

### Nozzle Selection and Burner Settings

1. See table below for recommended oil nozzle selections and initial burner settings. Follow Burner Manual and Boiler Manual for installation of nozzle (not supplied with burner) and correct head bar.
2. Where the table calls for an oil pump pressure other than as shipped, adjust the pump pressure to the setting shown, following pump manufacturer's instructions.

**⚠ WARNING** Installer/servicer – Except where specifically stated otherwise, this Supplement must be used only by a **qualified service technician**. Follow all guidelines in the Burner Manual and Heating Appliance Manual. Failure to comply with this or other requirements in this manual could result in severe personal injury, death or substantial property damage.

**NOTICE** Installer must verify correct size nozzle for appliance is installed and confirm it is properly tightened.

**Table 1** Burner Specifications and settings for Weil-McLain Ultra Oil Boiler

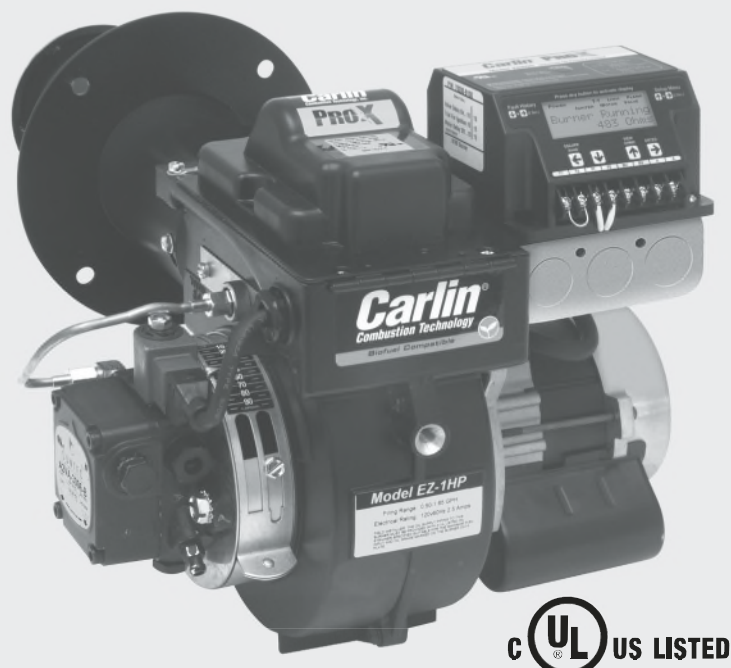
| Boiler Model | Input | Air Tube & Flange |                   | Nozzle Specifications |      |              | Oil Pump Pressure<br>PSIG | Air Shutter | Head Position | Air Band Setting |
|--------------|-------|-------------------|-------------------|-----------------------|------|--------------|---------------------------|-------------|---------------|------------------|
|              | GPH   | Part No.          | UTL               | Size                  | Type | Manufacturer |                           |             | "Dimension A" |                  |
| UO-3RE       | 0.80  | 51765             | 1 $\frac{7}{8}$ " | 0.60                  | 70A  | Delavan      | 180                       | Blank       | 2             | 45%              |
| UO-3E*       | 1.00  | 51765             | 1 $\frac{7}{8}$ " | 0.85                  | 70A  | Delavan      | 150                       | Blank       | 3             | 60%              |
| UO-4E        | 1.20  | 51765             | 1 $\frac{7}{8}$ " | 1.00                  | 70A  | Delavan      | 145                       | Blank       | 3             | 80%              |
| UO-5E        | 1.40  | 51765             | 1 $\frac{7}{8}$ " | 1.10                  | 70A  | Delavan      | 165                       | Blank       | 4             | 85%              |

**\*Setting as shipped from factory**

Additional nozzles packed separately. Please see table for proper nozzles, head bar, air setting, and fuel unit pressure to ensure proper firing rate for the specific application.

# Carlin®

Combustion Technology



## Ratings

|             |                                                                                           |
|-------------|-------------------------------------------------------------------------------------------|
| Input:      | EZ LF .....0.35 to 1.45 GPH                                                               |
|             | EZ 1, EZ-1-HP .....0.50 to 1.65 GPH                                                       |
|             | EZ 2, EZ-2-HP ..... 1.50 to 2.25 GPH                                                      |
|             | EZ 3, EZ-3-HP ..... 2.00 to 2.60 GPH                                                      |
| Fuels:      | U.S.....No. 1 or No. 2 Fuel oil including<br>bio blends B6 - B100 (U.S. Only) (ASTM D396) |
|             | Canada.....No. 1 Stove oil or No. 2 Heating oil<br>(ASTM D396)                            |
| Electrical: | Power.....120V/60 HZ/1-PHASE                                                              |
|             | Motor..... Carlin PSC, 1/6 HP, 3450 RPM                                                   |
|             | Current.....Approx. 2.5 AMPS                                                              |
| Ignition:   | Carlin Model 45000 electronic ..... 19,000 VOLTS                                          |
| Control:    | U.L. Group I or II primary safety control                                                 |
| Agencies:   | UL Listed (US and Canada)                                                                 |

### WARNING

Installer/servicer — Except where specifically stated otherwise, this manual must be used only by a qualified service technician. Failure to comply with this or other requirements in this manual could result in severe personal injury, death or substantial property damage.

### WARNING

User — The burner Instruction Manual is intended only for your service technician. The burner and heat exchanger must be inspected and started at least annually by your service technician.

# MODEL **EZ 1,2,3**™ AND **LF** Oil/ Biofuel Burners Instruction Manual

## Contents

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### NOTICE

## BEST PRACTICES FOR BIODIESEL FUELS

When using Higher Bio Blends, we recommend reviewing our “Best Practices” guides at the end of this manual to achieve best results.

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**W-M D/N: A001010 - Rev: 00**

## PLEASE read this first . . .

### Special attention flags

Please pay particular attention to the following when you see them throughout this manual.

**DANGER** Notifies you of hazards that **WILL** cause severe personal injury, death or substantial property damage.

**WARNING** Notifies you of hazards that **CAN** cause severe personal injury, death or substantial property damage.

**CAUTION** Notifies you of hazards that **WILL** or **CAN** cause minor personal injury or property damage.

**NOTICE** Notifies you of special instructions on installation, operation or maintenance that are important, but are not normally related to injury or property damage hazards.

### General information

#### Burner applications

Follow all instructions in this manual, the primary control data sheet and the appliance manual. Verify the burner is correct for the appliance being used and for all applicable codes/standards.

#### Damage or shortage claims

The consignee of the shipment must file damage or shortage claims immediately against the transportation company.

#### When calling or writing about the burner . . .

Please provide us with the UL serial number and burner model number to assist us in locating information. This information can be helpful when troubleshooting or obtaining replacement parts.

### Burner options . . .

#### Optional Burner Cover with Carlin Combustion Air Proving System (CAP)

- Carlin's optional burner cover is available on all residential burner models.
- Combustion air can be taken from the room or can be piped to the burner cover when the Carlin CAP System is installed, see page 6 for details. (Requires Field CAS-1 combustion air system.)
- See separate instructions provided with the cover kit, as well as the Carlin CAP System.

#### WARNING

#### Should overheating occur:

1. Shut off the oil supply to the burner.
2. **DO NOT** shut off the control switch to the circulator or blower.

#### WARNING

Follow the guidelines below to avoid potential severe personal injury, death or substantial property damage.

### Installer/service technician . . .

- Read all instructions before proceeding. Perform all procedures, and in the order given to avoid potential of severe personal injury, death or substantial property damage.
- Before leaving the site after startup or service, review the User's information page with the user. Make the user aware of all potential hazards and perform the training outlined below.

### Train the user . . .

- To properly operate the burner/appliance per this manual and the appliance instructions see User's information.
- To keep this manual at or near the burner/appliance for ready access by the user and service technician.
- To contact the service technician or oil dealer if he encounters problems with the burner/appliance.
- To keep the appliance space free of flammable liquids or vapors and other combustible materials.
- Do not use laundry products, paints, varnishes or other chemicals in the room occupied by the burner/appliance.
- To contact the service technician at least annually for startup and burner/appliance service.

### When servicing the burner . . .

- Disconnect the electrical supply to the burner before attempting to service to avoid electrical shock or possible injury from moving parts.
- Burner and appliance components can be extremely hot. Allow all parts to cool before attempting to handle or service to avoid potential of severe burns.

# 1. Application Information

## Codes and standards

### Certification

EZ 1, 2, 3 and LF burners are U.L. listed for the U.S. and Canada, certified to comply with ANSI/UL 296, for use with #1 or #2 heating oil as well as bio blends B6 - B100 (U.S. Only) (per standard ASTM D396).

Burner labels list compliance, when required, with special local, state or provincial approvals.

**NOTICE** Install this burner in accordance with all local codes and authorities having jurisdiction. Regulations of these authorities take precedence over the general instructions provided in this manual.

### United States installations

Burner/appliance installations in the United States must comply with the latest editions of NFPA 31 (Standard for the Installation of Oil-Burning Equipment), ANSI/NFPA 70 (National Electrical Code), and all applicable local codes.

### Canadian installations

Burner/appliance installations in Canada must comply with the latest editions of CSA B139 (Installation Code for Oil Burning Equipment), CSA standard C22, Part 1 (Canadian Electrical Code), and all applicable local codes.

## Conversion burners

### General information — conversion burners

Carlin EZ burners are shipped for general distribution, with fuel units set for 150 PSIG. Burners are usually shipped assembled, with a universal slip-on flange. Air tubes and housings will be installed or shipped in separate boxes for field assembly.

Before installing the burner, follow guidelines in this manual to ensure you are using the correct nozzle, head-positioning bar and air tube length.

### Oil nozzle selection — conversion burners

If oil nozzle selection information for the application is not available from appliance documents, you can use Table 1, page 4, for an initial nozzle selection for the application. Specific applications may require testing more than one nozzle to obtain both clean combustion and a good match of flame shape to the combustion chamber.

## OEM burners

### General information — OEM burners

EZ burners manufactured for heating appliance manufacturers (OEM's) are generally identical to conversion burners (distributed through supply houses) with one or more of the following differences:

- Burners are fully assembled, with a welded flange set at the proper insertion depth and pitch for the appliance.
- Burners may be installed on the appliance or shipped in a separate carton.
- Burner nozzles may be installed in the burner, bagged and tied onto the burner chassis.
- Head positioning bars may be installed or bagged to the burner chassis. Up to seven bars may be supplied. Use Table 1, page 4, for an initial nozzle selection for the application.

EZ burners with the “-HP” suffix are only supplied through the heating appliance manufacturer (OEM) market. These burners differ from standard models as follows:

- Fuel unit pressure is factory-set per OEM specifications. Check heating appliance manufacturer's specifications for the correct pressure setting.
- Set the air band to match the appliance manufacturer's specifications.

### Installing OEM burners

- Burner flanges are welded to the air tube to ensure the correct pitch.

### Oil nozzle selection — OEM burners

- Use only the nozzle specified in the heating appliance manufacturer's manual or burner supplement.

**NOTICE** When using a burner with a nozzle, it is the installer's responsibility to verify correct nozzle is installed and properly tightened.

