<u>DRIEAZ</u> Owner's Manual – Dragon K85 Mobile Furnace

TUINACE 115-volt model

DRI-EAZ PRODUCTS. INC.

15180 Josh Wilson Road, Burlington, WA USA 98233 Fax: (360) 757-7950 Phone: (360) 757-7776 www.dri-eaz.com

The Dragon K85 Mobile Furnace is a diesel fuel- and electric-powered indirect fired heater. It provides heated air without adding moisture for a variety of applications, including water damage restoration, structural drying, construction, and temporary event shelters.

Safety Information

Read this Owner's Manual carefully to learn how to properly operate and service your Dragon K85 Mobile Furnace. This manual should be considered a permanent part of the machine and should remain with the Dragon if you sell it.

AWARNING

Failure to comply with the instructions and precautions provided in this Owner's Manual can result in death, serious bodily injury, and/or property loss or damage from hazards of fire, explosion, burn, asphyxiation, carbon monoxide poisoning, and/or electrical shock.

Electrical Connections

The Dragon K85 Mobile Furnace is designed to operate on a 115V/60 Hz electrical connection. Make sure that the electrical outlet is grounded with three prongs. When using with an extension cord, use only a grounded cord intended for outdoor use and rated to deliver enough power to the Dragon (4.4 amps@115V or 506W).

Fuel Type

The Dragon K85 Mobile Furnace is designed to operate on diesel #2 fuel oil only. The Dragon can operate for a minimum of 8 hours using the <u>internal</u> tank that holds 9.3 gallons (35 L). <u>Do not run the Dragon out of fuel</u>, as it may be difficult to restart. For longer unattended use, it is recommended that you purchase a larger, DOTapproved <u>external</u> fuel tank to use with the external fuel siphon.

If external tank is used, cover opening to prevent contaminants from entering tank. Place tank on flat, stable surface to prevent tipping or spilling. Failure to use diesel fuel could cause injury and permanent damage to the unit. It may also void the Dri-Eaz warranty.

Altitude Adjustment

The Dragon is factory-set for use at elevations up to 2000 feet. For use above 2000 feet, the unit must be adjusted to avoid excessive soot build-up and possible flue fire. Failure to adjust for high-altitude use could cause injury, permanent damage to the unit and secondary damage when ducting into a structure. It may also void the Dri-Eaz warranty. Have a qualified HVAC technician adjust the unit for use in your area. Black or gray/white smoke coming from the flue indicates an improper air to fuel ratio. Call an authorized service center or HVAC specialist for assistance. For questions call: 1-888-867-3235.

OVERVIEW

Introduction

The Dragon K85 Mobile Furnace is an indirect fired heater. It supplies heated air to an area without adding any moisture or fumes through the heating process. The Dragon is able to do this by using a heat exchanger so that the process air never comes into direct contact with the flame in the combustion chamber.

The Dragon operates from outside the structure. It draws in the ambient outdoor air and increases its temperature by 81°F. An electric fan directs this heated air into the structure through ducting. The remote thermostat automatically cycles the Dragon on and off to maintain a preset temperature in the affected area.

The clean, dry heat from the Dragon helps reduce drying times while maintaining stable and comfortable temperatures. The Dragon is ideal for any number of applications, including:

- water damage restoration
- new construction drying
- unheated jobsites
- temporary event shelters
- any situation calling for clean, dry heat

Principles of Use

For applications like water damage restoration and new construction drying, the Dragon can increase drying efficiency.

Areas of a structure that can benefit from the addition of heat for drying include: crawlspaces, basements, or parts of a building where heat is not available.

Cold air actually impairs the evaporation of moisture from materials. Warm air from the Dragon helps airmovers and dehumidifiers evaporate more moisture from materials and remove it from the structure. For instance, raising the temperature of an area with the Dragon by just 10°F (from 60°F to 70°F) can increase the evaporative potential of your existing drying system up to 45 percent.

The specific target drying temperature will vary according to the conditions of each drying job. Determining, creating, and maintaining the optimum drying conditions on a job—including temperature and relative humidity—is your responsibility.

For best results when using the Dragon for drying, you should understand the basic principles of psychrometry—the science of drying. You should also know how to use moisture detection instruments to track the moisture content of a structure throughout the entire drying process. You can learn these skills and more in an IICRC-certified Applied Structural Drying (ASD) course. To learn more about ASD courses, contact the Dri-Eaz Education Department at 1-800-575-5152.

With this in mind, there are some general principles to keep in mind when using the Dragon. You should try to stabilize the temperature of the affected area near the ideal operating temperature of your drying equipment. Most dehumidifiers perform at their best between 70°F to 90°F. The added heat from the Dragon will increase the rate of evaporation by decreasing the relative humidity of the affected area. Be certain that your combination of airmovers and dehumidifiers is powerful enough to keep the relative humidity well below 60%RH to avoid secondary damage to the structure and contents.

Accessories Included

The Dragon K85 Mobile Furnace includes the following parts and accessories:

- 1 Dragon K85 Mobile Furnace
- 1 Flue with cap
- 1 Remote thermostat
- 1 External fuel siphon
- 2 30-ft ducting (8-in diameter)*
- 2 Duct clamps
- 2 2-ft heat shields (10-in diameter)

*Replacement ducting can be obtained from Grainger (Part #3XK06). For more information, go to www.grainger.com



- A Rear Handle
- B Air Intake Grill
- **C** Flue
- **D** Ducting
- E Fuel line guard plate
- F Internal tank fuel lines
- G External fuel siphon holder
- H Wheels
- I Duct rings
- J Front handle/cord wrap
- K Flame Control Reset Button
- L Fuel pump/blower assembly housing
- M Power cord
- N FAN switch
- O HEAT switch
- P Thermostat jack
- **Q** Temperature-Limiter Reset Button
- **R** Internal fuel tank fill neck
- S Internal fuel tank drain plug
- T Air Intake vents

OPERATING THE DRAGON

Breathing Hazard

AWARNING

Fuel exhaust contains deadly carbon monoxide gas. Operate Dragon only outdoors in open area. NEVER operate indoors or in enclosed spaces.

