# MEGASTAR™ BURNER
# MS-50 – MS-150

**WARNING**

These instructions are intended for use only by experienced, qualified combustion start-up personnel. Adjustment of this equipment by unqualified personnel can result in fire, explosion, severe personal injury or even death.

To make changes to the burner or adjust firing inputs: 1. Shut the burner down; 2. Make changes; 3. Restart the burner. **STAND CLEAR OF THE BURNER UNDER ANY FIRING CONDITIONS.**

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**WARNING**

This equipment is potentially dangerous with the possibility of serious personal injury and property damage. Hauck Manufacturing Company recommends the use of flame supervisory equipment and fuel safety shutoff valves. Furthermore, Hauck urges rigid adherence to National Fire Protection Association (NFPA) standards and insurance underwriter's requirements. Operation and regular preventative maintenance of this equipment should be performed only by properly trained and qualified personnel. Annual review and upgrading of safety equipment is recommended.

## A. GENERAL INFORMATION

The MegaStar™ Burner is the next generation of total air aggregate drying burners. It has the same quiet operation and ecological benefits as its predecessors, with the improved efficiency, emissions, and ease of operation. It is available with low pressure atomization for light fuel oils or LP, and is a highly efficient natural gas or vaporous propane burner. It features our lowest construction profile allowing for easier installation and easier access to working components on the burner. Flame adjustability allows a tailored fit to any drum configuration. Air/fuel ratio for the MegaStar burner can be maintained more precisely than ever before over the entire operating range by an energy saving VFD for maximum efficiency.

The MegaStar™ can be supplied with fuel manifolds as an integral part of the burner, or with optional remote rack mounted fuel manifolds. Natural gas firing does not require a primary air blower.

**NOTE**

The MegaStar™ is supplied with a Honeywell C7027A ultraviolet flame scanner. If an alternate flame scanner is required, consult Hauck.

## B. RECEIVING AND INSPECTION

Upon receipt, check each item on the bill of lading and/or invoice to determine that all equipment has been received. A careful examination of all parts should be made to ascertain if there has been any damage in shipment.

**IMPORTANT**

If the installation is delayed and the equipment is stored outside, provide adequate protection as dictated by climate and period of exposure. Special care should be given to all motors and bearings, if applicable, to protect them from rain or excessive moisture.

## C. BURNER CAPACITIES

| MEGASTAR | | BURNER MODEL | | | | |
|---|---|---|---|---|---|---|
| **GAS SPECIFICATIONS** | | **50** | **75** | **100** | **125** | **150** |
| **Capacity** | **(MMBTU/hr)** | **54** | **89** | **108** | **146** | **166** |
| | **(MW)** | **14.7** | **24.2** | **29.3** | **39.6** | **45.2** |
| Main Air Flow | (scfh) | 636,600 | 1,050,000 | 1,270,000 | 1,720,000 | 1,960,000 |
| | ($nm^3$/hr) | 17,100 | 28,100 | 34,000 | 46,100 | 52,500 |
| Main Air Pressure | (in.w.c.) | 14.3 | 12.6 | 15.3 | 13.8 | 14.5 |
| | (mbar) | 35.6 | 31.3 | 38.1 | 34.3 | 36.1 |
| Gas Flow Rate | (scfh) | 52,300 | 86,200 | 104,300 | 141,300 | 161,000 |
| | ($nm^3$/hr) | 1,400 | 2,300 | 2,800 | 3,800 | 4,300 |
| Capacity with Flue Gas Recirc | (MMBTU/hr) | 40.5 | 62 | 82 | 103 | 124 |
| | (MW) | 11.0 | 16.8 | 22.2 | 27.9 | 33.6 |
| Flame Length @ 30° Spin | (ft) | 12 | 14 | 9 | 11 | 15 |
| | (m) | 3.7 | 4.1 | 2.7 | 3.4 | 4.6 |
| Flame Diameter @ 30° Spin | (ft) | 4 | 7 | 5 | 8 | 7 |
| | (m) | 1.2 | 2.0 | 1.5 | 2.4 | 2.1 |

| MEGASTAR | | BURNER MODEL | | | | |
|---|---|---|---|---|---|---|
| **LIGHT OIL SPECIFICATIONS** | | **50** | **75** | **100** | **125** | **150** |
| **Capacity** | **(MMBTU/hr)** | **53** | **82** | **100** | **135** | **153** |
| | **(MW)** | **14.3** | **22.3** | **27.2** | **36.5** | **41.5** |
| Main Air Flow | (scfh) | 643,300 | 1,030,000 | 1,270,000 | 1,720,000 | 1,960,000 |
| | ($nm^3$/hr) | 17,200 | 27,600 | 34,000 | 46,100 | 52,500 |
| Main Air Pressure | (in.w.c.) | 14.3 | 12.0 | 16.2 | 13.7 | 144.0 |
| | (mbar) | 35.6 | 29.9 | 40.3 | 34.1 | 358.3 |
| Primary Air Flow | (scfh) | 46,500 | 46,500 | 46,500 | 46,500 | 46,500 |
| | ($nm^3$/hr) | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |
| Primary Air Pressure | (in.w.c.) | 62 | 62 | 62 | 62 | 62 |
| | (mbar) | 154 | 154 | 154 | 154 | 154 |
| Oil Flow Rate | (gal) | 370 | 580 | 710 | 950 | 1,080 |
| | (lph) | 1,400 | 2,200 | 2,690 | 3,600 | 4,090 |
| Flame Length @ 30° Spin | (ft) | 10 | 12 | 12 | 10 | 12 |
| | (m) | 3.1 | 3.7 | 3.7 | 3.1 | 3.7 |
| Flame Diameter @ 30° Spin | (ft) | 4 | 5 | 5 | 4 | 5 |
| | (m) | 1.2 | 1.5 | 1.5 | 1.2 | 1.5 |

