PUMP: The most "high maintenance" item on your vacuum oven is the vacuum pump.

OIL / ROTARY VANE PUMP: This pump will require oil changes. Watch for the oil to become cloudy, milky or bubbly. Time for a change. The appropriate vacuum pump oil can be found in the respective vacuum pump manual included with your oven. Depending on how much water or gunk is being pulled off your product and thru the pump, it may be a good time to also replace the mist eliminator and foreline trap at this time.

DRY/SCROLL PUMP: This pump will require "tip seal" changes. Most pump manufacturers recommend every 9,000 hours of use, or at least once per year. Degradation of vacuum levels or poor pump performance may mean it's time for a tip seal change. Tip seals and basic tools needed for this change are located in your vacuum pump manual.

A.2

Gasket Inspection: The door gasket is considered a "high-wear" item. Heat and pressure will take its toll. If you notice a loss of vacuum, the gasket is the first item to check. It is a good idea to have a spare gasket on hand. Contact Cascade TEK for replacement gaskets.

A.3

Interior Cleaning Improves Vacuum Performance: Remove shelves and door gasket. Be careful not to disturb the sensor 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 cloth, wash the oven chamber and all parts with isopropyl or ethyl alcohol. 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 get on electrical parts.

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B. TIPS, TRICKS & ANSWERS

PRECAUTIONS

B.1 **THIS IS NOT AN EXPLOSION PROOF OVEN.** Do not place or use explosive, combustible, or flammable materials in or around the oven. 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.

B.2 **Do not use sealed containers in the oven chamber.** The pressure differential under vacuum can make a mess when the container blows its top or explodes and may potentially hurt someone. Don't say we didn't warn you.

B.3 **Disconnect from electrical power source** before attempting to make any repairs, cleaning or component replacements. This is just plain common sense.

B.4 **Melting The Door Gasket:** Although the maximum temperature of the oven is rated at 220°C, different door gaskets will degrade at different temperatures.

Silicone gaskets, rated to 220°C are standard on Cascade TEK vacuum ovens. See **Section 4: Door Gaskets.**

INSTALLATION

Where / how does the oven exhaust?

The vacuum pump is the only component that exhausts. With the Cascade TEK oil pump connection kit, a mist eliminator is attached to the pump exhaust to filter the exhaust. You can run a hose from the pump exhaust if you would like to exhaust the pump away from the oven.

What are the BTU's of the oven?

There are formulas for calculating BTUs; based on the wattage of the oven. However, the actual BTU's for your particular situation would have to be determined by your specific use. Here are the MAXIMUM BTU calculations by model.

MODEL	WATTS	BTU's
TVO-1	1,000 Watts	3,400 BTU's
TVO-2	1,500 Watts	5,100 BTU's
TVO-5	1,500 Watts	5,100 BTU's

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PROCESS

I want to vent/ backfill with Nitrogen, CDA or Argon. What is the PSI for the inlet?	15 PSI.
How do I prevent over-pressurizing the oven when I backfill?	No worries. The oven's door window is spring loaded. When positively pressurizing or backfilling, the excess air or gas seeps out around the window. Still, this is a vacuum oven, not a pressure vessel. DO NOT use the vacuum oven as a positive pressure vessel.
Can I put my product on the oven floor?	No. The lower shelf must be in place for proper temperature control. Additionally, there are heaters on the bottom outside of the oven. The oven floor will become extremely hot.
Should I leave the vacuum pump on?	Yes. It is a good idea to leave the pump on at all times during the process and then for about 30 minutes to 1 hour after to allow the pump to clear moisture. NEVER shut your pump off with the vacuum valve open.
Should I close the vacuum valve once it reaches 30"Hg or ultimate vacuum?	No. If you are drying, it defeats the purpose. Leave the vacuum valve open and the vacuum pump on during your process.
How much weight will the shelves hold?	The shelves are made of aluminum, we estimate about 50 to 75 lbs. max.
How full can the oven be?	Due to the heat radiation – allow at least 2" of space from the product to the wall.

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CONTROL

Where is the oven's controller manual on the Watlow disc?	**Temperature Controller Manual (Watlow EZ)** **Over Temperature Controller Manual (Watlow EZ Limit)** Both of these manuals can also be found on the Watlow "Controller Support Tools" disc included with the oven. User Manuals > EZ ZONE User Manuals > PM Limit (Overtemp Controller) or PM Integrated (Temp Controller)
How do I calibrate a vacuum oven?	Let's clarify "Calibrate" **NOTE:** Temp/calibration studies must be done under vacuum. Are you trying to verify or establish temperature uniformity? Are you trying to calibrate the temperature controller? **Method 1** – "Reference Calibration". Place a hermetically sealed thermocouple tip directly onto the tip of the oven's thermocouple. Use a vacuum rated, hermitically sealed thermocouple fitting. Attach to the KF25 fitting in the back of the oven. Do not run reference thermocouples pinched through the door. **Method 2** – "Straight Input Calibration" (controller accuracy). Access the controller from the bottom of the oven. Refer to the oven's electrical schematic for wiring info. Do an input calibration with a sourcing calibrator. **Method 3** – Gradient. Cascade TEK offers a procedure for this. IQ/OQ manual. See **Section 5: Optional Features** to purchase.
How do I change my controller from Celsius to Fahrenheit?	1. Press and hold both UP and DOWN arrows 6 seconds. 2. Display says A1 SEt. 3. Use arrows to go to GLbL (Global) on upper display. 4. Press green Recycle Key once to display C or F. 5. Use arrows to go to change to C or F. 6. Press Infinity Key twice to exit to main screen. See video instructions **here**.
My display reads "Er11" or "Er12". What does it mean?	**Loose thermocouple.** Thermocouple wires have come loose on the back of the controller. Jumper a wire across the TC input to see if error clears. Check thermocouple connection inside oven. Er12 = Heater Loop Thermocouple Fail.