Electric Shock Hazard

AWARNING

Unit must be grounded. Use only with 3-hole grounded outlet.

Never modify plug or use an adaptor. If an extension cord is needed, it must have a three-prong grounding plug, be rated for outdoor use and be rated for at least 506 watts or 4.4 amps @ 115 volts.

Never operate the Dragon in pooled or standing water. If electrical components become wet, allow to dry before using.

AWARNING

Fire and Explosion Hazard

Burner produces sparks and flame and unit becomes hot during use.

Keep away from flammable vapors, such as those from gasoline, paint thinner or solvents.

Keep away from combustible dusts, such as coal dust or sawdust.

Keep unit at least ten feet away from any combustible material.

Keep children and pets away.

Diesel fuel is flammable and can be explosive.

Do not smoke while operating, servicing, or refueling the Dragon.

Before refueling, shut off unit, allow to cool and then unplug.

Hot surfaces can ignite fuel vapors.

Setting up the Dragon

AWARNING

Choosing a location

Use the Dragon outdoors <u>only</u>. Place the unit on a level, stable surface. Choose an inconspicuous location away from high-traffic areas for children and/or pets. Ensure there is no obstruction in the air intake during the use of the Dragon.

NOTICE: Keep air intake vents under unit clean and clear of any obstruction. Avoid setting up unit where the intake could be blocked or restricted i.e. tall grass, deep

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snow, etc. Blocking the air intake will cause the unit to burn inefficiently resulting in sooty exhaust and potential damage to the unit and the structure being heated.



Air Intake vents shown from underneath unit.

Connecting the internal tank fuel lines

To connect the fuel lines, simply push the male and female adapters together until the lock rings snap into place. Note that the adapters are arranged so that you will always connect the lines properly. You must always connect <u>both</u> fuel lines.



Connect the internal tank fuel lines

The Dragon is shipped with the fuel lines disconnected. Before operating, make sure the fuel lines from the internal tank are properly connected.

You may also operate the Dragon with an external fuel tank (not included). See the section "Connecting an external fuel tank" for more information.

Fill the internal fuel tank

The Dragon is shipped with an empty fuel tank. Before operating, fill the internal tank with <u>diesel #2 fuel oil</u> only. The internal tank has a 9.3-gallon capacity. Do not overfill.

Attaching the flue to the Dragon

The Dragon is designed to operate with the flue attached to the top of the unit. Always operate the Dragon with the flue attached. In addition to preventing any water or debris from falling into the heat exchanger, the flue creates a slight draft on the Dragon exhaust that assists in preventing thermal overload.

1. To attach the flue, slide it over the pipe on top of the heat exchanger.



Attach the flue to the Dragon

2. Drill two 1/8-inch holes through the bottom of the flue into the heat exchanger pipe. The holes should be approximately 90 degrees apart.



Drill two 1/8-inch holes in the flue

3. Drive a sheet metal screw (#8x1) through each hole to secure the flue to the Dragon.



Secure the flue to the Dragon with sheet metal screws

Attaching ducting to the Dragon

The Dragon delivers clean heat to a structure through two 30-foot lengths of 8-inch diameter aluminum ducting. You must attach both lengths of ducting to the Dragon for operation.

 Extend a 1-foot section of ducting and slide a hose clamp over the end. Slip the ducting over one of the Dragon outlet duct rings. Secure the ducting firmly to the duct ring with the hose clamp. Make sure the clamp is tight enough to hold the ducting in place when you extend it to the structure.



Clamp the ducting securely to the duct ring

2. Slide one of the heat shields over the ducting until it rests against the Dragon housing. This will provide extra protection against burns from accidental contact with hot surfaces near the duct rings.



Slide the heat shields in place

- 3. Grasp the free end of the ducting and pull until it reaches the structure. Take care not to damage the aluminum ducting, as this could restrict airflow during operation and cause the unit to shut off from thermal overload.
- 4. Repeat steps 1 through 3 for the other length of ducting. Always connect both lengths of ducting from the Dragon to the affected area.

Securing ducting to the structure

In most drying situations you will need to attach the end of the ducting to an opening in the structure such as a basement window or crawlspace vent hole. Since each structure is unique, you will usually need to build an adapter to fit the specific opening.

To build two adapters, you will need:

- 2 Plywood sheets
- 2 Duct adapters, 8-inch diameter
- 2 Hose clamps
- 1 Jigsaw
- 1. Cut a sheet of plywood to fit over the opening in the structure.
- 2. Use a jigsaw or similar tool to cut an 8-inch diameter hole in the center of the plywood.
- 3. Fit an 8-inch diameter duct adapter (available at most hardware stores) into the hole in the plywood. Secure the duct adapter to the plywood.
- 4. Slip a hose clamp (not included) over the free end of one of the 30-foot lengths of 8-inch diameter aluminum ducting. Slide the ducting over the adapter and secure firmly with the hose clamp.
- 5. Secure the plywood to the structure.

6. Repeat steps 1 through 4 for the second length of aluminum ducting. Always connect both lengths of ducting from the Dragon to the affected area.

Connecting the remote thermostat

The thermostat monitors the temperature in the affected area. It turns the Dragon on and off to maintain a preset temperature in the affected area.

Always operate the Dragon with the remote thermostat connected. The HEAT switch will not function and the Dragon will not heat the air if the thermostat is not connected.