# 1. EZ 1,2,3 Application Information (continued)

**Table 1** Apply the guidelines below to select a nozzle when appliance-specific nozzle data is not available from the manufacturer (see notes at end of table for application tips). DO NOT apply for EZ-1-HP, EZ-2-HP or EZ-3-HP models – see information supplied with appliance/burner.

| EZ 1 Burner nozzle selections (EZ LF can use 0.50 to 1.35 GPH) |            |                 |                                      |      |      |      |      |      |      |      |      |      |      |                     |
|----------------------------------------------------------------|------------|-----------------|--------------------------------------|------|------|------|------|------|------|------|------|------|------|---------------------|
| Brand                                                          | Spray      | Angle & pattern | Head Positioning Bar (Head Position) |      |      |      |      |      |      |      |      |      |      | Flame length needed |
|                                                                |            |                 | 0                                    | 1    | 2    | 3    | 4    | 5    | 6    |      |      |      |      |                     |
|                                                                |            |                 | Nozzle rating, GPH                   |      |      |      |      |      |      |      |      |      |      |                     |
|                                                                |            |                 | 0.50                                 | 0.60 | 0.65 | 0.75 | 0.85 | 1.00 | 1.10 | 1.25 | 1.35 | 1.50 | 1.65 |                     |
| Delavan                                                        | Hollow     | 60A             |                                      |      |      | •    | •    | •    | •    |      |      |      |      | Medium              |
|                                                                | Hollow     | 70A             | •                                    | •    | •    | •    | •    | •    |      |      |      |      |      | Short               |
|                                                                | Semi-solid | 60SS            | •                                    | •    | •    | •    | •    |      |      |      |      |      |      | Short               |
|                                                                | Solid      | 60B             |                                      |      |      |      |      | •    | •    | •    | •    | •    | •    | Very long           |
|                                                                | Solid      | 70B             |                                      |      |      |      |      | •    | •    | •    | •    | •    | •    | Long                |
| Hago                                                           | Hollow     | 60H             | •                                    | •    | •    | •    | •    | •    |      |      |      |      |      | Short               |
|                                                                | Hollow     | 70H             | •                                    | •    | •    | •    | •    |      |      |      |      |      |      | Short               |
|                                                                | Semi-solid | 60SS            | •                                    | •    | •    | •    | •    | •    | •    | •    | •    | •    |      | Short               |
|                                                                | Solid      | 60ES            | •                                    | •    | •    | •    | •    | •    | •    | •    | •    | •    | •    | Medium              |
|                                                                | Solid      | 70ES            | •                                    | •    | •    | •    | •    | •    |      |      |      |      |      | Medium              |
|                                                                | Solid      | 60B             |                                      |      |      |      |      | •    | •    | •    | •    | •    | •    | Long                |
|                                                                | Solid      | 70B             |                                      |      |      |      |      | •    | •    | •    | •    | •    | •    | Long                |
| Monarch                                                        | Hollow     | 60NS            | •                                    |      | •    | •    | •    | •    |      |      |      |      |      | Short               |
|                                                                | Hollow     | 70NS            | •                                    | •    | •    |      |      |      |      |      |      |      |      | Short               |
|                                                                | Semi-solid | 60AR            |                                      |      | •    | •    | •    | •    | •    | •    | •    |      |      | Medium              |
|                                                                | Semi-solid | 70AR            |                                      |      |      | •    | •    |      |      |      |      |      |      | Short               |
|                                                                | Solid      | 60R             |                                      |      | •    | •    | •    | •    | •    | •    | •    | •    | •    | Medium              |
|                                                                | Solid      | 70R             |                                      | •    | •    | •    | •    |      |      |      |      |      |      | Medium              |
| Danfoss                                                        | Hollow     | 60AH            | •                                    | •    | •    | •    | •    | •    |      |      |      |      |      | Short               |
|                                                                | Semi-solid | 60AB            |                                      |      |      | •    | •    | •    | •    | •    | •    | •    | •    | Medium              |
|                                                                | Solid      | 60AS            |                                      | •    | •    | •    | •    | •    | •    | •    | •    | •    | •    | Medium              |

| EZ 2 Burner nozzle selections |            |                 |                                      |      |      |      |      |
|-------------------------------|------------|-----------------|--------------------------------------|------|------|------|------|
| Brand                         | Spray      | Angle & pattern | Head Positioning Bar (Head Position) |      |      |      |      |
|                               |            |                 | 4                                    | 4.5  | 5.5  | 6.5  |      |
|                               |            |                 | Nozzle rating, GPH                   |      |      |      |      |
|                               |            |                 | 1.50                                 | 1.65 | 1.75 | 2.00 | 2.25 |
| Delavan                       | Hollow     | 60A             | •                                    | •    | •    | •    | •    |
|                               | Solid      | 60B             | •                                    | •    | •    | •    | •    |
|                               | Semi-solid | 60SS            | •                                    | •    | •    | •    | •    |
| Hago                          | Semi-solid | 60SS            | •                                    | •    | •    | •    | •    |
|                               | Solid      | 60B             | •                                    | •    | •    | •    |      |
|                               | Solid      | 60ES            | •                                    | •    | •    |      |      |
|                               | Solid      | 60P             |                                      |      |      | •    | •    |
| Monarch                       | Solid      | 60R             | •                                    | •    | •    | •    | •    |
|                               | Semi-solid | 60AR            | •                                    | •    | •    | •    | •    |
|                               | Hollow     | 60AS            | •                                    | •    | •    |      |      |
| Danfoss                       | Hollow     | 60AH            | •                                    | •    | •    | •    | •    |
|                               | Semi-solid | 60AB            | •                                    | •    | •    | •    | •    |
|                               | Solid      | 60AS            | •                                    | •    | •    | •    | •    |

| EZ 3 Burner nozzle selections |            |                 |                                         |      |      |                           |
|-------------------------------|------------|-----------------|-----------------------------------------|------|------|---------------------------|
| Brand                         | Spray      | Angle & pattern | Head Positioning Bar<br>(Head Position) |      |      | Flame<br>length<br>needed |
|                               |            |                 | 5.5                                     | 6.5  | 8.0  |                           |
|                               |            |                 | Nozzle rating, GPH                      |      |      |                           |
|                               |            |                 | 2.00                                    | 2.25 | 2.50 |                           |
| Delavan                       | Hollow     | 60A             | •                                       | •    | •    | Medium                    |
|                               | Solid      | 60B             | •                                       | •    | •    | Long                      |
|                               | Semi-solid | 60SS            | •                                       | •    | •    | Medium                    |
| Hago                          | Semi-solid | 60SS            | •                                       | •    | •    | Medium                    |
|                               | Solid      | 60P             | •                                       | •    | •    | Long                      |
|                               | Solid      | 60B             | •                                       |      |      | Long                      |
|                               |            |                 |                                         |      |      | Long                      |
| Monarch                       | Solid      | 60R             | •                                       | •    | •    | Medium                    |
|                               | Semi-solid | 60AR            | •                                       | •    | •    | Medium                    |
| Danfoss                       |            |                 | •                                       | •    | •    | Medium                    |
|                               | Hollow     | 60AH            | •                                       | •    | •    | Short                     |
|                               | Semi-solid | 60AB            | •                                       | •    | •    | Medium                    |
|                               | Solid      | 60AS            | •                                       | •    | •    | Long                      |

- In general, all the nozzles shown above will burn well. However, in short combustion chambers, solid nozzles are not recommended because the flame may impinge on the back wall.
- If the nozzle selected for a retrofit application results in a smoky fire, you can sometimes determine the best nozzle to use by observing the flame. To do this, slowly cover the air band slots with your fingers while the burner is firing. The flame will begin to smoke in the area where there is more fuel than air. If the smoke begins on the outer edges, try a narrower or more solid nozzle spray pattern. If the flame begins to smoke at the tips, try a wider or more hollow nozzle spray pattern.
- For a packaged appliance application on which the burner has been tested, use the nozzle given in the appliance manufacturer's instructions or supplement for the best results.

## 2. Prepare Site • Assemble Burner • Mount Burner

### Inspect/repair/replace vent system

**WARNING** Do not install this burner unless you have verified the entire vent system and the appliance are in good condition and comply with all applicable codes. And ... The vent and chimney must be sized and constructed in accordance with all applicable codes. Do not install or use an existing manual damper in the breeching (vent connector) or chimney. Do not connect the appliance vent connector to a chimney or vent serving a fireplace, incinerator or solid-fuel-burning apparatus. In a cold climate, do not vent into a masonry chimney that has one or more sides exposed to the outside. Install a listed stainless steel liner to vent the flue products. A defective vent system could result in severe personal injury, death or substantial property damage.

#### Prepare vent/chimney

- Secure all metal vent joints with screws, following the vent manufacturer's instructions. Seal all joints in the vent system and chimney. Repair masonry chimney lining and repair all mortar joints as needed.
- Install a barometric draft regulator in the vent piping if specified in the appliance manual. (The damper must be located in the same space as the appliance.)
- Provide support for the vent piping. Do not rest the weight of any of the vent piping on the appliance flue outlet.

### Combustion/ventilation air openings

**WARNING** Even if combustion air is piped to an (optional) burner air intake adapter, the boiler room must still have the minimum air openings listed in Table 2 and described in the following paragraphs. This is to provide needed ventilation to keep the burner and appliance cool and to avoid the boiler room developing negative pressure.

The combustion air openings **MUST** be sized based on the total input of **all appliances in the room**.

Check appliance manual and applicable codes for required sizing/design/placement of combustion/ventilation air openings. You can use the following general guidelines, taken from NFPA 31, provided they meet all local requirements.

#### Louvers/screens

- Air opening sizes are always given in free area. This means after deduction for louver obstruction. If you can't find the louver reduction for the grilles used, assume free area is 20% of total for wood louvers, or 60% of total for metal louvers.
- Screens can be no finer than ¼-inch mesh, and must be accessible for cleaning.

#### Residential installations

Unconfined spaces (at least 7,000 cubic feet per GPH)

- An unconfined space means a room with at least 7,000 cubic feet volume for each GPH input (or 50 cubic feet per MBH) of **all appliances in the room**. Example: For each 1 GPH oil input,

the room must have 7,000 cubic feet (875 square feet with an 8-foot ceiling height.)

- Open basements and crawl spaces are usually large enough, and will generally allow enough air infiltration so special provisions will seldom be required.
- If the building is tightly constructed, you will have to provide outside air openings into the building. The total free area of the openings must be at least 1 square inch per 5,000 Btuh (28 square inches per GPH) of all appliances in the space.
- See Table 2 for summary.

#### Air openings to confined spaces (less than 7,000 cubic feet per GPH)

- Air taken from inside building only —
  - Provide two openings — one near floor, the other near ceiling. Provide free area of 140 square inches per GPH input. If building is tightly constructed, provide air opening(s) into building providing 30 square inches per GPH as well.
  - Air taken from outside —
    - Direct through outside wall or vertical ducts: Provide two openings — one near floor, the other near ceiling. Provide free area of 35 square inches per GPH input.
    - Through horizontal ducts: Provide two openings — one near floor, the other near ceiling. Provide free area of 70 square inches per GPH input.
  - Ventilation air from inside/combustion air from outside
- Size openings to interior to provide 140 square inches free area per GPH input. Size outside air duct to provide 28 square inches free area per GPH.
- See Table 2 for summary.