**Table 1. Burner Capacity Data For Natural Gas & Light Oil**

## C. BURNER CAPACITIES (Continued)

| MEGASTAR | | BURNER MODEL | | | | |
|---|---|---|---|---|---|---|
| LIQUID PROPANE SPECIFICATIONS | | 50 | 75 | 100 | 125 | 150 |
| **Capacity** | (MMBTU/hr) | Pending | 80 | 97 | 128 | 145 |
| | (MW) | | 21.7 | 26.4 | 34.6 | 39.3 |
| Main Air Flow | (scfh) | | 980,000 | 1,200,000 | 1,590,000 | 1,810,000 |
| | ($nm^3$/hr) | | 26,300 | 32,100 | 42,600 | 48,500 |
| Main Air Pressure | (in.w.c.) | | 12.8 | 18.5 | 15.0 | 18.3 |
| | (mbar) | | 31.8 | 46.0 | 37.3 | 45.5 |
| Primary Air Flow | (scfh) | | 46,500 | 46,500 | 46,500 | 46,500 |
| | ($nm^3$/hr) | | 1,200 | 1,200 | 1,200 | 1,200 |
| Primary Air Pressure | (in.w.c.) | | 62 | 62 | 62 | 62 |
| | (mbar) | | 154 | 154 | 154 | 154 |
| Propane Flow Rate | (gal) | | 880 | 1,070 | 1,400 | 1,590 |
| | (lph) | | 3,330 | 4,050 | 5,300 | 6,020 |
| Flame Length @ 30° Spin | (ft) | | 14 | 15 | 13 | 15 |
| | (m) | | 4.3 | 4.6 | 4.0 | 4.6 |
| Flame Diameter @ 30° Spin | (ft) | | 5 | 5 | 6 | 6 |
| | (m) | | 1.5 | 1.5 | 1.8 | 1.8 |

| MEGASTAR | | BURNER MODEL | | | | |
|---|---|---|---|---|---|---|
| COMPRESSED AIR SPECIFICATIONS | | 50 | 75 | 100 | 125 | 150 |
| **Capacity** | (MMBTU/hr) | Not Available | 79 | 100 | 130 | 150 |
| | (MW) | | 21.4 | 27.2 | 35.3 | 40.7 |
| Main Air Flow | (scfh) | | 1,030,000 | 1,310,000 | 1,700,000 | 1,960,000 |
| | ($nm^3$/hr) | | 27,600 | 35,100 | 45,500 | 52,500 |
| Main Air Pressure | (in.w.c.) | | 12.0 | 16.2 | 13.2 | 14.4 |
| | (mbar) | | 29.9 | 40.3 | 32.8 | 35.8 |
| Compressed Air Flow | (scfh) | | 3,600 | 3,600 | 5,400 | 5,400 |
| | ($nm^3$/hr) | | 100 | 100 | 100 | 100 |
| Compressed Air Pressure | (psig) | | 60 | 60 | 60 | 60 |
| | (bar) | | 4 | 4 | 4 | 4 |
| Oil Flow Rate | (gal) | | 560 | 710 | 920 | 1,060 |
| | (lph) | | 2,120 | 2,690 | 3,480 | 4,010 |
| Flame Length @ 30° Spin | (ft) | | 9 | 9 | 10 | 10 |
| | (m) | | 2.7 | 2.7 | 3.1 | 3.1 |
| Flame Diameter @ 30° Spin | (ft) | | 5 | 5 | 5 | 5 |
| | (m) | | 1.5 | 1.5 | 1.5 | 1.5 |

**Table 2. Burner Capacity Data For Liquid Propane & Compressed Air**

## C. BURNER CAPACITIES (Continued)

**Table 1 & 2 Notes:**

1. Burner capacity is based on 60Hz power and scfh ($nm^3$/hr) 60°F (0°C) air at sea level. Correction factors must be applied for variations in altitude, temperature, or frequency; consult Hauck. An altitude correction table is available in Hauck Application Sheet GJ75.
2. Natural gas capacities based on higher heating value of 1,034 Btu per cubic foot (lower heating value of 36.74 MJ/$nm^{3)}$, 2-4 psig (138 – 276 mbar) manifold pressure, 25% excess air, and stoichiometric ratio of 9.74:1.
3. No. 2 fuel oil capacities based on higher heating value of 141,146 Btu per gallon (lower heating value of 36.99 MJ/liter), 35% excess air, and stoichiometric ratio of 1371.1 cubic feet air/gallon of No. 2 oil (9.7 $nm^3$ air/liter).
4. Liquid propane capacities based on higher heating value of 90,912 Btu per gallon (lower heating value of 23.83 MJ/liter), 35% excess air, and stoichiometric ratio of 864 cubic feet air/gallon of liquid propane (6.1 $nm^3$ air/liter).
5. The exhaust fan must be able to provide a slight negative pressure, suction in the range of 0.25 to 1” wc (.6 to 2.5 mbar), at the burner breech plate to exhaust the products of combustion.
6. MegaStar™ Burner airflow can be accurately monitored using the body pressure tap on either side of the burner air plenum. An accurate device capable of reading up to 15" wc (75 mbar) will be required for this measurement.
7. All burner fuel manifolds are supplied with fuel flow measuring devices. Liquid fuel manifolds are equipped with an inline flow meter. Gaseous fuel manifolds are equipped with a gas orifice meter that can be accurately checked for gas flow by measuring the differential pressure across the orifice meter with a U-tube device (manometer) capable of reading in the range of 0 to 20"wc (0 to 50 mbar).
8. Low pressure atomizing air, used for firing low pressure fuel oil or LP, is provided by a 36 osi (155 mbar) Hauck high efficiency Turbo Blower. The low pressure air is used to not only atomize liquid fuels, but also improve mixing speed in the combustion zone.
9. High pressure compressed air, used for firing heavy oils or any fuel oil at high elevations, must be supplied by the customer at a nominal 60 psig (4140 mbar) to the burner nozzle for optimum fuel oil atomization.

## D. DIMENSIONS

See appropriate section of MS-3 for detailed dimensional information.