The remote thermostat sensor cable, control box, cable, and jack

- 1. Run the thermostat's 8-foot sensor cable into the affected area. If necessary, drill a small hole in the plywood adapter.
- 2. Position the tip of the sensor cable as far away as possible from the Dragon process air—at least six feet for best results.

Note: Only the tip of the sensor cable will read temperature.

3. Place the thermostat control box where it will be easy to monitor temperature setting. The control box is weatherproof and may be left outside. 4. Plug the thermostat into the jack on the Dragon. The jack is located next to the HEAT and FAN switches.



Plug the thermostat into the jack on the Dragon

Note: The HEAT switch will not function and the Dragon will not heat the air unless the thermostat is plugged into the jack.

For more information about operating the remote thermostat, see the section "Programming the thermostat."

Establishing negative air pressure

Always create a negative air pressure in the affected area when using the Dragon. An area has negative air pressure when the air pressure inside is lower than outside. This helps prevent odors and contaminants from spreading to unaffected areas through cracks, crevices, and openings in the structure walls.

On average, the Dragon will force in about 800 CFM. As long as you remove more than 800 CFM through an exhaust opening, more air will flow <u>out</u> of the affected area than will flow <u>in</u> from the Dragon. This differential creates the negative air pressure in the affected area—a slight vacuum effect—so that any contaminants and odors are exhausted harmlessly outdoors instead of being forced into other areas of the structure.

- 1. First close or block any large openings between the affected area and other parts of the structure.
- 2. Select an opening between the affected area and the outdoors to use as an exhaust, preferably on a side opposite the Dragon process air. A window or crawlspace vent hole will do.
- 3. Place a TurboDryer, Vortex Axial Fan, or other airmover so that it forces air <u>out</u> of the affected area <u>to the outdoors</u> through the selected opening. The airmover should remove at least 800 CFM from the affected area.

Starting the Dragon

Inspecting before operation

Warning! Before starting the Dragon:

 \Box Check for any fuel leaks around the fuel tank or fuel lines.

□ Check for nearby hazards like combustible materials or flammable vapor sources.

□ Check the power cord for damage.

Correct these and any other safety hazards before starting the Dragon.

Starting the Dragon

- 1. Check the fuel tank. If needed, add #2 diesel fuel to the fuel tank. Do not overfill. **WARNING!** Turn off power and allow unit to cool before refueling.
- 2. With the ducting secured, the thermostat in place, and negative air pressure established, plug the Dragon's power cord into a nearby outlet.
- 3. Turn the HEAT switch to on. This provides power to the thermostat. The thermostat will only function when the HEAT switch is on.
- 4. While the Dragon's heat exchanger is warming up, set the desired temperature on the thermostat control box. See the next section, "Programming the thermostat," for more information.
- 5. Monitor the settings on the Dragon and conditions in the structure at least twice daily during operation.

Programming the thermostat

The remote thermostat controls the operation of the Dragon. Based on the settings you program, the Dragon will cycle on and off to maintain a predetermined temperature in the affected area. It can be programmed in either degrees Fahrenheit or Celsius.

1. When the Dragon is plugged in and the HEAT switch is first turned on, the thermostat will display the ambient temperature.



Before programming, the thermostat shows the current ambient temperature

 Press the SET key once to access the Fahrenheit/Celsius mode. The display will show the current status, either F for Fahrenheit or C for Celsius. To switch between the two, press either arrow key. Choose either F or C.



Choose either Fahrenheit (F) or Celsius (C) mode

2. Press the SET key again to access the setpoint. The display will blink "S1" and show the current setpoint in degrees. The setpoint is the maximum temperature you wish to maintain in the affected area.

For example, with a setpoint of 85°F, the Dragon will stop heating when the temperature exceeds 85°F.

Use the arrows to choose a setpoint.



Use the arrows to choose a setpoint

3. Press the SET key again to access the differential. The display will blink "DIF 1" and show the current differential. The differential is the number of degrees the temperature will drop below the setpoint before the Dragon begins a heating cycle. In other words, the differential determines the minimum temperature of the affected area.

For example, with a setpoint of $85^{\circ}F$ and a differential of 5, the Dragon will begin a heating cycle when the temperature of the affected area drops below $80^{\circ}F$.

Press the up or down arrow keys to select a differential. You can select a differential from 1°F to 30°F.



Use the arrows to select a differential

 Press the SET key again to access the heating or cooling mode. The display will show the current mode, either C1 for cooling or H1 for heating. Using the arrow keys, <u>select H1</u> for the <u>heating mode</u>.



Important! Make sure the thermostat is set to H1 for the <u>heating mode</u>. The Dragon will not function properly with the thermostat in cooling mode.

5. Press the SET key once more to complete the programming of the thermostat.

Shutting the Dragon Off

- 1. Turn the HEAT switch to "Off" but leave the unit plugged in. *NOTICE:* Do not turn the Dragon off by simply unplugging the unit, as this could cause thermal overload. You must allow time for the fan to cool the heat exchanger.
- 2. Leave the unit plugged in for at least 10 minutes while the fan cools the heat exchanger. The fan will turn off and on during the cooling cycle.
- 3. After a minimum 10-minute cooling period, you may unplug the unit.

Special Instructions

Preventing thermal overload

If the temperature of the heat exchanger exceeds 212°F (100°C), the Dragon will automatically shut down due to thermal overload and must be reset before it will start again. The most common cause of thermal overload is restricted airflow. To help prevent thermal overload, you should:

- Make ducting runs as straight as possible
- Keep the ducting free of debris and unobstructed
- Keep the air intake grill unobstructed

Restarting after thermal overload

If the Dragon shuts off due to thermal overload, follow these instructions for restarting.