**Table 2** Minimum combustion/ventilation air openings

| Source<br>of air                                                            | Mininum<br>free area<br>of opening(s)                                                               | Total grill area, typical (sq. in.)<br>for firing rates of: |       |       |       |       |       |
|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-------|-------|-------|-------|-------|
|                                                                             |                                                                                                     | 1 GPH                                                       |       | 2 GPH |       | 3 GPH |       |
|                                                                             |                                                                                                     | Wood                                                        | Metal | Wood  | Metal | Wood  | Metal |
| Residential installations, unconfined spaces (7,000 cu. ft. volume per GPH) |                                                                                                     |                                                             |       |       |       |       |       |
| From inside building,<br>typical construction                               | No special openings required if natural infiltration is sufficient.                                 |                                                             |       |       |       |       |       |
| From inside building,<br>tight construction                                 | 1 or more grilles<br>30 Sq. in./ GPH                                                                | 150                                                         | 50    | 300   | 100   | 450   | 150   |
| Residential installations, confined spaces                                  |                                                                                                     |                                                             |       |       |       |       |       |
| From inside building<br>through interior walls                              | 2 openings, each<br>140 Sq. in./ GPH                                                                | 700                                                         | 234   | 1400  | 467   | 2100  | 700   |
| From outside building<br>direct through outside<br>wall                     | 2 openings, each<br>35 Sq. In./ GPH                                                                 | 175                                                         | 59    | 350   | 117   | 525   | 175   |
| From outside building<br>through vertical ducts                             | 2 openings, each<br>35 Sq. In./ GPH                                                                 | 175                                                         | 59    | 350   | 117   | 525   | 175   |
| From outside building<br>through horizontal<br>ducts                        | 2 openings, each<br>70 Sq. In./ GPH                                                                 | 350                                                         | 117   | 700   | 234   | 1050  | 350   |
| Ventilation through<br>interior walls, with an<br>opening to outside        | 2 Int. openings,<br>each<br>140 Sq. In./ GPH                                                        | 700                                                         | 234   | 1400  | 467   | 2100  | 700   |
|                                                                             | 1 Exterior opening<br>28 Sq. In./ GPH                                                               | 140                                                         | 47    | 280   | 94    | 420   | 140   |
| Commercial installations                                                    |                                                                                                     |                                                             |       |       |       |       |       |
| From outside building<br>direct through adjacent<br>outside wall            | One opening through outside wall, providing free area of at least<br>28 Square inches per GPH input |                                                             |       |       |       |       |       |
| Other conditions                                                            | Size openings per local codes/jurisdictions                                                         |                                                             |       |       |       |       |       |

## 2. Prepare Site • Assemble Burner • Mount Burner (continued)

### WARNING

The burner may operate successfully under momentary downdraft conditions, but sustained downdraft is unsafe. This can occur with an inadequate or incorrectly installed chimney/vent. It can also occur in rooms/buildings equipped with exhaust fans or unsealed return air ducts.

Always check operation of the burner under all conditions to verify vent system operates correctly.

### Combustion/ventilation air openings:

Always provide combustion/ventilation air to the appliance room sufficient to prevent any negative pressure in the space — if necessary, install new or additional air openings. See instructions in this manual for combustion air openings.

### Piped combustion air applications:

Burners with piped combustion air require a Carlin CAP System or a Field CAS-1 combustion air system.

Failure to correct downdraft or negative room pressure operation could result in severe personal injury, death or substantial property damage.

## Optional Combustion Air Intake Systems

### WARNING

Even if using an (optional) air intake system, make sure the space provides enough ventilation to prevent overheating of the appliance, burner and controls. The equipment room must have combustion air/ventilation openings sized large enough to provide air for cooling the equipment and for combustion when needed. Failure to comply can result in severe personal injury, death or substantial property damage.

### CAP System

The CAP System is designed to shut down the burner in the event the outside combustion air supply becomes blocked. At each burner startup, the system will check the air intake during pre-purge (Valve Delay On). If the air is blocked, the control will abort ignition and shutdown the burner. If the air intake is not blocked during this startup test, but becomes blocked during normal burner operation, the burner will shut down if the air remains blocked for 20 seconds. Following any shutdown, the burner will be permitted to recycle 3 times following a 1 minute delay. The system will lock out the burner if the blockage continues throughout 3 recycles during any single call for heat.

### Air piping

Install 3" PVC vent pipe to provide outside air to the CAP System

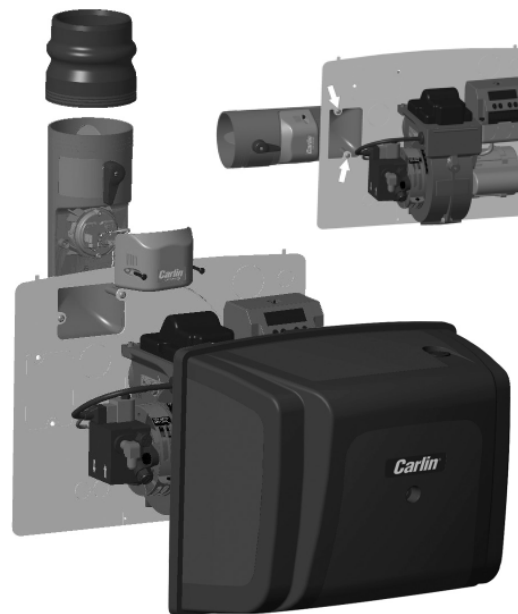
**IMPORTANT:** For proper operation of the CAP System, air inlet piping should only use schedule 40 or 80 PVC pipe (maximum of 80' total with each elbow equal to 10').

Combustion air outdoor termination, use PVC elbow (downward facing) and bird screen provided. Maintain 12" clearance above highest anticipated snow level. Avoid locations where snow may drift and block combustion air. Ice or snow may cause burner to shut down if combustion air becomes obstructed. Combustion air termination must be min. 12" from or below doors, windows or gravity inlet. USE SWEEP ELBOWS FOR ALL COMBUSTION AIR PIPING. DO NOT USE short radius elbows for combustion air piping – burner performance could be affected.

See CAP System manual for additional setup and burner adjustment information.

## Combustion/ventilation air checklist

- ☐ Verify that openings are unobstructed.
- ☐ Verify that appliance space and air source spaces are free of:
  - Gasoline or other flammable liquids or vapors.
  - Combustible materials.
  - Air contaminants and chemicals, such as laundry products, paint, thinner, varnish, etc.
- ☐ Confirm with the building owner that the area will be kept free of these materials at all times and that air openings will be kept unobstructed.



HORIZONTAL or VERTICAL MOUNTING

## 2. Prepare Site • Assemble Burner • Mount Burner (continued)

### Field CAS-1 System

- Combustion air can be piped to the burner from outside if the burner is fitted with either a Burner Cover or P/N 97406 Air Intake System.
  - You must use a Field Controls Model CAS-1 Combustion Air Supply Duct Kit or equivalent, and install as per kit manufacturer's instructions and any associated instructions in the Burner Cover or 97406 Air Intake System instructions.
1. Install the optional air inlet adapter if the burner is fitted with a Burner Cover.

**NOTICE** Air piping must be 4-inch diameter metal or PVC.

2. Connect air piping to the Field Controls Model CAS-1 Combustion Air Supply Duct Kit and install as per Field Controls' instructions.)

### Maximum air piping length

1. USE ONLY 4-inch air piping.
2. **DO NOT exceed 80 equivalent feet of air piping. NOTE: Install vent piping** as specified in appliance manufacturer's instructions.
3. Reduce maximum length by 10 equivalent feet for each elbow in the air piping.
4. Example: The air piping could consist of (3) elbows (equals 30 equivalent feet) and 50 feet of straight piping; or (4) elbows (equals 40 equivalent feet) and 40 feet of straight piping.

### *Optional Combustion Air Intake Systems Require:*

#### **Burner adjustments with optional Burner Cover**

1. Follow the instructions in this manual for final adjustments to the burner using combustion test instruments.
2. Once combustion is initially set, re-install the cover and test again. If necessary, remove the cover and readjust the burner. Repeat the process until combustion is correct with the cover in place.
3. You must also measure air inlet temperature during start-up to properly set combustion. Follow the instructions in this manual.

#### **Burner adjustments with optional Air Intake System**

1. Follow the instructions in this manual and in the Air Intake System instructions for adjustments to the burner using combustion test instruments.
2. You must also measure air inlet temperature during start-up to properly set combustion. Follow the instructions in this manual.

## 2. Prepare Site • Assemble Burner • Mount Burner (continued)

### Verify clearances

Verify that the burner/appliance will maintain all clearances from combustible construction and clearances for service/maintenance as required in the appliance manual and applicable codes.

Verify that the vent system components maintain all necessary clearances to combustible construction, including the correct design of thimbles and insulation where penetrating combustible walls.

### Verify combustion chamber

#### General guidelines

- If retrofitting the burner to an appliance, install the burner in accordance with the appliance instruction manual, when available. If no specific application data is available from the appliance manufacturer, apply the guidelines in Table 3 to check whether the burner is likely to work acceptably in the application.
- Clean all appliance flues and heating surfaces thoroughly, removing all soot and scale.
- Seal all joints and gaps using furnace cement to prevent excess air infiltration.

#### Minimum combustion chamber dimensions

- Illustrations A to C in Table 3 show different chamber configurations.
- Do not attempt to fire the burner in a chamber with dimensions smaller than shown in Table 3 unless the application has been

specifically tested and listed by the appliance manufacturer and/or Carlin.

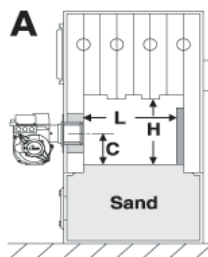
- Please notice the special requirements given in Table 3 notes.

#### Using chamber linings and lightweight chambers

- When using refractory liners or lightweight chambers, use insulating-type refractory rated 2300°F minimum.
- You must install a target wall liner if flame length is close to the length of the chamber.
- Use a floor liner when possible. The floor liner will improve firing in most applications. Extend floor liner 3 to 4 inches up side wall.
- Target wall liners — Corbel the top of target wall liners 1½ to 2½ inches deep and extend at least 3 to 4 inches above the center of the flame.
- Use pre-formed chamber liners when available.
- For firing rates below 0.75 GPH, it is best to apply in a refractory-lined or stainless tube (designed for application) chamber. Lining the floor and target wall of the chamber with lightweight insulating refractory will accomplish the same.
- When conversion firing coal-fired units, install a combustion chamber in the ashpit area, or fill ashpit with sand up to 2 inches above the “mud ring” of a boiler (firing through the door). Install a lightweight refractory liner on the target wall as in Table 3, Figure C. Make sure the minimum dimensions comply with those listed.

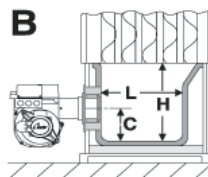
**Table 3** Burner retrofit applications — guidelines and minimum dimensions for combustion chambers

| 1<br>Firing rate | 2<br>L<br>Inches                                                                                                                                                                                                           | 3<br>W<br>Inches (3) | 4<br>C<br>Inches | 5<br>H<br>Inches | 6<br>DV<br>Inches (5) |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------|------------------|-----------------------|
| GPH              |                                                                                                                                                                                                                            |                      |                  |                  |                       |
| 0.50             | 7                                                                                                                                                                                                                          | 6                    | 3                | 8                | 7                     |
| 0.65             | 7.5                                                                                                                                                                                                                        | 7                    | 3.5              | 9                | 7.5                   |
| 0.75             | 8                                                                                                                                                                                                                          | 7                    | 3.5              | 9                | 8                     |
| 0.85             | 9                                                                                                                                                                                                                          | 7                    | 3.5              | 9                | 8.5                   |
| 1.00             | 10                                                                                                                                                                                                                         | 8                    | 4                | 10               | 9                     |
| 1.10             | 11                                                                                                                                                                                                                         | 8                    | 4                | 10               | 9.5                   |
| 1.25             | 12                                                                                                                                                                                                                         | 8                    | 4                | 10               | 10                    |
| 1.35             | 13                                                                                                                                                                                                                         | 8                    | 4                | 10               | 11                    |
| 1.50             | 14                                                                                                                                                                                                                         | 8                    | 4.5              | 11               | 12                    |
| 1.65             | 15                                                                                                                                                                                                                         | 9                    | 4.5              | 11               | 13                    |
| 1.75             | 16                                                                                                                                                                                                                         | 9                    | 4.5              | 11               | 14                    |
| 2.00             | 17                                                                                                                                                                                                                         | 9                    | 4.5              | 11               | 15                    |
| 2.25             | 18                                                                                                                                                                                                                         | 10                   | 5                | 12               | 16                    |
| 2.50             | 19                                                                                                                                                                                                                         | 10                   | 5                | 12               | 17                    |
| Notes            |                                                                                                                                                                                                                            |                      |                  |                  |                       |
| 1                | Some tested appliances operate well with dimensions other than above.                                                                                                                                                      |                      |                  |                  |                       |
| 2                | Generally, the application should be acceptable for dimensions as large as 50% greater than the above.                                                                                                                     |                      |                  |                  |                       |
| 3                | Horizontal cylinder chambers should have a diameter at least as large as the dimension in column 3. Horizontal steel cylinder chambers should have diameters at least 1 to 4 inches larger than the dimension in column 3. |                      |                  |                  |                       |
| 4                | Wing walls are not recommended. Corbels can be beneficial to heat distribution in some appliances.                                                                                                                         |                      |                  |                  |                       |
| 5                | DV is the minimum diameter for vertical cylinder chambers.                                                                                                                                                                 |                      |                  |                  |                       |



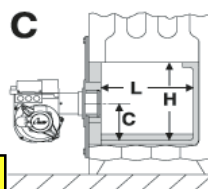
#### A. Conversion firing coal-fired units

1. Install a combustion chamber in the ashpit area, or fill ashpit with sand up to 2 inches above the “mud ring” of a boiler (firing through door).
2. When firing through door, install a lightweight refractory “target” on the rear wall, as shown.