## E. COMPONENT IDENTIFICATION

| ITEM | DESCRIPTION |
|---|---|
| 1 | ATTENUATOR UNIT ASSY, SOUND |
| 2 | MANIFOLD ASSY, PILOT |
| 3 | VALVE,SOLENOID,1/2NPT,GAS |
| 4 | PILOT ASSY, BURNER |
| 5 | SCANNER ASSY |
| 6 | SCANNER,UV,0 TO 215F |
| 7 | SWTCH,PRESSURE,0.4-7"WC,AIR/GAS |
| 8 | PLATE ASSY, HEATSHIELD |
| 9 | COVER,3"ANSI |
| 10 | FAN ASSY, W/TEFC MOTOR |
| 11 | CONE |
| 12 | IMPELLER,AIRFOIL SOLID NOSE BLADE,CW |
| 13 | MOTOR |
| 14 | FLANGE ASSY, COMPANION |
| 15 | INSERT ASSY, COMP AIR |
| 16 | INSERT ASSY, LP |
| 17 | SWTCH,PRESSURE,12-90"WC,AIR/GAS |
| 18 | INSERT ASSY, OIL |
| 19 | SWTCH,PRESSURE,12-90"WC,AIR/GAS |
| 20 | KIT ASSY,ESII HEAVY OIL HEATER INSERT |
| 21 | KIT, HEAVY OIL |
| 22 | MANIFOLD ASSY, GAS |
| 23 | MANIFOLD ASSY, OIL |
| 24 | MANIFOLD, COMP AIR W/REG |
| 25 | MANIFOLD ASSY, LP |

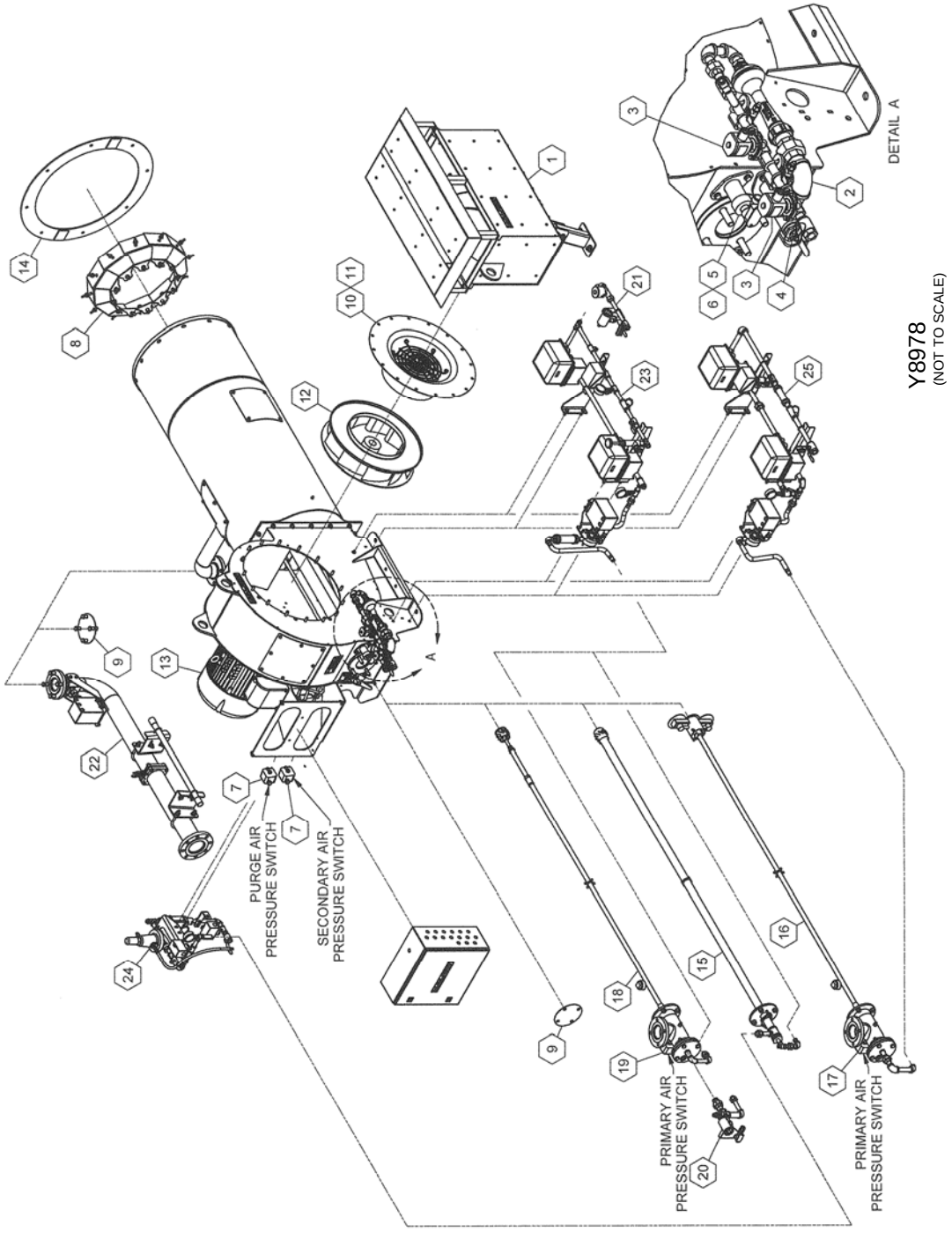



**Figure 1. MegaStar™ Burner Components**

## F. COMBUSTION FLIGHTING

Flight design in the combustion zone is very important. Correct flighting can minimize pollutant emissions, and provide heat shielding to keep the drum surface temperature down. To obtain complete combustion, the combustion zone must be sized to provide enough combustion volume for the flame to burn, and it should also be clear of veiling material that can quench the flame, resulting in poor combustion efficiency.