- 1. Wait 10 minutes to let the Dragon cool down.
- 2. Make certain that ducting runs are straight and unobstructed. Make certain the air intake is unobstructed.
- 3. Unscrew the plastic cover for the Temperature-Limiter Reset Button located near the HEAT and FAN switches.



Remove the plastic cover for the Temperature-Limiter Reset Button

4. Using a pen or a pencil, depress the Temperature-Limiter Reset Button.



Use a pen or pencil to depress the Temperature-Limiter Reset Button

- 4. Replace the plastic cover on the Temperature-Limiter Reset Button.
- 5. Make certain the HEAT switch is turned on.

If the heater continues to shut off due to thermal overload, contact the Dri-Eaz Service Department at 1-888-867-3235.

Restarting after running out of fuel

If the Dragon runs out of fuel, it will automatically shut off.

NOTICE: Check internal tank fuel level at least every 8 hours to avoid running out of fuel, as the unit may require servicing to be restarted.

Follow these instructions for restarting:

- Turn the HEAT switch off and unplug the Dragon. WARNING! Allow the Dragon to cool for at least 10 minutes.
- 2. Refill the fuel tank with diesel #2 fuel oil only. The internal tank has a 9.3-gallon capacity. Do not overfill. Turn off power and allow unit to cool before refueling.
- 3. Plug the Dragon back in to a grounded outlet using an appropriately rated extension cord.
- 4. Turn the HEAT switch to on.

5. Press the Flame Control Reset Button once. To access the button, swivel the metal cover on the fuel pump/blower assembly housing.



Press the Flame Control Reset Button

 The Dragon will restart after priming the fuel pump. If the Dragon does not restart immediately, wait one minute and press the Flame Control Reset Button again. Repeat until the Dragon starts. If the unit will not restart, contact Dri-Eaz Service at 888-867-3235.

Using an external fuel tank

The <u>internal</u> fuel tank of the Dragon K85 Mobile Furnace has a capacity of 9.3 gallons (35 L). Depending on the specific conditions and thermostat settings, the Dragon can operate anywhere from a minimum of 8 hours (firing continuously at 0.69 gal/hr) up to more than 24 hours (firing intermittently to maintain a constant temperature) on a full <u>internal</u> tank of fuel.

If you will be operating the unit unattended for more than 8 hours, we recommend that you purchase a larger DOT-approved <u>external</u> fuel tank to use with the external fuel siphon on the Dragon. This will allow you to operate the Dragon for longer periods between refueling. Even though you may not need to refuel with an external tank, you should continue to physically check the Dragon at least once a day during operation.

WARNING! Diesel fuel is flammable and potentially explosive. Place external tank on flat, stable surface to prevent spills.

NOTICE: Always use a clean fuel tank and fuel source to prevent fuel problems. Cover the opening to prevent moisture or contaminants from getting into fuel.

Connecting an external fuel tank

WARNING! Diesel fuel is flammable and potentially explosive. Always turn off and unplug the Dragon before switching between internal and external tanks. Do not smoke while connecting fuel tanks. Keep away from open flame.

- 1. Disconnect the two fuel lines coming from the internal fuel tank. To do this, slide the lock rings back and pull the adapters apart.
- 2. To prevent fuel leakage or damage to the adapters, connect the fuel lines together while not in use. Wipe any excess fuel oil from the adapters.
- Connect the fuel lines from the external fuel siphon to the adapters on the Dragon housing. To do this, push the male and female adapters together until the lock rings snap into place. *NOTICE:* Be sure the lock rings snap securely to avoid diesel fuel leakage.
- 4. Insert the siphon into the external fuel tank. Feed the fuel lines through the plastic cover until the siphon rests on the bottom of the tank.
- 5. Operate the Dragon as instructed elsewhere in this manual.

Reconnecting the internal fuel tank

WARNING! Diesel fuel is flammable and potentially explosive. *NOTICE:* Always turn off and unplug the Dragon before switching between internal and external tanks. Do not smoke while connecting fuel tanks. Keep away from open flame.

- 1. Remove the external fuel siphon from the external fuel tank. Wipe the siphon and fuel lines clean of excess fuel oil.
- 2. Disconnect the fuel lines from the external tank. To do this, slide the lock rings back on the female adapters and pull the adapters apart.
- 3. To prevent fuel leakage or damage to the external fuel line adapters, connect the lines together while not in use. Wipe away any excess fuel oil.
- 4. Connect the fuel lines from the internal fuel tank to the adapters on the Dragon housing. To do this, push the male and female adapters together until the lock rings snap into place. Note that the male and female adapters are arranged so that you will always connect the lines properly.

Draining the internal fuel tank

You may occasionally need to drain the internal fuel tank for shipping or storage. The Dragon is equipped with a fuel tank drain plug on the bottom of the unit near the wheel axle.



The internal fuel tank drain plug

WARNING! Diesel fuel is flammable and potentially explosive. Always turn off and unplug the Dragon before draining the internal fuel tank. Do not smoke while draining fuel. Keep away from open flame.

- 1. Place an appropriate container beneath the drain plug to catch any remaining fuel oil.
- 2. Remove the drain plug with a wrench.
- 3. Allow the internal fuel tank to drain completely.
- 4. Screw the drain plug back into the Dragon. Tighten with a wrench.
- 5. Dispose of excess fuel oil in accordance with local regulations.

Using the Dragon as a ventilator

The Dragon may also be used purely as a ventilator to deliver clean, <u>unheated</u> air to an affected area.

NOTICE: If you are ventilating spaces adjacent to living areas, you must still create a negative pressure in the affected area. This will help prevent contaminants from being forced into clean areas. See the section "Establishing negative air pressure" for more information.

1. Set up the Dragon as directed in the section "Setting up the Dragon." However, you do not need to add fuel, attach the flue, or connect the remote thermostat. As a ventilator the Dragon will operate on electricity alone.