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CONTROL

How do I find the serial number of my Watlow EZ Controller?

This info may be necessary for warranty support from Watlow:

1. Hold down the Infinity and Green Recycle Keys simultaneously (will take about 8 seconds).
2. Display says CUSt and FCtY.
3. Press DOWN arrow once to go to diAG on upper display.
4. Press Green Recycle Key once to display Pn (Part Number).
5. Part number will scroll across display, it should look similar this "PrOGr ICJ-ACFJCAA".
6. Press green Recycle Key again to see Sn (Serial Number).
7. Press green Recycle Key again to see dAtE (Date of Manufacture).
8. Press Infinity Key twice to exit to main screen.

What do the Watlow profile terms mean?

Terms	Description
t1	**Time Step:** Select temperature, time to temperature and toggle outputs.
Ent1	**Event 1:** Usually vacuum valve.
Ent2	**Event 2:** Usually vent valve (on automated systems only).
SoAk	**SOAK:** Holds temperature for set time period. Can also set events in this step.
JL	**Jump Loop:** Jumps to previous step (JS) for number of counts (JC)
WPr	**Wait For Process.** Waits for temperature to reach set-point before next step continues.
WP1	**Select Process Input #1** (chamber thermocouple)
WP1	**Select Process Value.** Choose ~5° less than desired to prevent long waits during undershoot.
End	**End Step.** Choose user to return to set-point before profile.

Watch our video: Cascade TEK Tutorial on Watlow EZ-Zone.

How do I get the EZ-Zone out of "OFF" mode?

1. Hold down UP and DOWN arrows together.
2. Display says A1 and oPEr.
3. Use UP/DOWN arrow to go to LooP on upper display.
4. Press green Recycle Key to display 1 LooP.
5. Press green Recycle Key again and use UP/DOWN keys to ensure display reads "Auto".
6. Press Infinity Key 3 times to exit to main screen.
7. Arrows should allow you to manually change temperature.

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C. TROUBLE SHOOTING

TEMPERATURE

Why does the temperature overshoot?	It is normal for temperature to overshoot in a vacuum oven prior to stabilization. This overshoot should be within 7% of the set-point. Once stable, the unit should maintain within the specified uniformity. **If the oven is overshooting and staying too hot, check the following:** 1. Temperature controller set too high. This will cause wild temperature swings and overshoot. 2. Oven is not under vacuum. Always run the oven under vacuum. **Call us if:** 1. Your oven is at or over the set temperature and the red "1" light is lit (blinking is to be expected and represents heaters maintaining set-point.) 2. Your oven temperature is over the temperature set on the Limit Controller and there is no alarm message.
Why doesn't the temperature display and my reference value not match?	Often times our customers want to see the exact heat that a part is seeing in an oven. Because there is no air in the chamber, the heat must radiate and conduct across the shelves and through the chamber. This takes a lot of time. **It is common for shelves to be much cooler than the walls and even the temperature probe for a number of hours during warm up.** When using an independent thermocouple to verify temperature, remember the following: 1. Always have the unit under vacuum when checking temperature. This means that TCs need to be remote access (wireless) or introduced through a hermetically sealed pass-through. You cannot run a TC through the door and expect good results. 2. Allow time for the unit to stabilize. We recommend at least 4 hours. 3. Attach the probe to the shelf with heat-resistant, non-conductive tape. 4. The reading should be within the uniformity tolerance in the specifications and may not match exactly. If the shelves run cooler than you would like to process your parts, you can use the temperature setting to increase the heat. Turn the oven up until the independent TC on the shelf or part is at your process temp.

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TEMPERATURE

Why does my vacuum oven take so long to heat up?	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 then the shelves, followed by the product. This takes time.
My temperature seems too low. Why?	Due to the lack of air in a vacuum oven, heat is transferred slowly by radiation and conduction. It takes much longer (up to 4 hours) for a vacuum oven to heat up and stabilize than a forced air oven. You can tell if the oven is heating by looking at the Temperature Controller display. There is a small number "1" on the display in the lower right corner. If this is on solid or blinking, the unit is calling for heat. If this is off, the unit is not heating. Try using up arrows on controllers to increase the temperature. If "1" does not come on = problem. 1. **Is the Temperature set-point (green display) greater than the current temperature (red display)?** a. If yes, the oven should be calling for heat and the red "1" should be on solid or blinking. b. If no, the oven is not heating because the set-point is less than the current temperature. 2. **Is the Limit Controller displaying an alarm message?** a. When the limit controller is set to a temperature less than the main temperature controller, the limit will trip, cutting power to the heaters. Check the limit setting. Increase the temperature of the limit controller to at least 10° over the main temperature controller setting. 3. **Has the door been opened or has there been a power outage?** a. It takes a number of hours for the unit to regain heat and stabilize. Look for the solid or flashing red "1" to make sure the unit is heating and then wait for it to come up to temperature. 4. **Is your unit getting enough supply voltage?**
Why isn't my unit heating up?	If the red "1" light is lit, this means the controller is calling for heat. If no heat is being generated, a relay may have failed, so the heaters are not being energized. 1. **Is your overtemp limit alarming?** a. If the EZ Limit Controller is alarming or set too low, it will prevent the oven from heating.