Combustion flights provide protection for the drum by shielding it from direct flame radiation. Construction of the combustion flights should be such that no material is allowed to fall through the flame. Combustion flights should also have a means of dissipating heat to prevent their destruction by the flame. This is typically done by plowing material over the fights and keeping the flights as low as possible to the drum. Consult Hauck for details on flight design and combustion zone requirements.

Flights are available from Hauck to optimize performance of the MegaStar™ on a rotary dryer; for detailed installation instructions of Hauck weld-in type flights, see Y7100 in the Appendix. For additional information on application issues for an MegaStar™ on a rotary dryer, see Hauck Application Sheet GJ75.

## G. BURNER MOUNTING

**IMPORTANT**

For MegaStar™ burners with an extended burner nose length, the nose must be supported to avoid undue strain on the burner housing. Consult dryer manufacturer for extended burner nose support recommendations.

1. The burner should be mounted on the drum centerline at the same pitch as the drum. Install a structure to support the burner. Refer to dimensional drawings in the Section D. The support structure must be able to support the weight of the burner (see Table 3). If the optional primary air turbo blower (TBA) is to be mounted on the same structure as the burner, allow for the additional weight. Consult Hauck for recommended burner mounting options. If applicable, choose a suitable location for the optional remote mounted fuel rack and primary air TBA blower. The fuel rack should be firmly attached to the base structure or concrete pad. The fuel rack is supplied with mounting holes in the base angle iron. Consult Hauck for the remote mounted fuel rack dimensional drawing Y6967 if applicable. Consult TBA blower instruction sheet (TBA-9) for proper mounting instructions for the primary air TBA blower.

2. The burner is supplied with lifting eyes to facilitate lifting the burner into place. **Do not use the lifting eye on the main blower motor for lifting the entire burner unit.** The optional TBA blower is also supplied with lifting eyes on the blower frame. Do not use the motor lifting eye to lift the entire blower unit.

| MegaStar™ Model No. | 50 | 75 | 100 | 125 | 150 |
|---|---|---|---|---|---|
| Approx. Net Weight* (lb) [kg] | 2,500 [1,130] | 5,000 [2,270] | 5,800 [2,630] | 6,500 [2,950] | 6,500 [2,950] |

**Table 3. MegaStar™ Approximate Burner Net Weights**

3. The burner can be ordered with a split-mounting companion flange that can be bolted onto the dryer breech plate (see Table 4). This allows positioning the burner at various insertion depths past the breech plate. Typical burner insertion depth is 18 to 24" (460 to 610mm). Cut out a hole in the breech plate 2" (50mm) in diameter larger than the burner tube. Do not weld the split-mounting flange to the burner body, as the breech will expand and contract with changes in temperature. If the split-mounting flange is welded to the burner, heat and stress will damage the burner. Tightly seal the burner to the breech. If using oil as a primary fuel, the insertion depth may have to extend more than 24" (610mm) due to the amount of radiant heat from an oil flame depending on the application.

| MegaStar™ Model No. | 50 | 75-100 | 125-150 |
|---|---|---|---|
| Companion Flange Part No. | 407091 | 56548x001 | 56549x008 |

**Table 4. MegaStar™ Burner Recommended Split-Mounting Companion Flange**

4. Bolt the burner to the support structure.

5. Wire the main fan motor and the optional TBA blower motor (if applicable) per instructions on the motor.

6. Rotation of all blowers must be checked prior to burner startup. The rotation is marked with an arrow on the blower housings. **Do not operate the burner until all blowers are checked for rotation and are rotating correctly.**

**NOTE**

All rotating components were balanced from factory at a level meeting ISO 1940-2. A variety of external causes such as handling, installation, or misalignment may cause imbalance prior to use. To ensure the intended long life of the equipment and components, and to meet warranty requirements, equipment and vibration levels should be checked by experienced personnel and trim balanced if no longer meeting ISO 1940-2 requirements. Under no circumstances should equipment with excessive vibration be operated at the risk of damaging that equipment or the personnel operating it.

## H. FUEL MANIFOLD INSTALLATION

The MegaStar™ burner can be supplied with integral fuel manifolds on the burner or with optional remote rack mounted fuel manifolds. The fuel manifold has all modulating fuel valves mounted on it. In addition to modulating fuel valves, the manifold includes the automatic oil, gas and LP safety shutoff valves.

**IMPORTANT**

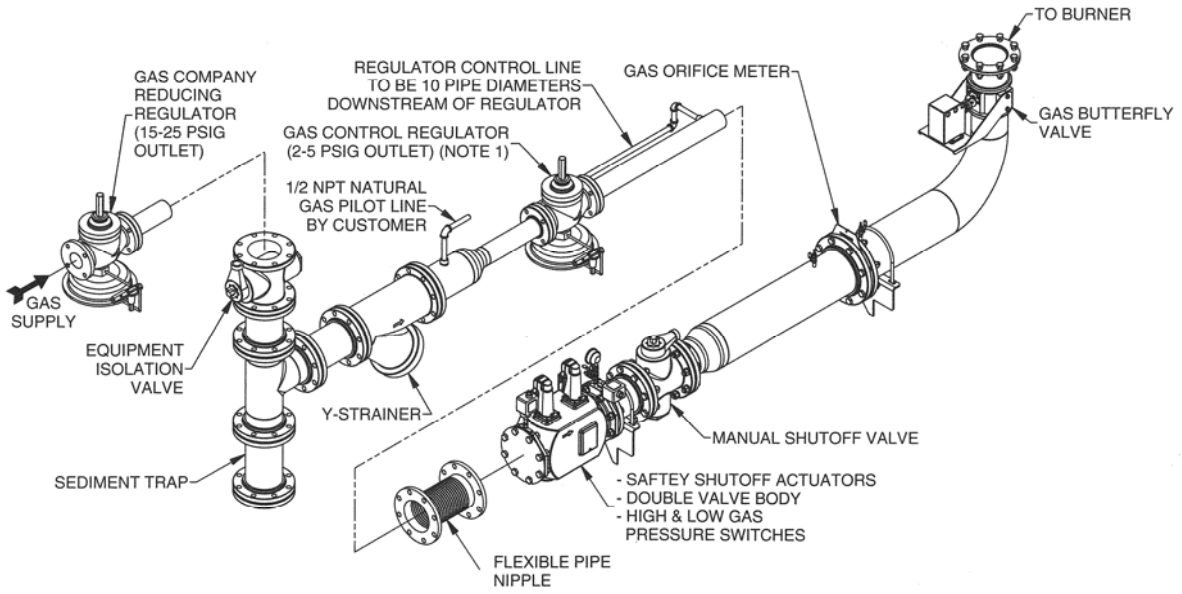
Fuel manifolds must be mounted in a horizontal position. Safety shutoff valves will not function properly if mounted vertically. Liquid fuel manifolds should not be mounted above the burner centerline. Oil and LP manifolds should be mounted as close to the burner as possible. For heavy fuel oil applications, i.e., any fuel requiring heating for use, **oil piping must be heat traced** (electric or steam) **and insulated**. Self-regulating heat tracing is recommended to maintain the desired temperature of a given fuel oil to achieve 90 SSU ($1.8x10^{-5}$ $m^2$/sec) or less at the burner. Electric heat tracing with a nominal rating of 12W/ft (39W/m) covered with a nominal 2" (50mm) fiberglass type insulation is sufficient for most applications. **Fuel oil temperature should not exceed 250°F (120°C)**. Oil viscosity should be checked prior to burner operation.