2. Turn the FAN switch to "On."

MAINTENANCE

Replacing the fuel intake filter

The fuel intake filter should be replaced at least once every year. Depending on the quality of fuel oil and the frequency of use, the fuel intake filter may need to be replaced more frequently. You will need:

- Phillips screwdriver
- Clean shop rags
- 1. Remove the housing cover for the fuel pump/blower assembly and the fuel line guard plate. To do this, remove the six Phillips screws that secure the housing cover and guard plate.



Remove the fuel pump/blower assembly housing and guard plate

2. Close the fuel line shut-off valve by turning the red knob clockwise.



Close the fuel line shut-off valve

3. Place a shop rag beneath the filter reservoir to catch any spilled fuel, and then unscrew the reservoir by hand. Dispose of the fuel oil in the reservoir in accordance with local regulations. Wipe down the inside of the empty reservoir with a clean rag to remove any debris. Set the empty reservoir aside.



Unscrew the filter reservoir by hand

4. Unscrew the fuel intake filter by hand. Dispose of the used filter in accordance with local regulations.



Unscrew the fuel intake filter by hand

- 5. Insert a new fuel intake filter and gently tighten by hand. Do not reuse the old filter. Do not overtighten.
- 6. Replace the reservoir and gently tighten by hand. Do not overtighten. Wipe up any spilled fuel oil.
- 7. Reopen the fuel line shut-off valve by turning the red knob counter-clockwise.

Note: You should also inspect the fuel pump screen whenever you replace the fuel intake filter. For more information, see the section titled, "Inspecting the fuel pump screen."

 With the housing cover still off, check for leaks around the fuel intake filter reservoir during operation. To do this, set the Dragon up outside and allow to run in HEAT mode for several minutes. If the reservoir does not leak, proceed to step 9.

If the reservoir leaks, turn off and unplug unit before attempting to tighten or reseal the fuel intake filter and reservoir. If the fuel intake filter and reservoir will not stop leaking, have the unit inspected at a qualified service center.

9. Reattach the fuel pump/blower assembly housing cover and guard plate.

Inspecting the fuel pump screen

You should inspect and clean the fuel pump screen at least once a year or whenever you replace the fuel intake filter. Depending on the quality of fuel oil and the frequency of use, the screen may need to be cleaned more often. If the screen is damaged, it must be replaced. Barring damage, the screen may be cleaned and reused indefinitely.

You will need:

- Phillips screwdriver
- 4-mm Allen wrench
- 1/4 cup of clean fuel oil
- Small nylon-bristled brush
- Shop rags
- New fuel pump screen (if necessary)
- 1. Remove the housing cover for the fuel pump/blower assembly and the guard plate for the external fuel line connections. To do this, remove the six Phillips screws that secure the housing cover and guard plate.
- 2. Close the fuel line shut-off valve by turning the red knob clockwise.

3. Place a shop rag beneath the fuel pump to catch any spilled fuel oil, and then remove the fuel pump cover. To do this, use a 4-mm Allen wrench to remove the four bolts that secure the cover to the fuel pump/blower assembly.



Remove the fuel pump cover

4. Remove the fuel pump screen.



Remove the fuel pump screen

5. Inspect the screen for damage. If the screen is not damaged, proceed to step 6. If the screen is bent, torn, cracked, or damaged in any way, discard it and skip to step 7 with a new fuel pump screen.

- 6. Rinse the screen in the 1/4 cup of clean fuel oil. If necessary, gently scrub the screen with the nylonbristled brush (a toothbrush works well) to remove any debris or buildup.
- 7. Replace the screen and fuel pump cover. Tighten the bolts snugly. Wipe up any spilled fuel oil from the housing or fuel pump.
- 8. Reopen the fuel line shut-off valve by turning the red knob counter-clockwise.
- 9. Before replacing the housing cover, check for leaks around the pump cover during operation. To do this, set up the Dragon outside and allow to run in HEAT mode for several minutes. If the fuel pump cover does not leak, proceed to step 9.

If the fuel pump cover leaks, turn off and unplug unit before attempting to tighten or reseal the cover. If the cover will not stop leaking, have the unit inspected at a qualified service center.

10. Reattach the housing cover and guard plate.

Cleaning the Dragon

The heat exchanger and combustion chamber should be cleaned at least once a year to remove soot buildup. The cleaning should be performed by a qualified HVAC technician at a local service center. Contact your local distributor or the Dri-Eaz Service Department at 1-888-867-3235 for the location of a service center near you.

To clean the Dragon housing, use a cleaner with a degreasing agent similar to Simple Green[®].

SPECIFICATIONS

MODEL	Dragon K85 Mobile Furnace	
Model Number	F260	
Dimensions – HxWxD	28" x 23" x 40" (71 x 58 x 102 cm)	
Use Weight	188 lb (85 kg)	
Voltage	115V	
Frequency	60Hz	
Power Required	4.4 amps	
Fuel Consumption	0.69 gal/hr (2.6 L/hr)	
Fuel Type	Diesel fuel oil #2	
Fuel Tank Capacity	9.3 gal (35 L)	
Rated Heat Output	85,000 BTU/hr	
Process Air Rating	1,200 CFM (2,039 CMH)	
Static Pressure	0.2" (0.5 cm)	
Temp. Increase	+ 81°F (+ 27.2°C)	
Combustion exhaust duct	6" (15.2 cm)	
Ducting	8" x 30 ft (20 cm x 9.1 m)	
Wheels and handle	Yes	

Specifications are subject to change without notice. Some values are approximate.

TROUBLESHOOTING

In COLUMN 3, "FS" or Field Solutions can be handled by the technician in the field. Other solutions should be handled by an Authorized Service Technician, or "AST."

