North American Orifice Metering System

8697 and M8697 Metering Orifices accurately measure gas flows to industrial burners. They are compact, inexpensive, and can be installed in individual burner gas lines to expedite adjustment of air/fuel ratio. They allow easy checking of operation while burners are firing.

Individual metering orifices are a great convenience on multi-burner furnaces, facilitating setting all burners the same or in desired gradients. Some installations add a larger 8697 Metering Orifice (upstream of the individual units) for continuous metering of total gas consumption in a zone or for the whole furnace.

Many plants also use 8697 Metering Orifices in burner air lines to enable precise matching flows of combustion air and gas.

FEATURES

8697 Sizes: ½" through 4" pipe size
M8697 Sizes: ½" through 2" in ISO 7-Rp

Nominal flows: 90 cfh to 15,700 cfh natural gas
(2.5 m³/h to 444.6 m³/h)

Flexibility: Each orifice holder offers a choice of seven or eight plates that can be exchanged without removing holder from pipe. This allows convenient on the job tailoring of the meter to fit its requirements.

INSTALLATION

10 Straight clean pipe diameters upstream, 4 diameters downstream, without valves or fittings.

For maximum accuracy, readings must be corrected for:
- gas (or air) line pressure
- gas (or air) temperature
- barometric pressure
Sheets 8697-3 and 8697-5 deal with correction factors

Observe straight pipe run requirements.

Pressure taps should be on top or side of pipe to reduce problems with dirt or condensate collecting in taps or manometer hose.

When pressure is over 3 psi (207 mbar), remove hose barbs and install tube fittings to use metal tubing, rather than hose, between metering orifice and manometer.

When metering oxygen, use specially cleaned pipe and oxygen approved differential-pressure gauges and equipment.

Models:
8697- -A: Standard meter for air and fuel gases up to 25 psi (1.7bar) pressure.
8697- -C: Meter specially cleaned for oxygen service up to 25 psi (1.7bar) pressure.

SELECTING AN ORIFICE

1. Determine high fire air flow rate at the burner.
2. Determine corresponding gas flow rate: (For typical natural gas, divide air flow by 11 to determine gas flow.) See table below for other air/gas volume ratios.
3. Select next smaller orifice plate capacity from Table B1 (realize that the plate capacity is offered in a number of different pipe size holders).

* Maximum allowable pressure is 3 psig on all 8697A series orifice holders manufactured prior to October 2011.

<table>
<thead>
<tr>
<th>Fuel Gases</th>
<th>Air/gas volume ratios (10% XSAir and typical fuels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>natural</td>
<td>11</td>
</tr>
<tr>
<td>propane</td>
<td>26.2</td>
</tr>
<tr>
<td>butane</td>
<td>33.6</td>
</tr>
<tr>
<td>coke oven</td>
<td>5.3</td>
</tr>
</tbody>
</table>

Example:
1. A 4422-7-A Burner passes 27,000 cfh air at 16 osi (assuming 16 osi represents "high fire" for this example).
2. Corresponding natural gas flow is 2455 cfh.
3. A #2000 plate is preferred because its higher required pressure drop--approximately 5.3"wc--means low fire readings will be easier and more accurate.

The 4422-7-A Burner has a 2½" gas connection; a #2000 plate is offered in the 8697-5 (2½") holder (as well as in the -3 [1½"] and -4 [2"] units), so an 8697-5-A2000 Metering Orifice may be the most convenient for this job.
## TABLE B1. Flow Capacities

<table>
<thead>
<tr>
<th>T</th>
<th>Bulletin 8697</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.397 psia inlet pressure; 80 F inlet temperature</td>
<td></td>
</tr>
</tbody>
</table>
Piping for metering orifices with nozzle-mix burners (with premix burners, install orifice holder between atmospheric regulator and mixer). One portable manometer can be used for all orifice differential readings.

**CHANGING ORIFICES**

1. Turn off gas supply.
2. Remove orifice plate size tag.
3. Remove cover screws and cover.
4. Loosen internal spring holding screw.
5. Remove orifice plate.
6. Install new orifice plate.
7. Tighten internal spring holding screw.
8. Replace cover and cover screws.
10. Perform leak test to verify no leakage.