Hauck recommends the use of schedule 40 iron pipe and fittings rated for 150 psig (10.3 bar) for natural gas and oil system interconnecting piping**. LP applications require the use of schedule 80 pipe and fittings rated for 350 psig (24.1 bar)**.

## I. NATURAL GAS FUEL PIPING SYSTEM

**NOTE**

Hauck recommends the use of gas manifolds that meet NFPA guidelines. NFPA requires two fuel safety shutoff valves wired in series and a shutoff valve downstream of the second (blocking) safety shutoff valve, and high and low pressure switches that are interlocked with the burner's safety shutoff valves. Hauck gas manifolds have been designed to ensure compliance to NFPA requirements.




NOTES:
1. GAS CONTROL REGULATOR MUST BE WITHIN 25 FEET OF BURNER TO SUPPLY CONSTANT OPERATING PRESSURE; INLET GAS PRESSURE TO GAS CONTROL REGULATOR SHOULD BE 15-25 PSIG AND REQUIRED OUTLET GAS PRESSURE SHOULD BE 2-5 PSIG.
2. WHEN USING SIEMENS SAFETY SHUTOFF VALVES: THE GAS SERVICE REGULATOR SHOULD BE SET TO AN OUTLET PRESSURE OF 10 PSI (690 MBAR) AND THE CONTROL REGULATOR CLOSER TO THE BURNER SHOULD BE SET AT 2-5 PSI (140-350 MBAR).

   WHEN USING MAXON SAFETY SHUTOFF VALVES: THE GAS SERVICE REGULATOR SHOULD BE SET TO AN OUTLET PRESSURE OF 20 PSI (1.4 BAR) AND CONTROL REGULATOR CLOSER TO THE BURNER SHOULD BE SET AT 2-5 PSI (140-350 MBAR).

Y7863
(NOT TO SCALE)

**Figure 2. Typical Schematic of Burner Gas Piping**

1. Install a controlling gas regulator in the main gas line within 25 ft (7.6m) of the burner. This regulator should be sized to provide the required gas flow at the inlet of the burner manifold. Exact gas pressure must be set at the initial start-up depending on piping configuration, burner size, and maximum capacity desired. Regular settings are designed for best operation and compliance with NFPA 54 (see Figure 2).

2. A manual equipment isolation valve, sediment trap and gas strainer must be installed upstream of the gas control regulator to ensure compliance to NFPA requirements. The manual equipment isolation valve facilitates servicing of the gas control regulator, sediment trap, strainer, and other components in the gas manifold.

3. The gas company should purge the main gas line to remove scale and dirt before it is attached to the burner gas manifold.

4. Connect the main gas line (see Figure 2). A flexible pipe nipple should be used to connect the gas line to the burner gas manifold (see Table 5 for sizes).

**IMPORTANT**
Install a flexible fitting between the gas manifold and the burner gas connection to reduce vibration stress on the manifold.

| MegaStar™ Model No. | 50 | 75-100 | 125-150 |
|---|---|---|---|
| FPN Part No. | 800598 | 800599 | 800600 |
| Size | 3” (DN 80) | 4" (DN 100) | 6" (DN 150) |

**Table 5. MegaStar™ Burner Recommended Flexible Pipe Nipples**

5. The piping from the gas regulator outlet to the burner gas manifold should be sized to minimize pressure losses. See Figure 3 for pipe pressure losses.

6. The OMG gas orifice meter is an integral part of the gas manifold located on the burner (refer to Figure 2). Refer to individual burner gas orifice meters graph for gas flows through the gas orifice meter (see Figure 4). Orifice meter sizes and part numbers are shown below in Table 6.