PROBLEM	CAUSE	See Above	SOLUTION
Burner does not start up	No power to unit	FS	Plug in the unit; check power at outlet.
•	HEAT switch not turned on	FS	Turn HEAT switch to "On.
	Setpoint too low	FS	Reprogram the thermostat and raise the setpoint above ambient temperature.
	Malfunction in the automatic oil firing system (Flame Safety Control Button will illuminate)	FS	Wait one minute, and then press the illuminated Flame Safety Control Button.
	Air bubbles in fuel oil line (especially on first start up)	FS	Press the Flame Safety Control Button. The burner will try to start up. If the burner does not start after approx. 1 minute, press the Flame Safety Control Button again. Repeat until the fuel line is clear of air bubbles and the burner starts
	Thermal overload	FS	Press the Temperature-Limiter Reset Button. See section on "Preventing Thermal Overload."
	Unit was turned off by being unplugged	FS	Press the Temperature-Limiter Reset Button. See section on "Shutting the Dragon off."
Burner starts up then shuts down, Flame Control Reset Button lights up	Fuel tank empty	FS	Refill fuel tank.
	Fuel line shut-off valve closed	FS	Open fuel line shut-off valve.
	Fuel lines not connected	FS	Connect fuel lines.
	Fuel intake filter is dirty	FS	Replace the fuel intake filter.
	Fuel pump screen is dirty or damaged	FS	Clean or replace fuel pump screen.
	Burner nozzle filter is dirty	AST	Call authorized service center.
	Fuel line leaks and lets in air	AST	Call authorized service center.
	Fuel pump produces no pressure	AST	Call authorized service center.
Burner starts but does not ignite, Flame Safety Control Button lights up	No ignition spark	AST	Call authorized service center.
•	Burner nozzle clogged	AST	Call authorized service center.
Flame goes out or burns unsteadily	Fuel intake filter is dirty	FS	Replace the fuel intake filter.
	Fuel pump screen is dirty or damaged	FS	Clean or replace fuel pump screen.
	Burner nozzle filter is dirty	AST	Call authorized service center.
	Fuel line leaks and lets in air	AST	Call authorized service center.
	Burner nozzle is clogged	AST	Call authorized service center.
	Combustion air mixture adjusted improperly	AST	Call authorized service center.
Burner does not switch off	Thermostat placed improperly	FS	Move thermostat so that it is not subject to cold air flow from doorways, windows, etc.
	Thermostat defective	AST	Call authorized service center.
Burner switches off too early	Thermostat placed improperly	FS	Move thermostat so that it is not subject to warm air flow or heat radiation from the sun, machines, hot water pipes, etc.
Black or gray/white smoke from flue	Improper air to fuel ratio	AST	Call authorized service center or HVAC specialist.
Black/white exhaust	Air intake vents are dirty or obstructed.	AST	Avoid setting up unit where the intake could be blocked or restricted, i.e., tall grass, deep snow, etc. Blocking the air intake will cause the unit to burn inefficiently resulting in sooty exhaust and potential damage to the unit and the structure being heated. Call authorized service center or HVAC specialist.

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PROBLEM	CAUSE	See Above	SOLUTION
Black smoke/exhaust coming from unit	Bad fuel, air to fuel mix ratio, and/or improper fuel pressure setting.	AST	Black smoke is an indication that the burner is receiving more fuel than it needs to operate efficiently. Call authorized service center or HVAC specialist.
Grey or white exhaust/ smoke coming from unit	Water in the fuel and/or too much air in the fuel/air mixture.	AST	If water is present in the fuel, the fuel tank will need to be drained and the fuel filter will need to be replaced prior to attempting to operate the unit. If the fuel does not contain water, then the fuel to air ratio is the most likely cause of the grey/ white discharge. Call authorized service center or HVAC specialist.

For the location of an authorized service center for your Dragon K85 Mobile Furnace, contact your local distributor or the Dri-Eaz Service Department at 1-888-867-3235.

Replacement Sensor - Order Part No. 1309007-044

SPECIFICATIONS

The 1309007-044 sensor is a negative temperature coefficient (NTC) thermistor sensor. The sensor resistance decreases with temperature increase. It is .25 x 1.94 long with 8 feet #22 AWG cable. The thermistor has a reference resistance of 30,000 ohms at 77°F (25°C).

IMPORTANT

The schematic drawings and other information included in these instructions are for the purpose of illustration and general reference only. Ranco assumes no responsibility for any unconventional application of this control, unless such application has been approved in writing by Ranco.

Deg. C.	Deg. F.	RES. Nom.
-40	-40	1,010,000
-30	-22	531,000
-20	-4	291,200
-10	14	166,000
0	32	97,960
10	50	59,700
20	68	37,470
25	77	30,000
30	86	24,170
40	104	15,980
50	122	10,810
60	140	7,464
70	158	5,200
80	176	3,774
90	194	2,753
100	212	2,036
110	230	1,531

Figure 10 : Resistance vs Temperature of 1309007-044. Sensor including 8 foot cable.



Ranco North America 8115 U.S. Rt. 42 North Plain City, Ohio 43064



RANCO INSTALLATION INSTRUCTIONS

PRODUCT DESCRIPTION

The Ranco ETC is a microprocessor-based family of electronic temperature controls, designed to provide on/off control for commercial heating, cooling, air conditioning and refrigeration. The ETC is equipped with a liquid crystal display (LCD) that provides a constant readout of the sensed temperature, and a touch keypad that allows the user to easily and accurately select the set point temperature, differential and heating/cooling mode of the operation. Models are available that operate on either line voltage (120/208/240 VAC) or low voltage (24VAC).