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MECHANICAL / VACUUM

My vacuum pump's oil is bubbly and milky. Why?

Rotary Vane pumps have a feature called the **gas ballast**. This feature of the pump might be useful to you if you have a high moisture application and are seeing water mixing with your oil. You can see this by looking in the sight glass. The oil will appear milky or you might see a layer of water or small trapped bubbles.

One way to keep this moisture out of your pump oil is to open the gas ballast valve. The gas ballast valve has two positions, "I" and "O". "O" is Off. It is acceptable to open the gas ballast valve to the atmosphere or use clean, dry air or nitrogen as a purge agent.

If you turn your gas ballast to open, your Vacuum Oven will not achieve the same ultimate pressure. In other words, your vacuum level will not be as low if you were running with the gas ballast open. Keep in mind that whatever you are pulling out of the oven is exiting the pump through the exhaust or the gas ballast. If you are evacuating compounds that cause a fire risk or inhalation hazard, you should be careful to make sure these are properly exhausted.

Oven won't hold vacuum. Why?

With any vacuum issues, there are a few things to check first before getting into the specific troubleshooting.

1. **First get back to basics:**
    a. Is the vent valve closed?
    b. Is the vacuum valve open?
    c. Is the vacuum pump properly connected to the vacuum port?
    d. Is the vacuum pump on and properly configured?
2. **Check the door gasket.** It should be well seated with no splits, cracks, flat or melted spots or any other defects. If any of these defects are present, replace the gasket.
3. **Check the door alignment.** When you close the door, is it making good contact with the gasket all the way around? When in doubt, use a little vacuum grease on the door gasket then shut the door. Did the grease transfer all the way around the gasket to the glass when opened? If not, realign the door using the floating hinges.
4. **Check connections to the pump** and any other feedthroughs or fittings. Is everything aligned properly and sealed?

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MECHANICAL / VACUUM

Why is vacuum pump oil bubbling out of the exhaust filter?

1. The simplest answer is that it is time to change your mist eliminator.
    a. **Check pump oil sight glass.** If you see clear oil right between the two lines, you probably just need to change your mist eliminator.
    b. **If the oil is cloudy**, fills up the sight glass so that you can't see the level or has water floating on top, keep reading.

2. **Excessive moisture can build up in the pump and displace the oil.** This can cause oil to get pushed out past the mist filter. Most likely you have moisture in your oil. You will likely need to do an oil change. Refer to your vacuum pump manual for type and amount of oil to purchase and instructions.

Once that is complete, let's talk about how to prevent this from happening. Here are some things to check:

1. **Is your process too wet?**
    a. Review your pump manual for water vapor tolerance. Does your application have too much water for your pump?
    b. If your pump can handle the vapor load, but it is still building up with moisture over time, try running the pump for 30 minutes to an hour after each cycle to allow the pump to clear the moisture.

2. **Are you pumping with the vent valve open?**
    a. The vacuum pump wants to pump down to ultimate vacuum and then idle there. The pump is not designed to overcome a large amount of atmosphere. This will happen if your vent AND vacuum valve are open at the same time.

    Never allow this to happen. Moisture from the atmosphere will condense in the pump oil, choking the pump.

Why doesn't my vacuum gauge get to 30" of Mercury (Hg)?

There are a couple of reasons that an oven may not make it to 30" Hg. **Rule out the following situations out before doing a leak check:**

1. Is the pump properly sized for the oven?
2. Is the pump getting the right amount of power?
3. Is there a large gas load coming off the samples?
4. Is the door sealing?

If all of those possibilities are ruled out, there may be a leak. Call our **customer service** group for advice.

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MECHANICAL / VACUUM

There is oil inside the oven, the inside window, and on my product. Why?

Do you have a dry–oil free pump connected to the oven?
If YES:

1. Your part is outgassing as part of the vacuum process.
2. Silicone door gasket has outgassed. Improperly cured door seal. Clean with IPA or other material suited for your part. Contact Cascade TEK for replacement.

Do you have an oil pump connected to the oven?
If YES:

"Backstreaming" may have occurred -- Operator error. Backstreaming occurs when:

1. The oven is under vacuum.
2. Vacuum and vent valves are CLOSED.
3. Vacuum pump is OFF.
4. Operator mistakenly opens the VACUUM valve. Nature abhors a vacuum, and rushes to equalize the pressure inside the oven. Since the vent valve is closed, the only air path is in thru the vacuum pump exhaust. Air rushes in thru the exhaust, back thru the pump, picking up oil and gunk from inside the pump, thru the vacuum line and deposits the gunk inside the oven.