#### B. Conversion firing dry-base units

1. Applies to brick, refractory, precast and preformed refractory fiber chambers. Lightweight, insulating-type materials are preferred because of their quick warm-up. Use material rated at least 2300°F.
2. Dimensions in the table can be exceeded without much effect for dry-base units.



#### C. Conversion firing wet-based units

1. Apply recommendations here to prevent flame from impinging on surfaces or being cooled too much by the cool walls of the heat exchanger. Do not exceed dimensions of table more than 50% to avoid flame chilling.
2. Install a ceramic fiber floor liner (extended 3 to 4 inches up the side walls) and a ceramic fiber rear target the full width of the back wall as well. Corbel the top of the target 1½” to 2½” deep and extend at least 3 to 4 inches above the center of the flame. Use preformed chambers and/or target walls if available.
3. Set the fuel unit pressure for approximately 150 PSIG and use a nozzle rated about 20% less than the firing rate to compensate for the higher pressure. This will improve atomization, making the flame more intense, shorter and hotter. Reference OEM Setup Tables for appliance specific settings, or Table 3A on page 12 if appliance is not listed.

## 2. Prepare Site • Assemble Burner • Mount Burner (continued)

### Inspect burner and components

- Check the air tube length. Verify the usable length of the tube UTL will be long enough (see “Mount burner in appliance”).
- Visually inspect all burner components and wiring.
- Verify that wiring is intact and leads are securely connected.

- Verify that all burner components are in good condition.

#### WARNING

Do not install or operate the burner if any component is damaged or if burner does not comply with the specifications of Table 1, page 3, and other guidelines of this manual and the appliance manual.

### Assemble burner (when required)

#### Welded-flange burners

1. Verify the bolt pattern on the appliance chamber matches the flange pattern.
2. Verify the insertion depth (UTL) matches the depth of the appliance opening (so the end of the air tube is flush with, or slightly short of, the inside surface of the combustion chamber).

#### Universal (adjustable) flange burners

1. Verify the flange mounting slots line up with the appliance bolts. See Figure 1.
2. Slip the adjustable flange onto the air tube.
3. Measure the distance from the inside of the combustion chamber to the outside of the appliance mounting plate.
4. Position the universal flange at this distance from the end of the air tube.
5. Tighten the locking screws finger tight.
6. Insert the air tube/flange assembly into the appliance opening and level the air tube with a spirit level. Adjust flange if needed.
7. The end of the air tube should be flush, or almost flush, with the inside of the combustion chamber wall.
8. Verify the air tube is level and inserted the corrected depth. Adjust if necessary. Then tighten the flange locking screws securely.
9. Remove the flange/air tube assembly from the opening.

#### Pedestal-mounted burners

1. Check the diameter of the appliance opening. If larger than 4½ inches, rebuild the opening so the open is reduced to 4½ inches maximum.
2. Insert the air tube into the appliance opening as in Figure 2. Do not attach air tube to housing yet.
3. Slide the tube in until the end of the tube is flush with, or up to ¼ inch short of, the inside of the combustion chamber.

#### NOTICE

When using a burner with a nozzle, it is the installer's responsibility to verify correct nozzle is installed and properly tightened

4. Level the air tube using a spirit level.
5. Mark the air tube position with a pen or pencil around the circumference of the tube.
6. Remove air tube from the opening.

Figure 1 Universal flange mounting dimensions

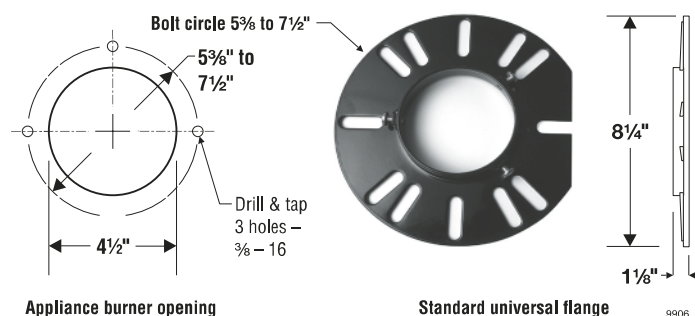
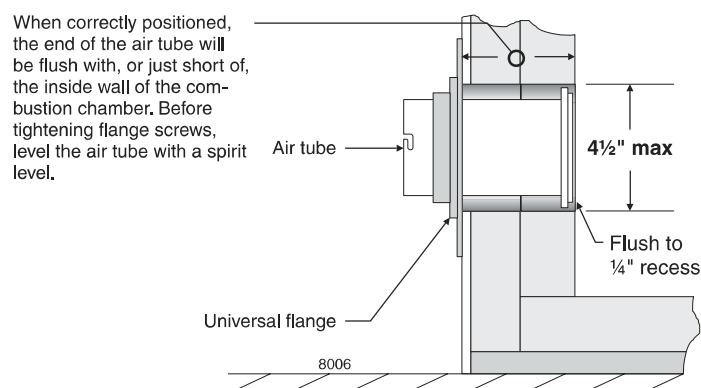


Figure 2 Mark insertion depth on air tube when using universal flange mounting

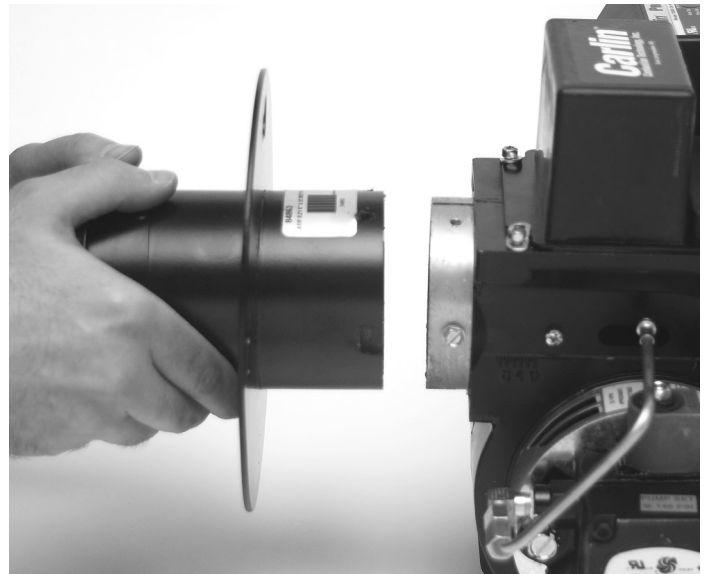


## 2. Prepare Site • Assemble Burner • Mount Burner (continued)

### Attach air tube to housing

1. The burner chassis is supplied with two screws mounted into the housing.
2. Loosen these screws about three turns.
3. Slide the air tube onto the housing, aligning the J-notches in the tube with the housing screws (Figure 3).
4. Turn the tube to engage the J-notches.
5. Insert the two mounting screws into the TOP TWO air tube holes.
6. Tighten the screws.

**Figure 3** Attaching air tube to burner chassis



### Mount burner in appliance

#### Welded flange-mounted burner

1. Place gasket over burner air tube and insert burner into appliance opening. Secure in place with hardware supplied with appliance.

**WARNING**

Universal flange or pedestal mount — these insertion methods are intended only for negative overfire pressure. For pressurized firing, you must obtain a burner with a welded flange, designed for use with the specific appliance. Failure to comply could result in severe personal injury, death or substantial property damage.

#### Universal flange-mounted burner

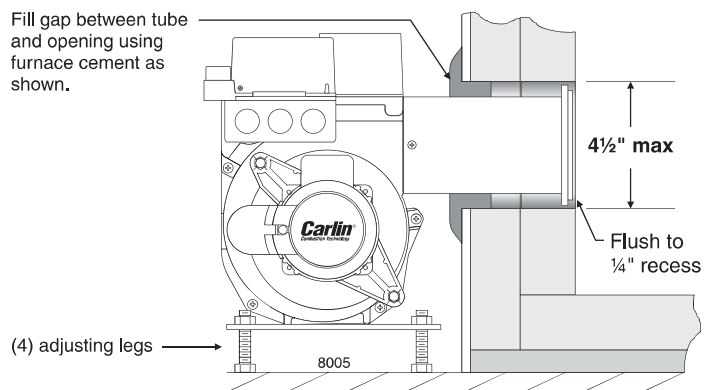
1. Place gasket over burner air tube.
2. Insert burner into appliance.
3. Verify burner is seated level and straight. Adjust flange slightly if necessary.
4. Secure flange to appliance with hardware supplied with appliance.

#### Pedestal mounted burner

1. Adjust the pedestal legs so the air tube is level and the center of the tube is at the same height as the center of the appliance opening.
2. Tighten the pedestal leg jam nuts.

3. Insert the burner/air tube into the appliance opening until pen/pencil line is even with appliance front (so end of air tube is flush with, or slightly short of, the inside of the chamber).
4. Seal the space around the air tube with furnace cement or equivalent (Figure 4).

**Figure 4** Seal opening around burner air tube when pedestal mounting (burner shown with tube attached to housing and installed)



### 3. Prepare Burner

#### Removing/installing head assembly

**WARNING** Use care when handling burner components after the burner has been firing. Components can be hot and could cause severe personal injury.

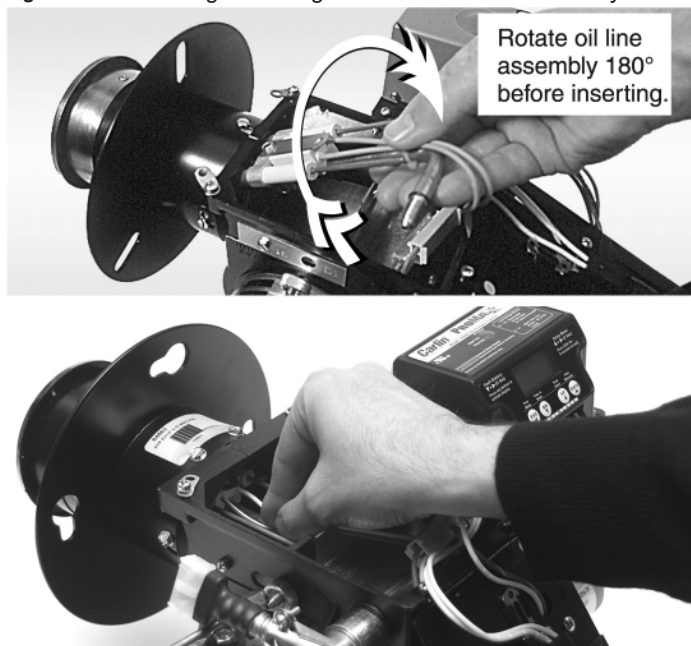
You will need to remove the combustion head assembly for inspection of the assembly, replacement of the oil nozzle or adjustment of electrodes.