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APPLICATIONS

With its wide temperature setpoint range and selectable heating or cooling modes, the ETC can be used for a wide variety of

applications including refrigerated display cases, walk-in and reach-in refrigerators, milk coolers, refrigerated warehouses, chillers, beer and beverage coolers, tank heating, space and return air temperature control and condenser fan cycling.

FFATURES

- Wide setpoint temperature range (-30°F to 220°F) and differential adjustment (1°F to 30°F).
- · Simple keypad programming of setpoint temperature, differential and cooling/heating modes.
- LCD readout of sensor temperature, control settings. relay status and onboard diagnostics.
- Remote temperature sensing up to 400 feet.
- SPDT output relay.
- User-selectable Fahrenheit/Celsius scales.
- Lockout switch to prevent tampering by unauthorized personnel.
- Choice of line voltage and low voltage models available.
- Optional 0 to 10 volt analog output available for remote temperature indication.

SPECIFICATIONS

120 or 208/240 VAC (24 VAC optional)		
-30°F to 220°F		
1°F to 30°F		
SPDT		
Thermistor, 1.94 in. long x 0.25 in. diam		
8 ft. cable		
120/208/240 VAC: 100 Milliamps		
24 VAC: 2 - 6 VA		

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Form No. 7515003-001 Rev. C

ETC SINGLE STAGE ELECTRONIC TEMPERATURE CONTROL

Relay Electrical Ratings	120V	208/240V
NO Contact		
Full-load amps	16 A	8 A
Locked rotor amps	96 A	48 A
Resistive amps	15 A	8 A
Horsepower	1 hp	1 hp
NC Contact		
Full-load amps	5.8 A	2.9 A
Locked rotor amps	34.8 A	17.4 A
Resistive amps	5.8 A	2.9 A
Horsepower	1/4 hp	1/4 hp

Pilot Duty: 125 VA at 120/208/240 VAC

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Control Ambient Temperature	
Operating	-20°F to 140°F (-29°C to 60°C)
Storage	-40°F to 176°F (-40°C to 80°C)
Ambient Humidity	0 to 95%, RH, Non-condensing
0 to 10 V Output Impedance	1K
Enclosure	NEMA 1, Plastic
Agency Approvals	UL Listed, File E94419, Guide XAPX
	CSA Certified, File LR68340, Class 4813 02

ETC ORDERING INFORMATION

Code Number	Input Voltage	No. of Stages	0 - 10 V Output
ETC-111000-000	120/240	1	No
ETC-111100-000	120/240	1	Yes
ETC-112000-000	24	1	No
ETC-112100-000	24	1	Yes

OPFRATION

Liquid Crystal Display (LCD)

The LCD display provides a constant readout of the sensor temperature and indicates if the output relay is energized. When the S1 annunciator is constantly illuminated during operation, the relay is energized. The display is also used in conjunction with the keypad to allow the user to adjust the setpoint temperature, differential and heating/cooling modes.

Control Setup

The temperature setpoint refers to the temperature at which the normally open (NO) contacts of the output relay will open. Determine the load (s) to be controlled and the operating mode required, cooling or heating. Refer to Figure 1 for a visual representation.

- When the cooling mode is chosen, the differential is above the setpoint. The relay will de-energize as the temperature falls to the setpoint.
 - When the heating mode is chosen, the differential is below the setpoint. The relay will de-energize as the temperature rises to the setpoint.

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50/60 Hz

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Figure 1: Setpoint and Differential Settings. Diagram indicates relay on and off points in either the heating or cooling modes.

Programming Steps and Display

The ETC can be programmed in four simple steps using the LCD display and the three keys on the face of the control.

- Step 1-To start programming, press the **SET** key once to access the Fahrenheit/Celsius mode. The display will show the current status, either F for degrees Fahrenheit or C for degrees Celsius. Then press either the up 1 or down 1 arrow key to toggle between the F or C designation.
- Step 2-Press the **SET** key again to access the setpoint. The LCD will display the current setpoint and the S1 annunciator will be blinking on and off to indicate that the control is in the setpoint mode. Then press either the up 1 key to increase or the down key to decrease the setpoint to the desired temperature.
- Step 3-Press the SET key again to access the differential. The LCD will display the current differential and the **DIF 1** annunciator will be blinking on and off to indicate that the control is in the differential mode. Then press either the up i key to increase or the down key to decrease the differential to the desired setting.
- Press the SET key again to access the cooling or heating mode. Step 4-The LCD will display the current mode, either C1 for cooling or H1 for heating. Then press either the up 1 or down 1 key to toggle between the C1 or H1 designation. Press the SET key once more and programming is complete.

		Dispia
F or C	Fahrenheit or Celsius Scale	F
S1 (blinking)	Setpoint Temperature	
DIF 1 (blinking)	Differential Temperature	
C1/H1	Cooling or Heating Mode	
	F or C S1 (blinking) DIF 1 (blinking) C1/H1	F or CFahrenheit or Celsius ScaleS1 (blinking)Setpoint TemperatureDIF 1 (blinking)Differential TemperatureC1/H1Cooling or Heating Mode

NOTE: The ETC will automatically end programming if no keys are depressed for a period of thirty seconds. Any settings that have been input to the control will be accepted at that point.

All control settings are retained in non-volatile memory if power to ETC is interrupted for any reason. Re-programming is not necessary after power outages or disconnects unless different control settings are required

Lockout Switch

The ETC is provided with a lockout switch to prevent tampering by unauthorized personnel. When placed in the LOCK position, the keypad is disabled and no changes to the settings can be made. When placed in the UNLOCK position, the keypad will function normally.

To access the lockout switch, disconnect the power supply and open the control. The switch is located on the inside cover about 2 inches above the bottom. (see Figure 2). To disable the keypad, slide the switch to the left LOCK position. To enable the keypad, slide the switch to the right **UNLOCK** position. All ETC controls are shipped with this switch in the **UNLOCK** position.