The Remedy: Foreline Trap. Cascade TEK Oil Pump Connection Kits come with a Foreline trap. This filter will catch the oil/gunk in the event of a backstreaming error. You can thank us later.

If you have the foreline trap installed and oil still contaminates the inside of your oven:

1. Your foreline trap is saturated, loaded with moisture. Replace.
2. Your foreline trap is not installed properly or not at all.

Other possible causes:
Your part is outgassing as part of the vacuum process. Silicone door gasket has outgassed. Improperly cured door seal.

Clean with IPA or other material suited for your part. Clean oven = happy oven.

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PARTS LIST

PART NO.	DESCRIPTION
TVO-1 VACUUM OVEN	
7420009	SHELF - TOP 2 EACH
7420016	SHELF - BOTTOM 1 EACH
3860006	HEATER ELEMENT ASSY., LEFT/RIGHT
1800002	POWER CORD (TVO-1 -120V)
TVO-2 VACUUM OVEN	
7420010	SHELF - TOP 2 EACH
7420017	SHELF - BOTTOM 1 EACH
3860007	HEATER ELEMENT ASSY., LEFT/RIGHT
3860008	HEATER ELEMENT ASSY., BOTTOM
1800002	POWER CORD (TVO-2 -120V)
1800003	POWER CORD (TVO-2 -240V)
TVO-5 VACUUM OVEN	
7420011	SHELF
7420013	SHELF CLIP
3860010	HEATER ELEMENT ASSY., SIDE / TOP
3860009	HEATER ELEMENT ASSY., BOTTOM
3860011	HEATER ELEMENT ASSY., SIDE W/PROBE
1800002	POWER CORD (TVO-5 -120V)
1800003	POWER CORD (TVO-5 -240V)

NOTE: Part Numbers are subject to change.
Please confirm description and model number with your order.

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SECTION 4: PARTS LIST

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PART NO.	DESCRIPTION
ALL VACUUM OVEN PARTS	
3100035	VALVE ASSY 1/4” SST FERRULE
3100037	VALVE ASSY 3/8” SST FERRULE
3500020	VACUUM GAUGE - BOURDON TUBE, NEEDLE
1750017	WATLOW EZ CONTROLLER - MAIN TEMP CONTROLLER
1750038	WATLOW EZ LIMIT CONTROLLER - OVER TEMP
7850028	GREEN I/O SWITCH
7950019	TERMINAL BLOCK 18 POSITION
703033	SOLID STATE RELAY
2700002	ADJUSTABLE FEET
3100087	1/4” BARBED INSERT
3100088	3/8” BARBED INSERT

PART NO.	Max. TEMP	DESCRIPTION
DOOR GASKETS		
TVO-1 (9x9)		
3450001	220°C	Silcone (Standard)
3450669	150°C	Viton (Low Outgassing)
TVO-2 (12x12)		
3450002	220°C	Silcone (Standard)
3450670	150°C	Viton (Low Outgassing)
TVO-5 (18x18)		
3450003	220°C	Silcone (Standard)
3450671	150°C	Viton (Low Outgassing)

NOTE: Part Numbers are subject to change.
Please confirm description and model number with your order.

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PUMP CONNECTION KIT COMPONENTS

OIL PUMPS

Item	QTY	Part Number
TVO-5 KF25 Oil Pump Kit	**1**	**9990001**
Hose Clamps	2	1150001
KF25 Clamps	3	8580001
KF25-3/8": Tube Stub	1	3100001
KF25 Centering Rings	1	8580006
Mist Eliminator	1	8590001
Foreline Trap	1	8590002
Vacuum Tubing, 3/8" ID	4'	8550001

Item	QTY	Part Number
TVO-2 KF16 Oil Pump Kit	**1**	**9990004**
Hose Clamps	2	1150001
KF16 Clamps	4	8580002
KF16-3/8": Tube Stub	1	3100003
KF16 Centering Rings	2	8580008
Mist Eliminator	1	8590003
Foreline Trap	1	8590004
Vacuum Tubing, 3/8" ID	4'	8550001
KF16 Full Nipple (Spacer)	1	3100004

DRY PUMPS

Item	QTY	Part Number
TVO-5 KF25 Dry Pump Kit	**1**	**9990006**
Hose Clamps	2	1150001
KF25 Clamps	1	1115001
KF25-3/8: Tube Stub	1	3100009
KF25 Centering Rings	1	6000001
Vacuum Tubing, 3/8" ID	4'	8550001

Item	QTY	Part Number
TVO-2 KF25 Dry Pump Kit	**1**	**9990006**
Hose Clamps	2	1150001
KF25 Clamps	1	8580001
KF25-3/8": Tube Stub	1	3100003
KF25 Centering Rings	1	8580006
Vacuum Tubing, 3/8" ID	4'	8550001

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USB TO RS-485 CABLE CONNECTION

This "plug and play" cable is available for purchase from Cascade TEK. Call us, we will send you one. It allows you to use Watlow's Configurator Software for your oven:

IQ / OQ: QUALIFICATION MANUALS

Complete IQ / OQ manual customized to your oven and tracked by serial number.