**IMPORTANT**
Failure to use the gas orifice meter assembly to measure gas flow will make initial setup and tuning difficult.

| MegaStar™ Model No. | 50 | 75-100 | 125-150 |
|---|---|---|---|
| OMG Part No. | 19816 | 48242x001 | 47181x005 |
| Pipe Size | 4” (DN 100) | 6" (DN 150) | 8" (DN 200) |
| Orifice Size | 3.25” (82.5mm) | 4.8" (122 mm) | 6.0" (152 mm) |

**Table 6. MegaStar™ Burner Natural Gas Orifice Meter Assemblies**

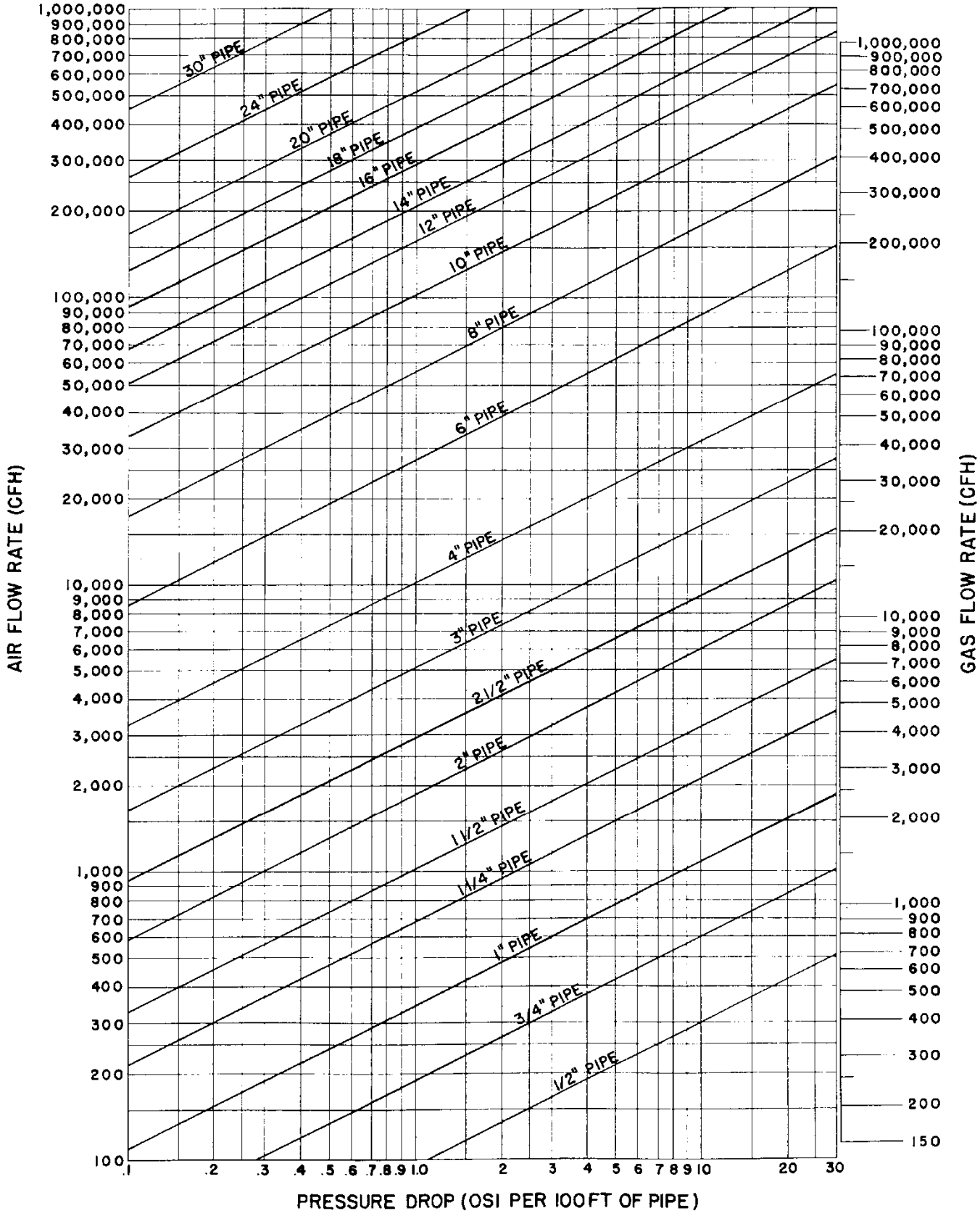



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**Figure 3. Simplified Gas and Air Flow Chart**
(@ Atmospheric Conditions)