Note: Do not have to remove access cover unless combustion head has baffle.

##### To remove the assembly:

1. Loosen, and then rotate the two ignitor hold-down clamps securing the ignitor in place. Swing the ignitor plate open.
2. Disconnect the nozzle line heater harness (if applicable).
3. Unscrew the oil line fitting and thumb nut at the burner housing.
4. Pull the threaded end of the oil tube into the blower housing (Figure 5).
5. Rotate the assembly 180° so the electrodes are upside down. This places the electrode insulators out of the way for easy removal.
6. Remove the combustion head assembly, as shown in Figure 5, by pulling the assembly up and out of the housing.
7. Handle the assembly with care to avoid bending/moving the electrodes, or damaging the electrode ceramic insulators.
8. Inspect the gasket on the bottom of the ignitor plate. The gasket prevents air from escaping from the housing. Replace the gasket if not in good condition.
9. Inspect the ignitor contact clips. Clean or replace if necessary to ensure reliable contact with the electrodes.

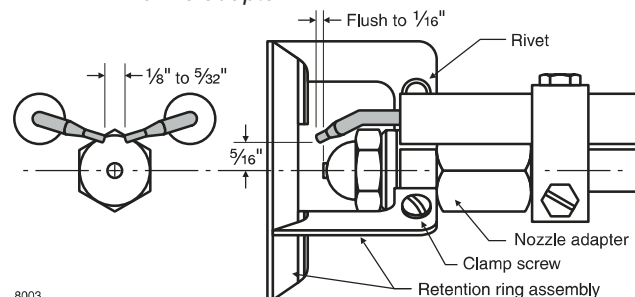
**Figure 5** Inserting/removing combustion head assembly



#### Install nozzle/check electrodes

1. Loosen the clamp screw on the retention ring assembly (see Figure 6). Slide the retention ring assembly off of the nozzle adapter.
2. Install and tighten the nozzle shown in Table 1, page 4, for retrofit applications. Install the nozzle given in the appliance manual when application information for the EZ 1,2,3 oil burner is given.
3. For OEM applications with a nozzle, verify nozzle is correct for the appliance and verify it is tight.
4. Hold the nozzle adapter securely when removing or replacing the nozzle (Figure 7). Take care not to damage the electrode insulators or to bend the electrodes in the process.

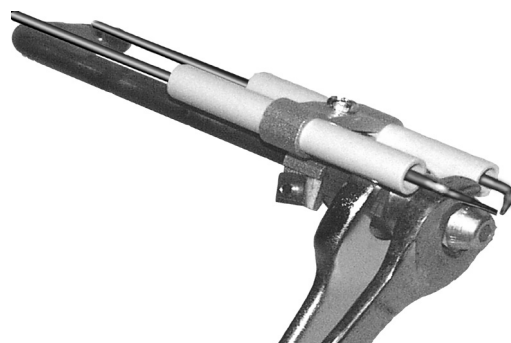
**Figure 6** Electrode placement, retention ring assembly and nozzle adapter



**WARNING** Inspect the nozzle adapter before replacing the nozzle. If the threads have been damaged or shows score marks, replace the nozzle line/adapter assembly.

5. Replace the retention ring assembly by slipping one of the riveted arms through the gap between the electrode tips. Align this arm straight up, with the ring clamp firmly against the nozzle adapter shoulder. Then tighten the clamping screw.
6. Check the electrode settings. Position the electrodes as shown in Figure 6. These settings are critical in ensuring a reliable ignition. Once the electrodes are set, check all clamps to be sure they are securely tightened.

**Figure 7** Carefully support the nozzle adapter when removing or installing nozzle



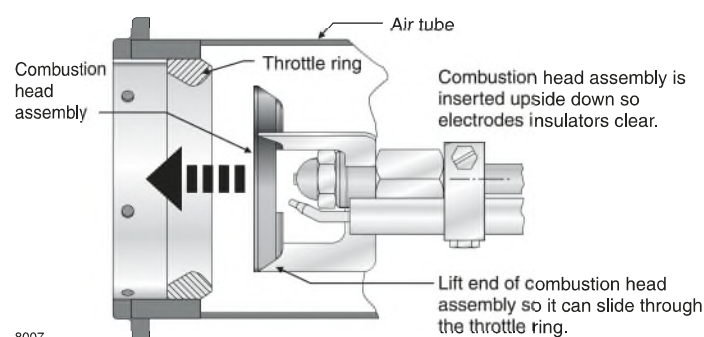
### 3. Prepare Burner (continued)

**To replace the combustion head assembly, reverse the previous sequence.**

- Remember to put the assembly in upside down, so the electrode insulators are out of the way.
- See Figure 8. You will have to lift the end of the assembly to guide it through the reduced diameter throttle cone at the end of the air tube. **DO NOT FORCE.**

**CAUTION** Use care when tightening the oil line fitting to oil tube extension. Tighten securely, but do not cross-thread or over-tighten.

**Figure 8** Inserting combustion head assembly



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### Install head positioning bar

- The EZ 1,2,3 are supplied with up to seven calibrated bars that properly position the head in the air tube. EZ LF has up to 6 calibrated bars, and 5 adjustable.
- The calibrated head positioning bars are stamped with a number, indicating head position.
- See Figure 9. If needed, remove the existing head bar and, using table 3A below, select the proper head bar based on Firing Rate. Note that these are just preliminary

**Table 3A** Head Positions and Approximate Air Settings for EZ Burners

| Firing Rate | Burner Model | GPH Head Bar    | Position Head Bar | Approximate Air Band Setting |
|-------------|--------------|-----------------|-------------------|------------------------------|
| 0.50        | EZ-1, EZ-LF  | 0.50, 0.35/0.55 | 0                 | 30%                          |
| 0.60        | EZ-1, EZ-LF  | 0.60/0.65       | 1                 | 35%                          |
| 0.65        | EZ-1, EZ-LF  | 0.60/0.65       | 1                 | 40%                          |
| 0.75        | EZ-1, EZ-LF  | 0.75            | 2                 | 45%                          |
| 0.85        | EZ-1, EZ-LF  | 0.85/1.00       | 3                 | 55%                          |
| 1.00        | EZ-1, EZ-LF  | 0.85/1.00       | 3                 | 60%                          |
| 1.10        | EZ-1, EZ-LF  | 1.10/1.25       | 4                 | 65%                          |
| 1.25        | EZ-1, EZ-LF  | 1.10/1.25       | 4                 | 70%                          |
| 1.35        | EZ-1, EZ-LF  | 1.35/1.50       | 5                 | 75%                          |
| 1.50        | EZ-1         | 1.35/1.50       | 5                 | 80%                          |
| 1.65        | EZ-1         | 1.65            | 6                 | 90%                          |
| 1.50        | EZ-2         | 1.50            | 4                 | 15%                          |
| 1.65        | EZ-2         | 1.65/1.75       | 4.5               | 25%                          |
| 1.75        | EZ-2         | 1.65/1.75       | 4.5               | 35%                          |
| 2.00        | EZ-2, EZ-3   | 2.00            | 5.5               | 50%                          |
| 2.25        | EZ-2, EZ-3   | 2.25            | 6.5               | 80%                          |
| 2.50        | EZ-3         | 2.50            | 8                 | 100%                         |

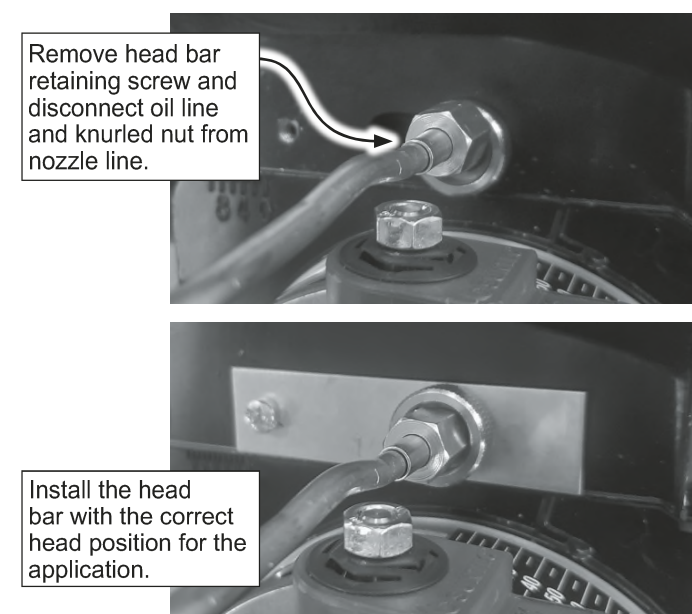
settings; combustion testing and review of your appliance manufacture's desired settings are required before firing.

- Confirm the number listed on the head bar lines up with the corresponding head position on the burner
- Store any remaining bars in the rear of the burner to allow future change, if needed.

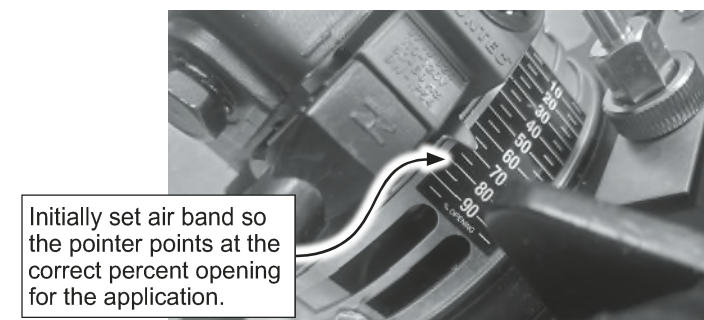
### Adjust air band (initial setting)

- The burner pump pressure is factory set. The air band divisions of the Carlin residential oil burner line are marked by percentage of opening. Loosen the lock screw and move the air band until the pointers line up with the setting indicated in the OEM Set-up Table or to a setting that matches firing rate indicated in table 3A on this page. See figure 10.
- NOTE:** For high altitude installations above 2,000 feet, increase the air supply setting 4% for each 1,000 feet above 2,000 feet above sea level.
- The burner is now adjusted to the approximate air band setting for the nozzle size indicated. When you check combustion with instruments during start-up or servicing, you may have to adjust the air band slightly to achieve the desired combustion readings. See "Adjust burner using test instruments," page 15.

**Figure 9** Installing head positioning bar



**Figure 10** Initial setting of air band



### 3. Prepare Burner (continued)

#### Inspect/install fuel supply

**CAUTION** Inspect the oil supply system. Ensure that the fuel lines are correctly sized and installed and that the fuel flow is unobstructed, the oil tank is clean and only #1 or #2 heating oil are supplied. Failure to supply a reliable oil flow could result in loss of heat and potential severe equipment damage.

#### General guidelines:

- When installing oil lines, use continuous runs of heavy-wall copper tubing if possible.
- Check fuel unit (oil pump) data sheet for recommended line sizing, lift limitations and maximum length.
- Check all connections and joints to ensure they are air-tight.
- Use flare fittings. Do NOT use compression fittings.
- Never use pipe sealing tape. Fragments can break off and plug fuel line components.
- Install a shut-off valve at the tank and one near the burner. (Use fusible handle design valves when possible or when required by codes.)
- Install a large capacity fuel filter (rated for 50 microns or less) near the burner.