ON-SITE QUALIFICATION SERVICES

Factory-Authorized performance of IQ / OQ available upon request. Please inquire for pricing and availability.

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TVO-1: 0.56 cubic foot Vacuum Oven

INTERIOR DIMENSIONS (WxHxD)	9” X 9” X 12”
EXTERIOR DIMENSIONS (WxHxD)	15.75” x 21.5” x 20”
TEMPERATURE RANGE	5° C above ambient to 220°C (gasket dependent)
TEMPERATURE UNIFORMITY	±7% of set-point @ 150°C
VACUUM RANGE	Better than 30 Microns (29.9” Hg)
VACUUM GAUGE	0-30” hg
CONTROLS	Watlow EZ programmable control with ramp & soak capabilities. Watlow EZ Limit Independent over temperature controller. DB25 pin RS-485 serial comm port.
HEATERS	1,000 watts
POWER	120V, 1ph, 50/60Hz, 9A
SHELVES	2 (stackable)
FULL GLASS VIEWING DOOR	
PORT	1” vacuum port in rear (KF25)
WEIGHT (UNCRATED)	68 lbs.
STANDARD DOOR GASKET	Silicone 220°C Max.

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SECTION 6: VACUUM OVEN SPECIFICATIONS

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TVO-2: 1.7 cubic foot Vacuum Oven

INTERIOR DIMENSIONS (WxHxD)	12” X 12” X 20”
EXTERIOR DIMENSIONS (WxHxD)	18.75” x 24.5” x 26.5”
TEMPERATURE RANGE	5° C above ambient to 220°C
TEMPERATURE UNIFORMITY	±7% of set-point @ 150°C
VACUUM RANGE	Better than 30 Microns (29.9” Hg)
VACUUM GAUGE	0-30” hg
CONTROLS	Watlow EZ programmable control with ramp & soak capabilities. Watlow EZ Limit Independent over temperature controller. DB25 pin RS-485 serial comm port.
HEATERS	1,500 watts
POWER	120V, 1ph, 50/60Hz, 13A
SHELVES	3 (stackable)
FULL GLASS VIEWING DOOR	
PORT	1” vacuum port in rear (KF25)
WEIGHT (UNCRATED)	148 lbs.
STANDARD DOOR GASKET	Silicone 220°C Max.

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SECTION 6: VACUUM OVEN SPECIFICATIONS

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TVO-5: 4.6 cubic foot Vacuum Oven

INTERIOR DIMENSIONS (WxHxD)	18.25” x 18.25” x 24”
EXTERIOR DIMENSIONS (WxHxD)	25” x 30.5” x 30.5”
TEMPERATURE RANGE	5° C above ambient to 220°C
TEMPERATURE UNIFORMITY	±7% of set-point @ 150°C
VACUUM RANGE	Better than 30 Microns (29.9” Hg)
VACUUM GAUGE	0-30” hg
CONTROLS	Watlow EZ programmable control with ramp & soak capabilities. Watlow EZ Limit Independent over temperature controller. DB25 pin RS-485 serial comm port.
HEATERS	1,500 watts
POWER	208V-220V, 1ph, 50/60Hz, 13 Amps
SHELVES	3 (adjustable)
FULL GLASS VIEWING DOOR	
PORT	1” vacuum port in rear (KF25)
WEIGHT (UNCRATED)	350 lbs.
STANDARD DOOR GASKET	Silicone 220°C Max.

