The Eclipse Auto-Recupe contains a nozzle mixing burner and recuperator coaxially mounted inside of a single-ended radiant tube (SER). Combustion air entering the Auto-Recupe is preheated in the recuperative section by waste exhaust heat, providing fuel savings from 35% to 55% over radiant tubes equipped with sealed ambient air burners. When used to replace atmospheric burners, an additional 8% to 10% fuel savings can be achieved. Auto-Recupes are available in five diameters from 3" to 7½". Radiant tube length is tailored to the application.

**CONTROL METHODS**

The Auto-Recupe is designed for high-low firing. However, due to the difficulty of controlling very small low fire inputs, Eclipse recommends high-off control for the 3" and 3¼" sizes, especially when chamber temperatures are above 1550°F. Control systems may use time proportional control. Modulating control must not be used.

**FEATURES**

- No hot air duct work required
- Recuperative section is positioned in furnace wall for minimum heat loss
- Even heat distribution down the length of the radiant tube
- Radiant tube life comparable to conventional radiant tubes
- Integral air orifice meter simplifies adjustment
- Easy installation, low maintenance; air connection need not be disturbed for burner or flame tube maintenance
- Sandwich flange construction eliminates bolt hole alignment problems

**PERFORMANCE DATA**

**FIRING RATES & EFFICIENCIES**

<table>
<thead>
<tr>
<th>Tube O.D.</th>
<th>Low Fire</th>
<th>High Fire</th>
<th>24″</th>
<th>30″</th>
<th>36″</th>
<th>40″</th>
<th>65″</th>
<th>74″</th>
<th>120″</th>
<th>160″</th>
</tr>
</thead>
<tbody>
<tr>
<td>3″</td>
<td>10</td>
<td>35</td>
<td>.74</td>
<td>.73</td>
<td>.72</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3-1/4″</td>
<td>12</td>
<td>50</td>
<td>.74</td>
<td>.73</td>
<td>.72</td>
<td>.70</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>4-1/2″</td>
<td>15</td>
<td>75</td>
<td>—</td>
<td>.74</td>
<td>.73</td>
<td>.72</td>
<td>.71</td>
<td>.70</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>6″</td>
<td>25</td>
<td>160</td>
<td>—</td>
<td>—</td>
<td>.74</td>
<td>.73</td>
<td>.72</td>
<td>.71</td>
<td>.68</td>
<td>—</td>
</tr>
<tr>
<td>7-1/2″</td>
<td>35</td>
<td>270</td>
<td>—</td>
<td>—</td>
<td>.74</td>
<td>.73</td>
<td>.72</td>
<td>.71</td>
<td>.70</td>
<td>.68</td>
</tr>
</tbody>
</table>

1 125% excess air required, or 12% O2 in flue gas.
2 Auto-Recupes burn cleanly with 10% excess air in this range.
3 Based on 1650°F furnace temperature and a "B" dimension (pg.2) of 19".

**MAXIMUM HEAT TRANSFER RATES**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Heat Transfer; Btu/Hr./Sq. In.</td>
<td>Tube Free to Radiate on Three Sides</td>
<td>Tube Enclosed on Three Sides</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>55</td>
<td>60</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>45</td>
<td>50</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>30</td>
</tr>
</tbody>
</table>

**ECLIPSE COMBUSTION**

ROCKFORD, ILLINOIS 61103 (815) 877-3031
CANADA: ECLIPSE FUEL ENGINEERING CO.
HOLLAND: FLAMECO-ECLIPSE
ENGLAND: ECLIPSE THERMAL SYSTEMS
The length of an Auto-Recupe is usually determined by the physical dimensions of the furnace. Once the maximum heat release required from the tubes is known, sizing is simply a matter of choosing the tube diameter that will release the required heat while operating within its capacity range.

Example: The Auto-Recupes shown are to be used at a chamber temperature of 1650°F. The total heat release required is 400,000 Btu/Hr.

Max. Heat Transfer (from page 1):
Upper Tubes = 60 Btu/Hr./Sq. In.
Lower Tubes = 45 Btu/Hr./Sq. In.

Using the 1819 AR with a tube O.D. of 4½" and an effective length of 70":
Surface Area = O.D. x π x Effective Length
= 4.5" x 3.14 x 70" = 989 Sq. In.

Efficiency (from page 1) = .70

Max. Input = \( \frac{\text{Heat Transfer} \times \text{Surface Area}}{\text{Efficiency}} \)

Upper Tubes = \( \frac{60 \times 989}{.70} \) = 84,770 Btu/Hr.

Lower Tubes = \( \frac{45 \times 989}{.70} \) = 63,580 Btu/Hr.

84,770 Btu/Hr. exceeds the maximum input rating for the 4½" 1819 AR as shown on page 1. Maximum input to the upper tubes would therefore be limited to 75,000 Btu/Hr.

Max. Heat Released = Maximum Input \times Efficiency
Upper Tubes = 75,000 Btu/Hr. \times .70 = 52,500 Btu/Hr.
Lower Tubes = 63,580 Btu/Hr. \times .70 = 44,510 Btu/Hr.

With three upper and three lower tubes, the total maximum heat release is 291,000 Btu/Hr. Since the furnace requires 400,000 Btu/Hr., a larger diameter Auto-Recupe is needed. Repeating the calculations using the 2419 AR with a 6" O.D. gives a maximum upper tube input of 111,500 Btu/Hr. and a maximum lower tube input of 83,600 Btu/Hr. Both are within the input range of the unit. Total maximum heat release would be 415,600 Btu/Hr., slightly more than enough to meet the furnace design requirements.
Each Auto-Recupe is supplied with two orifice plates installed between the air metering orifice flanges. The combustion air supply pressure at the inlet to the Auto-Recupe must be at least 3" w.c. higher than the high fire metering orifice pressure drop shown in the graph below.

If supply pressure is high enough for the smaller of the two orifices supplied, leave both plates between the flanges. If supply pressure is too low for the small diameter orifice, loosen the flange bolts and slip out the smaller orifice plate, leaving the larger one in place.

Example: The 2419 AR's selected on the previous page have a 6" O.D. and are shipped with the .625" and .875" orifice plates as shown in the table below. An existing blower can supply a pressure of 14" w.c. at the Auto-Recupe after piping and valve pressure drops are subtracted.

Upper Tubes: With an input of 111,500 Btu/Hr., the drop across the .875" orifice plate will be approximately 4.1" w.c. This will require an air inlet pressure of 7.1" w.c., easily within range of the existing blower. The .625" plate, however, would produce a pressure drop higher than the blower is capable of supplying. During installation, then, the .625" plate should be removed from the orifice meters of the upper tubes.

Lower Tubes: With an input of 83,600 Btu/Hr., the .625" orifice plate will have a drop of approximately 9.4" w.c. The air supply required is thus 12.4" w.c. Since the blower can supply this pressure, the .625" orifice plate need not be removed from the lower tubes.

---

**Metering Orifice Plates Supplied with Auto-Recupes**

<table>
<thead>
<tr>
<th>Tube O.D.</th>
<th>.375&quot;</th>
<th>.438&quot;</th>
<th>.500&quot;</th>
<th>.563&quot;</th>
<th>.625&quot;</th>
<th>.750&quot;</th>
<th>.875&quot;</th>
<th>1.00&quot;</th>
<th>1.125&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot;</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-1/4</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-1/2&quot;</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Orifices not shown as standard can be supplied on request.