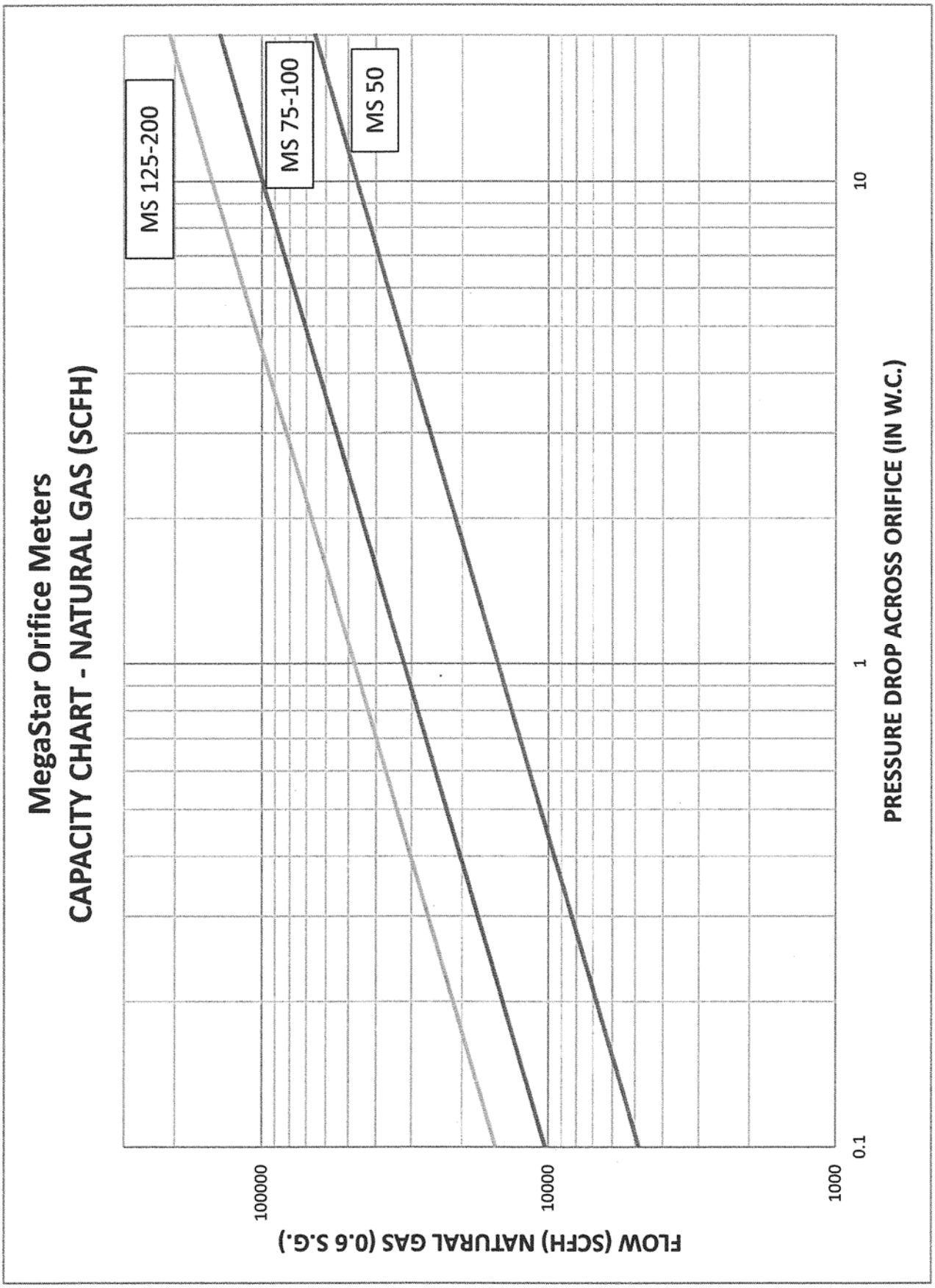



**Figure 4. MegaStar™ Gas Orifice Meters Graph**

## J. LIGHT FUEL OIL PIPING SYSTEM

**WARNING**

Adjustment of this equipment and its components by unqualified personnel can result in fire, explosion, severe personal injury, or even death.

**NOTE**

Hauck recommends the use of oil manifolds that meet NFPA guidelines. NFPA requires two safety shutoff valves piped in series in the burner's main oil line. A low/high oil pressure switch must be interlocked with the burner's safety shutoff valves. Hauck oil manifolds have been designed to ensure compliance to NFPA requirements.

1. Hauck recommends using a flexible connection to connect the oil line to the oil manifold on the burner. A flexible connection will reduce vibration stress on the oil manifold. Refer to Table 7 for recommended flex connection.

| MegaStar™ Model No. | 50 | 75-150 |
|---|---|---|
| Flex Oil Hose Part No. | 11078 | 20518 |
| Size | 1/2" (DN 15) | 1" (DN 25) |

**Table 7. Recommended Flexible Oil Hose Size**

2. For recommended piping sizes see Table 8. Before attaching fuel lines, purge the piping to remove scale and dirt that could clog and damage oil equipment. Follow Figure 5 for the suggested piping layout.

| | Discharge Piping, Light Oil Up to 100 SSU (Up to 2.1 x $10^{-5}$ $m^2$/sec) | | | Return Piping, Light Oil Up to 100 SSU (Up to 2.1 x $10^{-5}$ $m^2$/sec) | | | Return Piping Heavy Oil | | |
|---|---|---|---|---|---|---|---|---|---|
| MegaStar Model No. | Up to 25' (Up to 7.6m) | 25'– 49' (7.6-14.9m) | 50' – 100' (15.2-30.5m) | Up to 25' (Up to 7.6m) | 25' – 49' (7.6-14.9m) | 50' – 100' (15.2-30.5m) | Up to 25' (Up to 7.6m) | 25'– 49' (7.6-14.9m) | 50' – 100' (15.2-30.5m) |
| 50 | 1" (DN25) | 1" (DN25) | 1 ¼" (DN32) | 1" (DN25) | 1 ¼" (DN32) | 1 ¼" (DN32) | 1 ¼" (DN32) | 1 ½" (DN40) | 2" (DN50) |
| 75 | 1" (DN25) | 1" (DN25) | 1 ¼" (DN32) | 1" (DN25) | 1 ¼" (DN32) | 1 ¼" (DN32) | 1 ¼" (DN32) | 1 ½" (DN40) | 2" (DN50) |
| 100 | 1" (DN25) | 1" (DN25) | 1 ¼" (DN32) | 1 ¼" (DN32) | 1 ¼" (DN32) | 1 ¼" (DN32) | 1 ¼" (DN32) | 1 ½" (DN40) | 2" (DN50) |
| 125 | 1" (DN25) | 1 ¼" (DN32) | 1 ½" (DN40) | 1 ¼" (DN32) | 1 ¼" (DN32) | 1 ½" (DN40) | 1 ½" (DN40) | 2" (DN50) | 2" (DN50) |
| 150 | 1" (DN25) | 1 ¼" (DN32) | 1 ½" (DN40) | 1 ¼" (DN32) | 1 ¼" (DN32) | 1 ½" (DN40) | 1 ½" (DN40) | 2" (DN50) | 2" (DN50) |

**Table 8. Minimum Pipe Size For Hauck Oil Supply Pumping Units**

3. Adjust the bypass relief valve until required oil pressure is achieved. See Table 9 for approximate settings. Final oil pressure will have to be adjusted to attain desired burner output and stack exhaust gas analysis.

| MegaStar™ Model No. | Nominal Oil Pressure w/Low Pressure Atomizer | Nominal Oil Pressure w/Compressed Air Atomizer |
|---|---|---|
| 50 | 75 psig (5.15 bar) | 90 psig (6.20 bar) |
| 75 | 75 psig (5.15 bar) | 90 psig (6.20 bar) |
| 100 | 85 psig (5.85 bar) | 100 psig (6.90 bar) |
| 125 | 65 psig (4.50 bar) | 90 psig (6.20 bar) |
| 150 | 80 psig (5.50 bar) | 100 psig (6.90 bar) |

**Table 9. Nominal Light and Heavy Fuel Oil Pressure to Burner Manifold Inlet**

4. The low/high oil pressure switch is factory set at a low set point of 15 psig (1.03 bar) and a high set point of 80 psig (5.5 bar). Set point adjustments may be required depending on the burner and fuel piping specifics.