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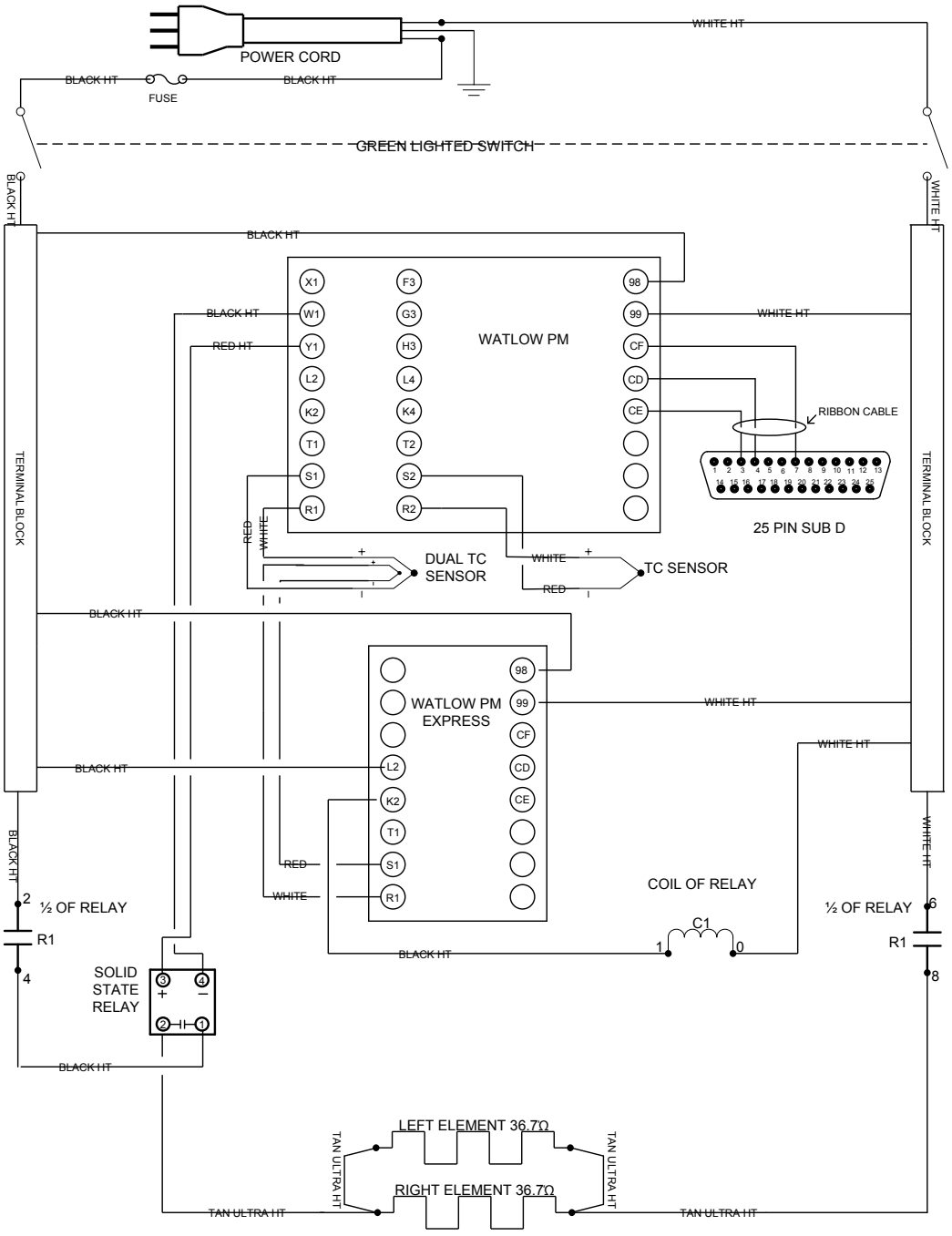
TVO-1 120V VACUUM OVEN



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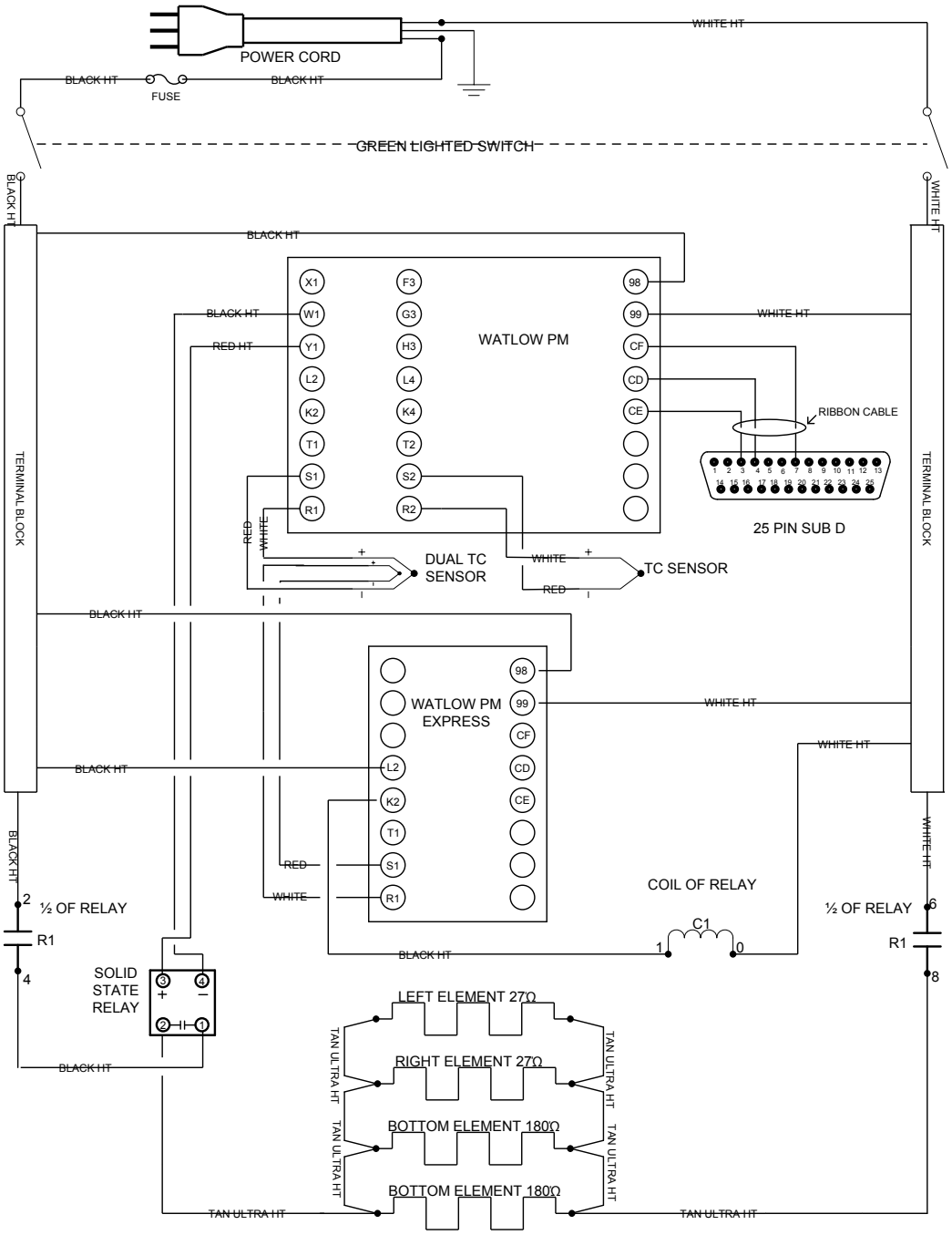
TVO-2 120V VACUUM OVEN