#### Fuel unit bypass plug

**WARNING** The fuel unit is shipped ready for a one-line oil system (bypass plug is shipped loose). Install the bypass plug only if connecting to a two-line oil system. Operating with the plug in place on a one-line system will damage the fuel unit and could lead to oil leakage and fire hazard.

**WARNING** If the fuel line or fuel supply is above burner, never exceed 3 PSIG pressure at the fuel unit inlet. Install a suitable OSV to reduce the pressure. Operating the fuel unit with higher inlet pressure could result in fuel unit seal damage, oil leakage and potential fire hazard.

#### Nozzle line heater (optional)

- Oil burners often operate in spaces where temperatures tend to be cool, typically 60°F or lower. Cool oil has higher viscosity, which can affect atomization, ignition, combustion and fuel consumption. The nozzle line heater avoids this problem by heating the nozzle line oil to between 120°F and 130°F, resulting in smoother ignition and improved combustion.

- The nozzle line heater needs power when the burner is in standby (no call for heat from the appliance). Make sure the nozzle line heater is powered directly from the 120 VAC HOT line, not through the appliance operating control circuit. The nozzle line heater wiring should be shown on the wiring diagram supplied with the appliance/burner unit.
- The nozzle line heater is supplied with an electrical disconnect harness, allowing removal of the combustion head assembly without disconnecting wires. Position the heater harness disconnect in the rear of the blower housing, above the blower access cover. The wire leads to the disconnect route through the side of the housing into the junction box.

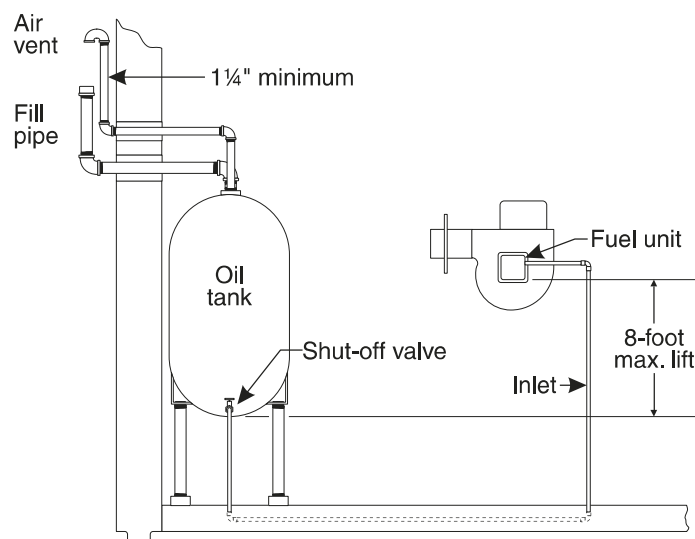
#### NOTICE

When first starting the burner, or after the service switch has been off for some time, the heater requires about 15 minutes to bring the oil to operating temperature.

#### One-line fuel system requirements

See Figure 11. The standard burner fuel unit is a single-stage, 3450-RPM oil pump. Apply this fuel unit only on one-line systems where the fuel supply is on the same level with, or higher than, the burner. This ensures oil flow by gravity. Also make sure the total lift does not exceed 8 feet (height difference from bottom of oil tank to fuel unit). For other conditions, you must provide a two-line fuel system. You may also have to change the fuel unit to a two-stage type.

**Figure 11** One-line fuel system



### 3. Prepare Burner (continued)

#### Two-line fuel system requirements

See Figure 12 and Table 4. Use Table 4 only for burners equipped with Suntec fuel units. For burners using other fuel units, read the fuel unit manufacturer's data sheet to determine maximum lengths and lifts.

The standard burner fuel unit is a single-stage, 3450-RPM oil pump. Use this fuel unit only on two-line oil systems that do not exceed the total tubing lengths allowed in Table 4 (for Suntec fuel units only). For longer systems (or where lift exceeds 10 feet), replace the one-stage fuel unit with a two-stage unit.

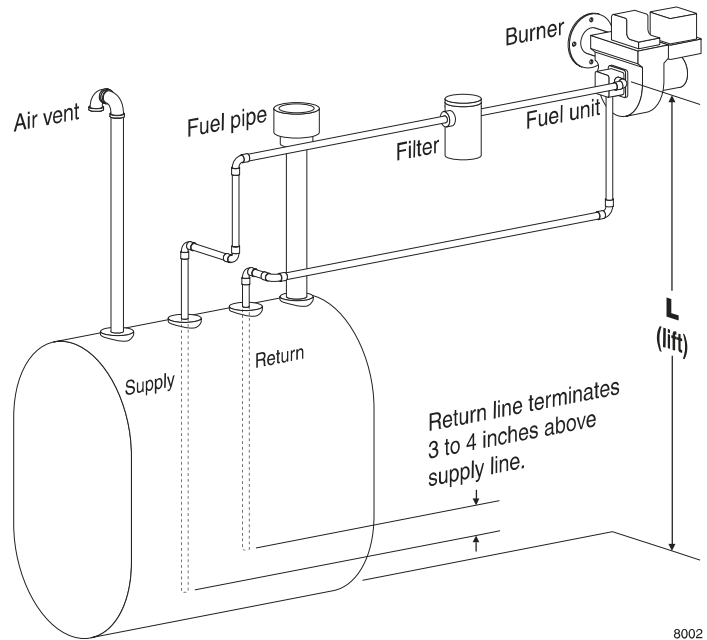
Always size fuel lines using an oil flow rate based on the fuel unit gearset capacity, not the burner firing rate. See fuel unit data sheet for information.

**NOTICE** Install the fuel unit bypass plug when connecting to a two-line system. The plug is shipped in a bag attached to the fuel unit, along with a fuel unit data sheet.

**Table 4** Two-line fuel system maximum lengths for 3/8" and 1/2" OD copper tubing distribution. Use only for burners equipped with Suntec fuel units. See fuel unit data sheet for any other fuel unit.

| Lift<br>(feet) | Max. total length of tubing, feet<br>(including both horizontal and vertical) |             |                     |             |
|----------------|-------------------------------------------------------------------------------|-------------|---------------------|-------------|
|                | Single-stage fuel unit                                                        |             | Two-stage fuel unit |             |
|                | 3/8" tubing                                                                   | 1/2" tubing | 3/8" tubing         | 1/2" tubing |
| 0              | 84                                                                            | 100         | 93                  | 100         |
| 2              | 73                                                                            | 100         | 85                  | 100         |
| 4              | 63                                                                            | 100         | 77                  | 100         |
| 6              | 52                                                                            | 100         | 69                  | 100         |
| 8              | 42                                                                            | 100         | 60                  | 100         |
| 10             | 31                                                                            | 100         | 52                  | 100         |
| 12             | NOT recommended —<br>use two-stage fuel unit                                  |             | 44                  | 100         |
| 14             |                                                                               |             | 36                  | 100         |
| 16             |                                                                               |             | 27                  | 100         |
| 18             |                                                                               |             | -                   | 76          |

**Figure 12** Two-line fuel system



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#### Perform checkout procedures

##### Verify before starting burner

- WARNING** Should overheating or an emergency occur, immediately:
- Shut off oil supply line valve.
  - Under some circumstances power should remain on for water pumps or blowers. Determine proper response before attempting start-up.
  - If burner fails ignition on several attempts, use burner blower to purge appliance chamber before restart.

##### Checklist

- ☐ Burner/appliance installed per appliance instruction manual?
- ☐ Burner nozzle and head positioning bar verified against Table 1, page 4, or appliance manufacturer's instructions?
- ☐ Burner/appliance installed per all applicable codes?
- ☐ Installation site has adequate combustion/ventilation air openings and vent system?
- ☐ Fuel supply line in good condition and sized/designed correctly?
- ☐ Oil tank has oil and oil line valves are open.
- ☐ Wiring installed per burner/appliance instructions?
- ☐ Burner, appliance and all components inspected and in good condition?

## 4. Wire Burner • Start Burner – See included Primary Control Data Sheet

**WARNING** Turn off power to appliance when servicing burner. Failure to comply could result in severe personal injury, death or substantial property damage.

## 5. Adjustment and Verification

### Perform combustion test

**WARNING** **COMBUSTION MUST BE VERIFIED WITH THE (OPTIONAL) BURNER COVER IN PLACE —**

Remove the burner cover if installed. Set up and adjust the burner using the following procedure. Replace the burner cover, allow the burner/appliance to run at least 15 minutes, then check combustion again. Readjust the burner is necessary. **The CO<sub>2</sub> will increase when the cover is put on**, particularly if combustion air is piped to the burner.

**WARNING** If air is ducted to an (optional) air adapter, combustion must be set based on the air inlet temperature. Air temperature variations will change how much air enters the burner, so the combustion must be set to anticipate the variations. Follow the guidelines below.

### Adjust burner using test instruments

1. Operate burner for 15 minutes before making final adjustments using test equipment.
2. Check for leaks in fuel piping.

**WARNING** Inspect fuel piping system for leaks. Repair any leaks to avoid fire hazard from oil leakage or combustion problems due to air infiltration into oil.

3. Inspect flame
  - Look at flame through appliance combustion chamber observation port. The flame should be well-defined and should not impinge on any appliance surface. (If you make air or gas pressure changes later, inspect the flame again.)

**WARNING** Do not attempt to confirm combustion simply by inspecting the flame visually. You must use combustion test instruments. Failure to properly verify/adjust combustion could allow unsafe operation of the burner, resulting in severe personal injury, death or substantial property damage.

4. Insert test probe into vent to sample flue products.

**WARNING** Heating units designed for natural draft operation are normally set for a slightly negative pressure, usually –0.01 to –0.02 inches w.c. draft at the combustion chamber test port. Appliances designed for forced draft (positive pressure in the chamber) must be air-tight to prevent exfiltration of harmful combustion products. Failure to properly set draft for the appliance could result in severe personal injury or death.

5. Use combustion test equipment to verify that the burner is properly set up for your installation. Appliances with positive pressure in the chamber may require a wider air opening. See appliance instructions for details. Verify/adjust settings by testing with instruments.

- With the EZ burner equipped with the correct positioning bar, oil nozzle and initial air band setting, the flue products will usually contain between 11½% and 12½% CO<sub>2</sub> (5.9% and 3.8% O<sub>2</sub>) and zero smoke. (Based on air inlet temperature of 70°F — see Table 5 for the proper values at other air temperatures for burners with ducted combustion air.)
- Depending on length of air piping (when used) and on air temperature, CO<sub>2</sub> may change one per cent or more with the cover in place.
- Check smoke. It should be zero on the Bacharach scale.
- Set the appliance flue damper or barometric draft regulator so the draft or pressure in the vent complies with the appliance manufacturer's instructions.

### Re-install (optional) burner cover and check combustion again

1. Allow the burner to operate with the cover on for at least 15 minutes. (Insert a temperature probe to measure incoming combustion air temperature if combustion air is ducted to the burner.)
  - Retest CO<sub>2</sub> (or O<sub>2</sub>) and smoke again. The values will change when the cover is installed. Depending on length of air piping and on air temperature, CO<sub>2</sub> may change one per cent or more with the cover in place.
  - Make sure the CO<sub>2</sub> (or O<sub>2</sub>) values are in the range given in Table 5 for the inlet air temperature measured. IF NOT, remove the cover and adjust the air band more open to decrease CO<sub>2</sub> (increase O<sub>2</sub>) or close the air band slightly to increase CO<sub>2</sub> (decrease O<sub>2</sub>).
  - Tighten air band clamping screw.

**WARNING** All installations should be checked after one to two weeks of operation to ensure the appliance/burner units are operating correctly.