Figure 2: Lockout Switch

TROUBLESHOOTING ERROR MESSAGES

Display Messages

E1 - Appears when either the up 1 or down 1 key is pressed when not in the programming mode.

To correct: If the E1 message appears even when no keys are being pressed, replace the control.

- E2 Appears if the control settings are not properly stored in memory. To correct: Check all settings and correct if necessary.
- **EP** Appears when the probe is open, shorted or sensing a temperature that is out of range.

To correct: Check to see if the sensed temperature is out of range. If not, check for probe damage by comparing it to a known ambient temperature between -30°F and 220°F. Replace the probe if necessary.

EE - Appears if the EEPROM data has been corrupted.

To correct: This condition cannot be field repaired. Replace the control.

CL - Appears if calibration mode has been entered. To correct: Remove power to the control for at least five seconds. Reapply power. If the CL message still appears, replace the control.







Figure 8: 0-10 V Analog Output Located on Power (Lower) Circuit

FIELD REPAIRS

Field calibrating or repairs to the ETC control must not be attempted. S and replacement controls are available through Ranco wholesalers.

SENSOR MOUNTING

For space sensing, mount the sensor where it will be unaffected by heat/cool discharge or radiated heat sources. Spot sensing requires the sensor to be in good contact with the surface being sensed. The sensor can be inserted in a bulb well for immersion sensina.

EXTENDING SENSOR

CAUTION: Sensor wiring splices may be made external from the control. **DO NOT** attempt to unsolder the sensor at the control circuit board!

CAUTION: Disconnect power to control before wiring to avoid possible electrical shock or damage to the controller.

Additional cable can be spliced to the sensor cable to increase the length beyond the standard 8 feet. It can be extended up to 400 feet. The cable should be at least 22 AWG or larger to keep additional resistance to a minimum.

All splices and wire lengths added to the sensor cable should be made according to acceptable wiring practices and should conform to the National Electrical Code and local regulations. Use copper conductors only. Shielded cable is not required.

Checkout Procedure

- 1. Before applying power, make sure installation and wiring connections are correct.
- 2. Apply power to the control and observe one or more cycles of operation.
- 3. If performance indicates a problem, check sensor resistance to determine if sensor or control is at fault.
- 4. To check sensor resistance, disconnect sensor and measure the resistance across the leads while measuring temperature at the sensor.

	TEMPER	ATURE AVERA	AGING
	SENSOR		SENSOR
	(4) Sensors wired in se	ries/parallel for temp	erature averaging.
	SENSOR		SENSOR
it Board.	\vdash		
Sensors		Fig	jure 9:
5		ETC	CONTROL



INSTALLATION INSTRUCTIONS

IMPORTANT

- 1. All ETC series controls are designed as operating controls only. If an operating control failure could result in personal injury or loss of property, a separate safety control and /or alarm should be installed.
- 2. The schematic drawings and other information included in these installation instructions are for the purpose of illustration and general reference only.
- 3. These instructions do not expand, reduce, modify or alter the Ranco Terms in any way; and no warranty or remedy in favor of the customer or any other person arises out of these instructions.
- 4. Ranco ETC controls have been approved by Underwriter's Laboratories as UL listed; however, approval does not extend to their use for any other purpose. Ranco assumes no responsibility for any unconventional application of its control unless such application has been approved in writing by Ranco.
- 5. It is the responsibility of the installer and the user to assure that his or its application and use of all Ranco products are in compliance with all federal, state and local requirements, including, without any limitation, all requirements imposed under the National Electric Code and any applicable building codes.



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Figure 3: Dimensions (Inches)

CAUTION

To prevent possible electrical shock or equipment damage, disconnect electrical power to the unit before and during installation. **DO NOT** restore electrical power to unit until the control is properly installed and the cover is assembled. **DO NOT** locate the control in an explosive atmosphere as a safety hazard can result due to possible spark generation in the control. Controls are not to be located in areas of significant moisture, dirt or dust, or in a corrosive explosive atmosphere. Use of control in such environments may result in injury or damage to the persons or property (or both) and are likely to shorten the control life;

Ranco assumes no responsibility for any such use.

CONTROL MOUNTING

Mount the ETC to a wall or any flat surface using a combination of any two or more of the slotted holes located on the back of the control case. The control's components are not position sensitive, but should be mounted so that they can be easily wired and adjusted. Avoid excessive conditions of moisture, dirt, and corrosive atmosphere.

The ETC has provisions for 1/2 inch conduit connections. The conduit hub should be secured to the conduit before securing the hub to the plastic housing of the control. When using the conduit entry in the rear of the case, a standard plug should be inserted into the conduit hole in the bottom. Caution should be exercised not to damage the control circuit board or wiring when installing a conduit connector.

CONTROL WIRING

General

- All wiring should conform to the National Electric Code and local regulations.
- The total electrical load must not exceed the maximum rating of the control (see Specifications).
- Use copper conductors only.
- Electrical leads should not be taut; allow slack for temperature change and vibration.

Input and Output Wiring

For typical wiring diagrams, refer to Figures 4, 5 and 6. All connections are made to the power (lower) circuit board. When using the 24 VAC powered models, the 24 VAC input lines must enter through the sidewall of the case. Refer to figure 3 for location of the entry hole. Figure 7 for wiring.

Analog Output

ETC models are available with an optional 0 to 10 volt analog output. This signal is a linear representation of the sensor temperature with 0 volts = -30°F and 10 volts = 220°F. See figure 8 for wiring information and figure 3 for location of the entry hole. The reference for this output is designated by the "-" symbol on the wiring diagram. The output signal is designated by the "+" symbol.



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Figure 4: Typical Line Voltage Wiring Diagram.