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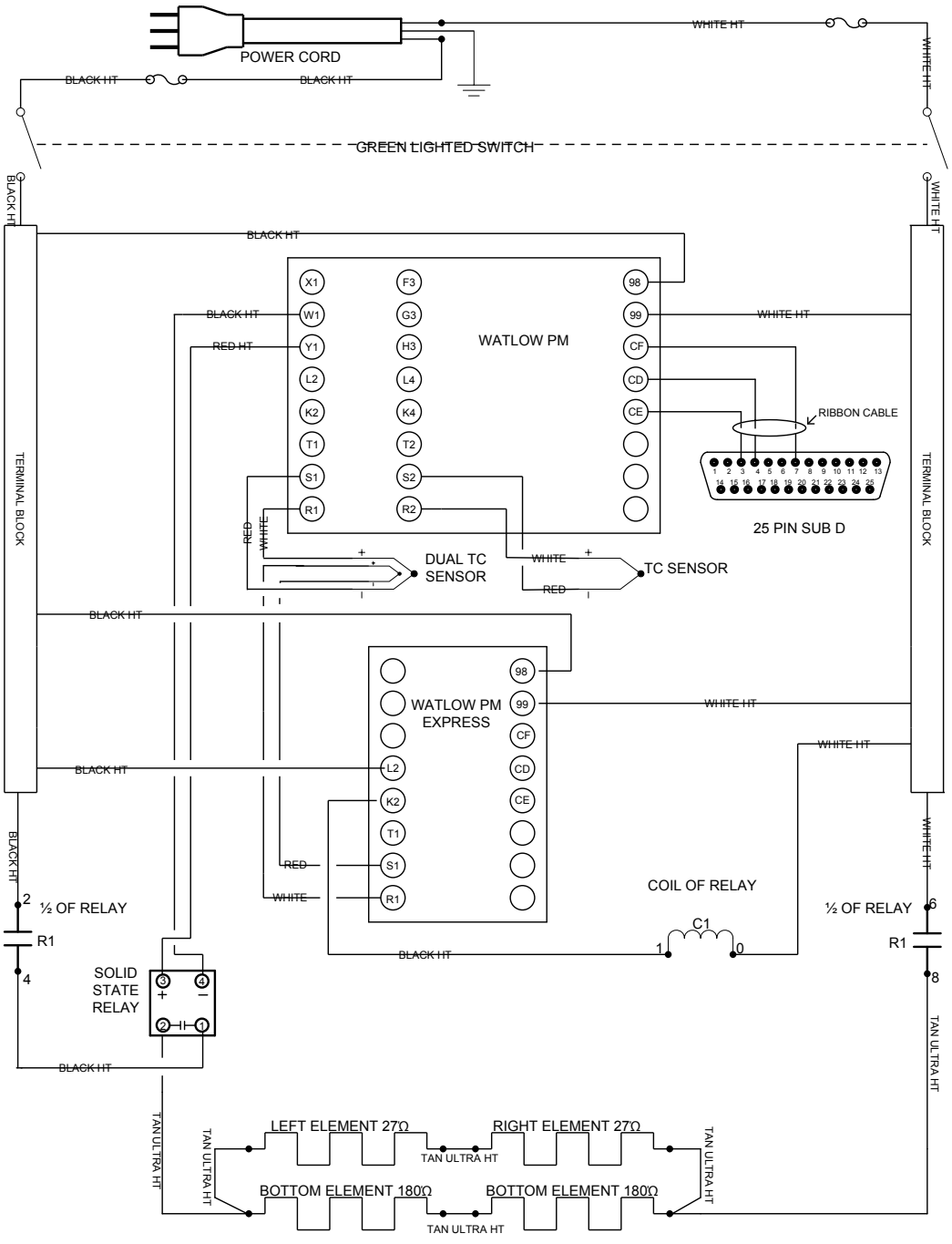
TVO-2 220V VACUUM OVEN