**Table 5** Burners using inside air for combustion – Use “65°F or higher” row in table below.

**Burners with ducted combustion air – MEASURE incoming combustion air temperature and set the CO<sub>2</sub> (or O<sub>2</sub>) using the following chart:**

| Incoming combustion air temperature during setup | CO <sub>2</sub> min | CO <sub>2</sub> max | O <sub>2</sub> max | O <sub>2</sub> min |
|--------------------------------------------------|---------------------|---------------------|--------------------|--------------------|
| <b>–20°F to 0°F</b>                              | 10.2%               | 11.0%               | 7.0%               | 5.8%               |
| <b>5°F to 30°F</b>                               | 11.0%               | 11.5%               | 5.8%               | 5.5%               |
| <b>35°F to 60°F</b>                              | 11.5%               | 12.2%               | 5.5%               | 4.2%               |
| <b>65°F or higher</b>                            | 12.0%               | 12.5%               | 4.6%               | 3.9%               |

## 5. Adjustment and Verification

(continued)

### Verify burner/appliance operation

#### Check burner/appliance/controls operation

- Test operating and limit controls on appliance as specified in appliance instructions.
- Check operation of the primary control by forcing lockout to occur. For primary controls that enter latch-up after multiple lockouts, force latch-up to occur as well. Reset primary control per control data sheet instructions after each test.
- Start and stop the burner several times, allowing the primary control to sequence through normal operation. Verify correct operation of burner and primary control throughout.

#### Verify vent system operation

- Verify vent is operating correctly and flue products are properly exhausted from building. If the building contains any exhaust fans or conditions that could affect vent performance, check burner/appliance/vent operation with exhaust fans (or other conditions) operating.

#### Combustion/ventilation air

- Verify combustion/ventilation air openings are not/will not be obstructed.
- Verify air opening louvers are full open.
- If louvers are motor-operated, verify motor and end switch are interlocked with appliance/burner wiring to prevent operation of the burner if the air louvers are not fully opened.

#### Prepare burner for normal operation

- Cycle burner off with appliance controls.
- Turn off power to the appliance.
- Seal the appliance flue damper test opening.
- Verify all components and wires are in place and burner is ready for operation.
- Restore power to the appliance.

#### Train the user

- Train the user to operate the burner and appliance under normal conditions.
- Explain procedure to shut down burner/appliance when required.
- Review rear cover of this manual (and the appliance manual) with the user.
- Verify the user is aware of all procedures specified in the manuals.
- Verify user will not store or use combustible liquids or materials or contaminants in the vicinity of the burner/appliance.

## 6. Annual Startup and Service

### Perform the following

#### WARNING

This burner must be started and serviced at least annually by a qualified service technician. Failure to properly maintain and service the burner could result in severe personal injury, death or substantial property damage.

- Discuss burner/appliance operation with user to determine any problems that may have occurred during the previous season and to verify user is aware of proper operation and care of the burner/appliance.
- Review proper operation of the appliance/burner unit with the user.
- Turn off power to appliance.
- Remove combustion head assembly to clean and adjust if necessary. (See procedure on page 10.)
- If the inside surface of the air tube and/or retention ring need to be cleaned, clean them with a vacuum cleaner with brush attachment while the combustion head assembly is out of the burner.
- Replace the oil nozzle with the correct size.
- Inspect and adjust the ignition electrodes and insulators per instructions on pages 10 and 11 of this manual. Replace if proper spacing cannot be achieved or if components are damaged.
- Close the housing cover plate and secure in place.
- Inspect the fuel line oil filter. Replace if necessary.

#### NOTICE

The National Oilheat Research Alliance (NORA) recommends single pipe oil systems and high-quality filtration for all fuel types. This should include at least a 10 micron Spin-on filter. Double filtration provides even greater assurance clean fuel will get to the pump. Contaminants in the tank that enter the fuel supply to the burner can cause pump sticking/seizing. These contaminants may increase in the early stages of transitioning to modern fuels (Ultra Low Sulfur and Bio Blends). High quality filtration adds protection against pump sticking.

- Perform the complete checkout procedures of pages 10 to 13, including system inspection and checks.
- Inform the user of any problems found.

## 7. Maintenance Procedures

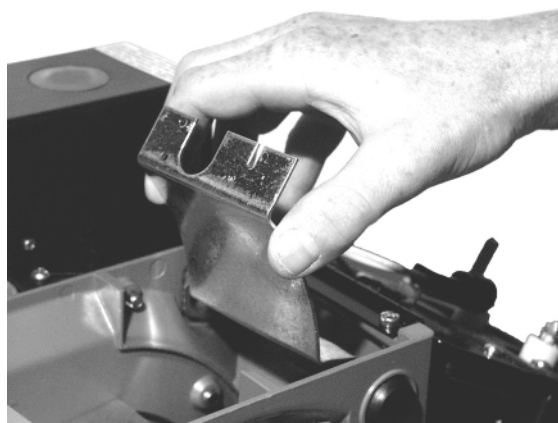
### Maintenance/service procedures

**WARNING** Turn off power to appliance when servicing burner. Failure to comply could result in severe personal injury, death or substantial property damage.

#### Cleaning blower wheel

1. The blower wheel accumulates dust and debris from normal operation. You will need to clean the wheel blades periodically to prevent reduction in airflow.
  - Inspect the blower wheel by removing the blower wheel access cover (See Figure 14).
  - To remove the cover, open the ignitor plate and loosen the blower wheel access cover screw about three turns.
  - Inspect the blower wheel to see if it needs to be cleaned. Dirt and lint on the wheel reduce air flow, and must be removed if the burner is to operate correctly.
2. To clean blades, remove the two bolts securing the motor to blower housing.
  - a. Slide the motor out and rotate to remove and access blower wheel.
  - b. Use a brush and vacuum to clean each blade and the blower housing interior.
  - c. Replace motor/wheel in blower housing and secure with the two bolts.
  - d. Push wire slack back into junction box.

Figure 13 Removing the blower wheel access cover



#### Replacing blower motor or wheel

1. If either the blower wheel or motor must be replaced, remove the two bolts securing the motor to housing.
2. Disconnect the motor wires in the burner junction box.
3. Loosen the Allen screw securing the blower to the motor shaft and remove the wheel.
4. When assembling the replacement assembly, slide the wheel onto the motor shaft and use feeler gauges to set a space of 3/64 inch between the blower wheel and the motor face.
5. Replace the motor/wheel assembly in the housing, wire the motor leads and secure the motor with the two bolts.

#### Motor maintenance

- The Carlin PSC motor is constructed with permanently-lubricated bearings, and requires no oiling. Should you replace the original motor with another type of motor, occasional oiling may be required, depending on motor design and manufacturer's recommendations.
- Any time you replace a component or disassemble any part of the burner for service/maintenance, perform a complete operational test after reassembly to verify the burner operates correctly. Failure to verify operation could result in severe personal injury, death or substantial property damage.

#### Checking ignitor

**WARNING** Never test an ignitor by placing a screwdriver (or other metallic object) across the high voltage clips. Check 40700 & 40900 ignitors only by observing spark at appliance ignition electrodes, with fuel supply OFF. Using any other method could cause ignitor damage and severe personal injury.

1. Checking 45000 ignitors only:
  - Disconnect electrical power to burner.
  - Remove hold down clips or screws. Lift ignitor mounting plate to the full-open position. Set high voltage clips to a 1/2" to 3/4" gap.
  - Carefully energize ignitor and check for spark arcing at the high voltage terminals. If spark jumps the gap, ignitor is good.

#### Ceramic fiber materials

**WARNING** The appliance may contain ceramic fiber and/or fiberglass materials. Ceramic fiber materials, such as chamber liners, may contain carcinogenic particles (chrysotilites) after exposure to heat. Airborne particles from fiberglass or ceramic fiber components have been listed as potentially carcinogenic by the State of California. Take the following precautions when removing, replacing and handling these items.

Avoid breathing dust and avoid contact with skin or eyes. Wear long-sleeved, loose-fitting clothing, gloves and eye protection. Use a NIOSH N95 certified respirator. This respirator meets requirements for protection from chrysotilites. Actual job requirements or NIOSH regulations may require other or additional protection. For information, refer to the NIOSH website, <http://www.cdc.gov/niosh/homepage.html>.

Ceramic fiber removal: To prevent airborne dust, thoroughly wet ceramic fiber with water before handling. Place ceramic fiber materials in a plastic bag and seal to dispose.

Avoid blowing, tearing, sawing or spraying fiberglass or ceramic fiber materials. If such operations are necessary, wear extra protection to prevent breathing dust.

Wash work clothes separately from other laundry. Rinse clothes washer thoroughly afterwards to prevent contamination of other clothing.

NIOSH First aid procedures:

Eye exposure — irrigate immediately

Breathing — fresh air.