**FIELD SETUP**

1. Light burner. Adjust regulator and limiting orifice valve per their instructions.
2. Attach a manometer or quality air pressure gauge to burner air connection. Set burner air valve for desired pressure.
3. Open each orifice holder pressure tap momentarily to flush out condensate and dirt.
4. Connect a manometer, with its equalizing valve open, to orifice holder taps. Slowly open these taps; then slowly close the equalizing valve, taking care not to "blow" the manometer.
5. Adjust limiting orifice valve for proper gas flow reading.

Using example (from "Selection," page 1):

If actual high fire air pressure on gauge is 14 osi, air flow is $27,000 \times \sqrt{14/16} = 25,260$ cfm and corresponding natural gas flow should be 2526 cfm.

Adjust limiting orifice gas valve until manometer across the #2400 plate shows 3.88"wc: $(2526/2400)^2 \times 3.5$. (If using an 8736-A Manometer, its right hand scale [specifically for 8697 Metering Orifices] could be used--in this case 2526/2400 = 1.05 scale factor.)
**8697-7 Orifice Holder** is identical in operation to smaller sizes, but it is mounted between flanges instead of being threaded onto pipe. Standard ANSI 125 psi flanges and full faced gaskets must be supplied separately.

Holder fits within bolt circle of flanges: Two top bolts on each side screw into the holder to assure correct alignment.

Weight: 25 pounds

**CONSTRUCTION**

Orifice plates: stainless steel. Accurately manufactured with a square edge orifice. Plate is stamped with its number, which is its capacity in cfh of 0.6 s.g. gas at 3.5"wc (8.72 mbar) pressure drop.

Orifice holders: cast iron. Stainless steel springs, neoprene gaskets, brass hose cocks--alternate cocks available for gases corrosive to brass.

**DIMENSIONS**

<table>
<thead>
<tr>
<th>Orifice Holder designation</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>wt in lb (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8697-01/M8697-01</td>
<td>1/4</td>
<td>1/2</td>
<td>3/8</td>
<td>3/8</td>
<td>1 1/16</td>
<td>1/2</td>
<td>3 1/8</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>8697-0/M8697-0</td>
<td>1/2</td>
<td>3/4</td>
<td>3/4</td>
<td>3/8</td>
<td>1 1/16</td>
<td>1/2</td>
<td>3 1/8</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>8697-1/M8697-1</td>
<td>1</td>
<td>3/4</td>
<td>3/4</td>
<td>3/8</td>
<td>1 1/16</td>
<td>1/2</td>
<td>3 1/8</td>
<td>1.6 (0.8)</td>
</tr>
<tr>
<td>8697-2/M8697-2</td>
<td>1 1/2</td>
<td>3/4</td>
<td>3/4</td>
<td>3/8</td>
<td>1 1/16</td>
<td>1/2</td>
<td>3 1/8</td>
<td>2.4 (1.2)</td>
</tr>
<tr>
<td>8697-3/M8697-3</td>
<td>1 1/2</td>
<td>3/4</td>
<td>3/4</td>
<td>3/8</td>
<td>1 1/16</td>
<td>1/2</td>
<td>3 1/8</td>
<td>4 (1.8)</td>
</tr>
<tr>
<td>8697-4/M8697-4</td>
<td>2</td>
<td>3/4</td>
<td>3/4</td>
<td>3/8</td>
<td>1 1/16</td>
<td>1/2</td>
<td>3 1/8</td>
<td>5.2 (2.5)</td>
</tr>
<tr>
<td>8697-5</td>
<td>2 1/2</td>
<td>3/4</td>
<td>3/4</td>
<td>3/8</td>
<td>1 1/16</td>
<td>1/2</td>
<td>3 1/8</td>
<td>9 (4.3)</td>
</tr>
<tr>
<td>8697-6</td>
<td>3</td>
<td>3/4</td>
<td>3/4</td>
<td>3/8</td>
<td>1 1/16</td>
<td>1/2</td>
<td>3 1/8</td>
<td>12 (5.6)</td>
</tr>
</tbody>
</table>

Dimensions shown are subject to change. Please obtain certified prints from Fives North American Combustion, Inc. If space limitations or other considerations make exact dimensions critical.