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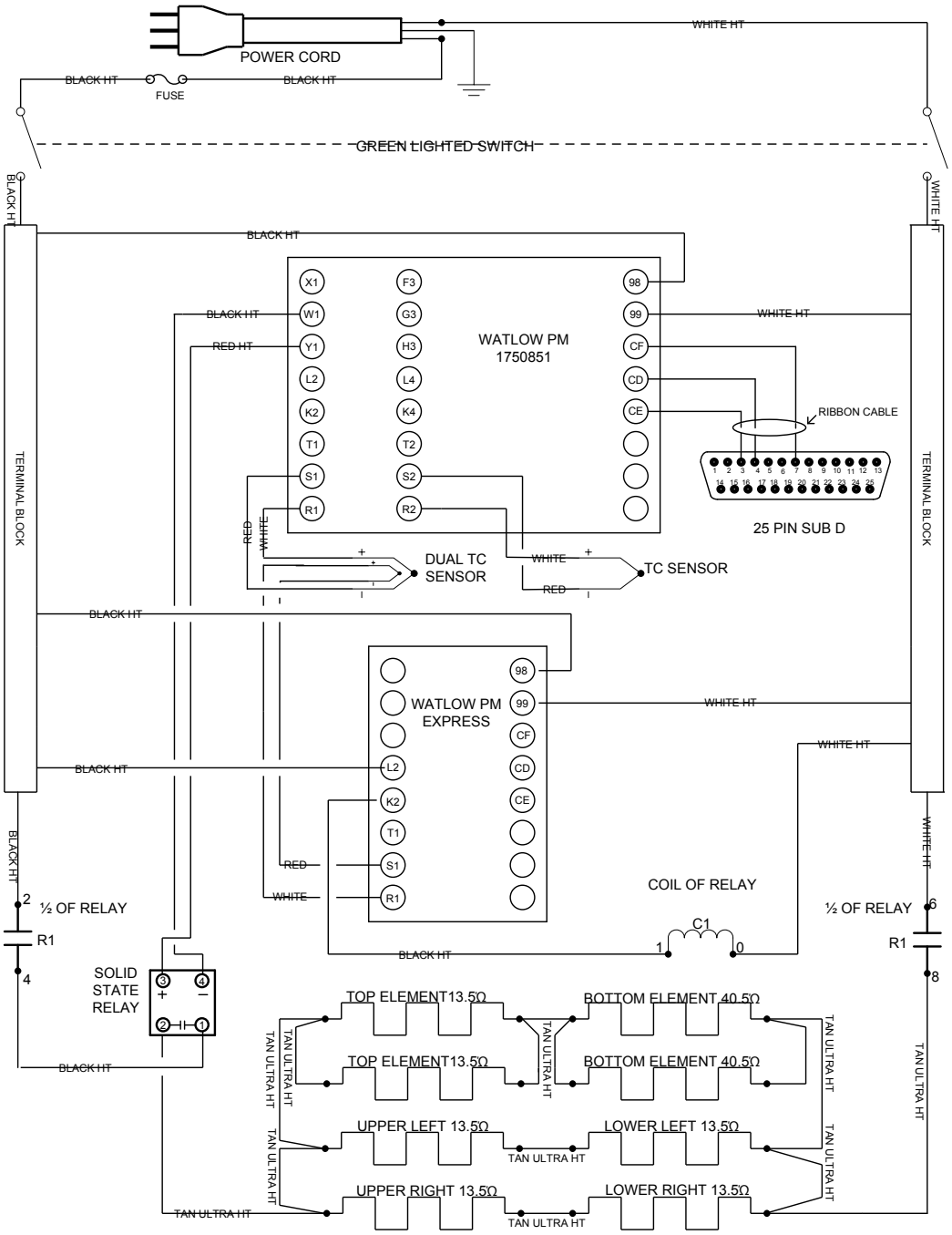
TVO-5 120V VACUUM OVEN



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SECTION 8: WARRANTY

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Manufacturer warrants for the original user of this product in the U.S.A. only that this product will be free from defects in material and workmanship for a period of one year from the date of delivery to the original user - the "Warranty Period".

During the Warranty Period, the Manufacturer, at its election and expense, will repair or replace the product or parts that are proven to Manufacturer's satisfaction to be defective, or at Manufacturer's option, refund the price or credit (against the price of future purchases of the product) the price of any products that are proven to Manufacturer's satisfaction to be defective.

This warranty does not include any labor charges if outside of the U.S.A. This warranty does not cover any damage due to accident, misuse, negligence, or abnormal use.

Use of Manufacturer's product in a system that includes components not manufactured by Manufacturer is not covered by this warranty.

This warranty is void in the event that repairs are made by anyone other than Manufacturer without prior authorization from Manufacturer.

Any alteration or removal of the serial number on Manufacturer's products will void this warranty. Under no circumstances will Manufacturer be liable for indirect, incidental, consequential, or special damages.

The terms of this warranty are governed by the laws of the state of Oregon without regards to the principles of conflicts of laws thereof. If any provision of this limited warranty is held to be unenforceable by any court of competent jurisdiction, the remainder of this limited warranty will remain in full force and effect.

This warranty is in lieu of and excludes all other warranties or obligations, either express or implied. Manufacturer expressly disclaims all implied warranties, including without limitation, the warranties of merchantability and fitness for a particular purpose.

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