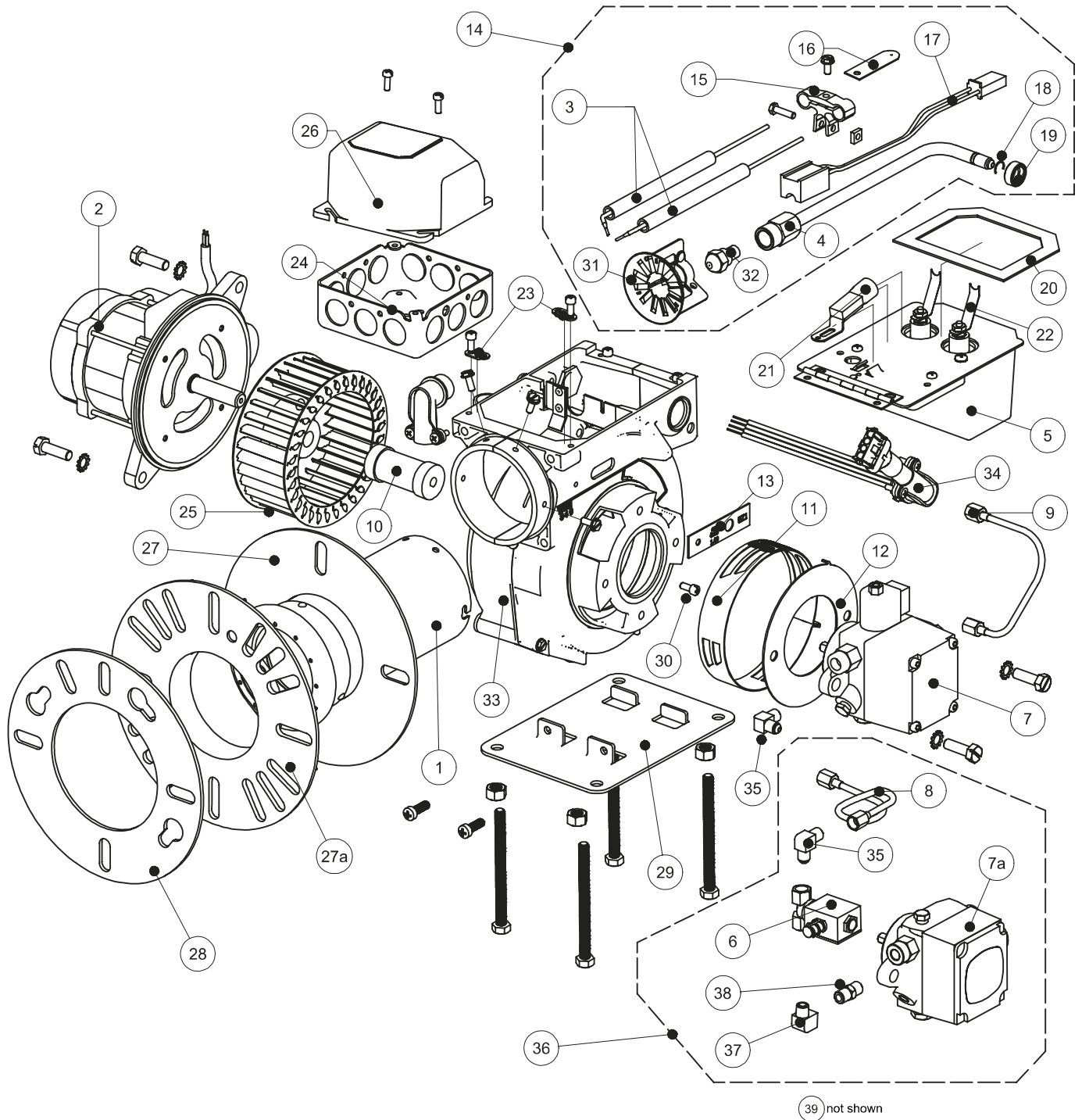
## 8. Repair Parts

| Item      | Description                                                              | Part No. |
|-----------|--------------------------------------------------------------------------|----------|
| <b>1</b>  | Air tube, 4" nominal, approx. 4-3/8" oal (EZ 1)                          | 77719    |
|           | Air tube, 5" nominal, approx. 5-3/8" oal (EZ 1)                          | 77727    |
|           | Air tube, 7" nominal, approx. 7-3/8" oal (EZ 1)                          | 77735    |
|           | Air tube, 9" nominal, approx. 9-3/8" oal (EZ 1)                          | 77743    |
|           | Air tube, 11" nominal, approx. 11-3/8" oal (EZ 1)                        | 77750    |
|           | Air tube, 5" nominal, approx. 5-1/4" oal (EZ 2 & 3)                      | 83816    |
|           | Air tube, 7" nominal, approx. 7-1/4" oal (EZ 2 & 3)                      | 83824    |
|           | Air tube, 9" nominal, approx. 9-1/4" oal (EZ 2 & 3)                      | 83832    |
|           | Air tube, 11" nominal, approx. 11-1/4" oal (EZ 2 & 3)                    | 83840    |
|           | Air tube with welded flange, for specific appliance (contact factory)    | —        |
|           | Air Tube, 4" nominal, approx. 4-3/8" oal (EZ LF)                         | 99802    |
|           | Air Tube, 4" nominal, approx. 5-3/8" oal (EZ LF)                         | 99914    |
|           | Air Tube, 4" nominal, approx. 7-3/8" oal (EZ LF)                         | 99780    |
|           | Air Tube, 4" nominal, approx. 9-3/8" oal (EZ LF)                         | 50017    |
|           | Air Tube, 4" nominal, approx. 11-3/8" oal (EZ LF)                        | 50699    |
| <b>2</b>  | Motor, 1/6 hp, 3450 rpm, Carlin PSC                                      | 98022    |
| <b>3</b>  | Electrode wire, set of 2, 4" nominal, approx. 5-1/2" oal (EZ 1 only)     | 82750    |
|           | Electrode wire, set of 2, 5" nominal, approx. 6-1/2" oal                 | 82768    |
|           | Electrode wire, set of 2, 7" nominal, approx. 8-1/2" oal                 | 82776    |
|           | Electrode wire, set of 2, 9" nominal, approx. 10-1/2" oal                | 82784    |
|           | Electrode wire, set of 2, 11" nominal, approx. 12-1/2" oal               | 82792    |
| <b>4</b>  | Nozzle line/adaptor assembly, 4" nominal, approx. 5-3/4" oal (EZ 1 only) | 56804    |
|           | Nozzle line/adaptor assembly, 5" nominal, approx. 6-3/4" oal             | 56820    |
|           | Nozzle line/adaptor assembly, 7" nominal, approx. 8-3/4" oal             | 56861    |
|           | Nozzle line/adaptor assembly, 9" nominal, approx. 10-3/4" oal            | 57315    |
|           | Nozzle line/adaptor assembly, 11" nominal, approx. 12-3/4" oal           | 56754    |
| <b>5</b>  | Ignitor, Carlin electronic                                               | 45000    |
| <b>6</b>  | Oil valve (optional)                                                     | SVC10FF  |
| <b>7</b>  | Fuel unit, Suntec A2VA-30061B, w/fitting                                 | 98750S   |
| <b>7a</b> | Fuel unit, std. single stage, Suntec A2VA-7116B, w/fitting               | 22996    |
| <b>8</b>  | Oil line, 3/16 od, oil valve to nozzle line                              | 34439    |
| <b>9</b>  | Oil line, 3/16 od, std. fuel unit to nozzle line                         | 34470    |
| <b>10</b> | Coupling, for std. fuel units, approx. 2-3/8" oal                        | 75564    |
| <b>11</b> | Air band (EZ 1)                                                          | 98055    |
|           | Air band (EZ 2)                                                          | 98087    |
|           | Air band (EZ 3)                                                          | 98089    |
|           | Air Band (EZ LF), Single                                                 | 98100    |
|           | Air Band (EZ LF), Dual                                                   | 98101    |
|           | Air Band (EZ LF), EZ                                                     | 50919    |
| <b>12</b> | Air shutter, blank (EZ 1) (EZ LF)                                        | 97780    |
|           | Air shutter, one slot (EZ 1)                                             | 98052    |
|           | Air shutter, three slots (EZ 2)                                          | 98109    |
|           | Air shutter, four slots (EZ 3)                                           | 98108    |
|           | Air Shutter Blank (EZ LF)                                                | 46938    |

| Item       | Description                                                     | Part No.     |
|------------|-----------------------------------------------------------------|--------------|
| <b>13</b>  | Head positioning bar kit w/7 bars & thumb screw (EZ 1, EZ-1-HP) | 98078        |
|            | Head positioning bar kit w/4 bars & thumb screw (EZ 2, EZ-2-HP) | 84715S       |
|            | Head positioning bar kit w/3 bars & thumb screw (EZ 3, EZ-3-HP) | 86389S       |
|            | Head positioning bar kit w/6 bars                               | 99831        |
|            | Limited adjustment head positioning bar kit w/5 bars            | 98115        |
| <b>14</b>  | Combustion head assembly 4" (EZ 1,2,3,LF)                       | 77941        |
|            | Combustion head assembly 5" (EZ 1,2,3,LF)                       | 77958        |
|            | Combustion head assembly 7" (EZ 1,2,3,LF)                       | 77966        |
|            | Combustion head assembly 9" (EZ 1,2,3,LF)                       | 77974        |
|            | Combustion head assembly 11" (EZ 1,2,3,LF)                      | 77982        |
| <b>15</b>  | Electrode bracket                                               | 23135        |
| <b>16</b>  | Bracket, nozzle line heater                                     | 64493        |
| <b>17</b>  | Nozzle line heater w/electrical disconnect (optional)           | 66795        |
| <b>18</b>  | E-ring for nozzle line                                          | 50624        |
| <b>19</b>  | Thumb nut, nozzle line                                          | 62885        |
| <b>20</b>  | Gasket, ignitor                                                 | 40167        |
| <b>21</b>  | Cad cell                                                        | 4002400A     |
| <b>22</b>  | Ignitor terminal kit, (2 terminals & nuts)                      | 24463        |
| <b>23</b>  | Ignitor hold-down tab, two required                             | 44842        |
| <b>24</b>  | Junction box, 4"x4", w/grommet and lockwasher                   | 44586        |
| <b>25</b>  | Blower wheel, 5-1/16d x 2w                                      | 77933        |
| <b>26</b>  | Primary control (consult factory for other controls)            | 70200        |
| <b>27</b>  | Welded flange, when supplied (contact factory)                  | —            |
| <b>27a</b> | Mounting flange, 3-1/2 id x 8-1/4 od Universal flange           | 81364        |
| <b>28</b>  | Gasket, mounting flange                                         | 40287        |
| <b>29</b>  | Pedestal w/hardware                                             | 23317        |
| <b>30</b>  | Screw, head positioning bar                                     | 98349        |
| <b>31</b>  | Flame retention ring assembly                                   | 77438        |
| <b>32</b>  | Nozzle (obtain locally)                                         | —            |
| <b>33</b>  | Housing                                                         | 50685A       |
| <b>34</b>  | Plug-in wire harness, when supplied (contact factory)           | —            |
| <b>35</b>  | Elbow, 3/16 flare x 1/8 NPT                                     | 29926        |
| <b>36</b>  | Optional Valve and Pump                                         | —            |
| <b>37</b>  | Elbow                                                           | 118-2671-001 |
| <b>38</b>  | Nipple                                                          | 29322        |
| <b>39</b>  | Access cover w/deflector (EZ 1,2,3,LF)                          | 99282A       |
|            | Access cover w/o deflector (EZ 1,2,3,LF)                        | 98281A       |
|            | Access cover w/36 hole blender (EZ LF)                          | 9975601A     |
|            | Access cover w/28 hole blender (EZ LF)                          | 9975601B     |

For parts not shown or listed, contact factory and/or check separate documentation supplied with appliance/burner unit.

## 8. Repair Parts (continued)



## EZ 1,2,3 and LF Oil/Bio-Fuel Burner User Care and Maintenance

### WARNING

#### Should overheating occur:

1. Shut off the oil supply to the burner.
2. **DO NOT** shut off the control switch to the circulator or blower.
3. Contact your oil dealer or service technician and the fire department (if needed).

### WARNING

The burner must be cleaned, tested and adjusted annually by a qualified oil burner service technician.

### WARNING

Refer only to the information on this page, intended for your use. The remainder of this manual is intended only for your service technician. Failure to comply could result in severe personal injury, death or substantial property damage.

For other than routine maintenance, contact a qualified service company. Perform the following as needed.

- Keep the area around the burner clear and free from combustible vapors and liquids.
- Do not obstruct the flow of combustion and ventilating air.
- Most motors currently used on residential type burners use permanently-lubricated bearings, and do not require field lubrication. Read the label on the motor to determine oiling needs, if any. Do not over-lubricate. This can cause as much trouble as not lubricating at all.

### WARNING

Never attempt to use gasoline as a fuel for this burner, as it is more combustible and could result in a serious explosion. Never attempt to burn refuse or use any fuel other than #1 or #2 heating oil or bio blends including B100 (U.S. Only) (ASTM D396).



## Biodiesel Best Practices

### For ALL Biodiesel blends

- **Single Pipe Systems:** The National Oilheat Research Alliance (NORA) recommends single pipe oil systems to reduce the amount of oil that circulates through the pump.
- **Improved Filtration:** NORA also recommends 10-micron Spin-on filters. Converting to biodiesel can mobilize sludge and other contaminants that have built up in the tank over time. This 'cleaning' process is short-term and occurs early in the biodiesel transition. During this time, it is important to protect the burner/pump with improved filtering. More frequent filter changes may also be needed during this transitional phase.

### For Biodiesel Blends above B20

- **Upgrade Older Carlin Burners:** Instructions for Field Conversion can be found in the "All Blends" section of our Online OEM Guide (<https://oemguide.carlincombustion.com/new-home/>). This upgrade will include a redesigned combustion head assembly, higher pump pressures, a B100 rated pump and alternate primary control settings – All designed to minimize head coking with high blend biodiesel.
- **Burner Setup:** Prior to transitioning to higher bio blends, an installed burner should be set to a higher CO<sub>2</sub> range (recommended 12% for B20 or less). Higher bio blends (above B50) will result in lower CO<sub>2</sub> readings. Making this adjustment in advance will insure that the lower limit of 11.5% CO<sub>2</sub> will be maintained during a transition from lower to higher blends. 100% BIO (B100) will operate best if the minimum CO<sub>2</sub> of 11.5% is used as a setting.