5. Inspect the complete fuel oil system for oil leaks and repair as necessary. Do not operate the burner until all fuel leaks are repaired.

6. The burner oil flow control (metering) valve is preset to travel from position 2 to 11. The low fire oil flow setting can be changed by loosening the coupling connecting the oil valve to the control motor, adjusting the oil valve pointer, and re-tightening the coupling. The high fire oil flow setting can be changed via the burner control system, or if necessary, by increasing or decreasing fuel oil pressure. See the individual burner performance sheets for fuel oil flow data.

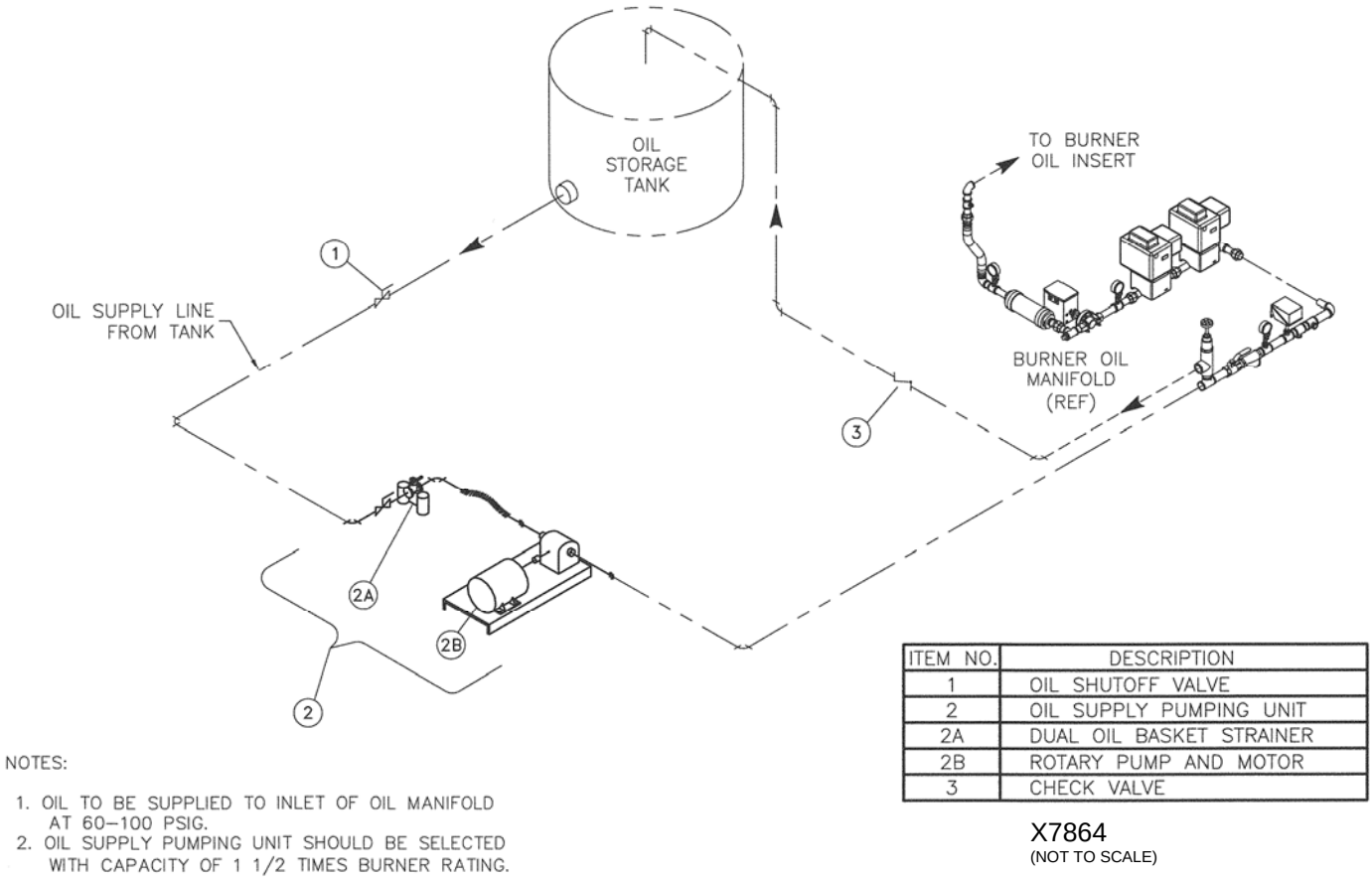
**CAUTION**

Any adjustment to the fuel oil flow settings should be made as a minor incremental change and verified that it has not resulted in any detrimental effect to plant operation prior to making another adjustment.

**NOTE**

Fuel oil flow settings per the individual burner performance sheets are for initial set-up only. Final settings may have to be readjusted for required operation.

7. Fuel oil flow rates can be checked with the in-line oil flow meter on the burner fuel oil manifold. The flow meter glass can be rotated to view the scale if required.




| ITEM NO. | DESCRIPTION |
|---|---|
| 1 | OIL SHUTOFF VALVE |
| 2 | OIL SUPPLY PUMPING UNIT |
| 2A | DUAL OIL BASKET STRAINER |
| 2B | ROTARY PUMP AND MOTOR |
| 3 | CHECK VALVE |

**Figure 5. Typical Schematic of Burner Light Fuel Oil Piping**

## K. HEAVY FUEL OIL PIPING SYSTEM

**WARNING**

Adjustment of this equipment and its components by unqualified personnel can result in fire, explosion, severe personal injury, or even death.

**Heated fuel oil and piping is hot.** Precautions should be taken to avoid contact with heated oil and piping. Proper insulation should be installed on hot oil pipes. Protective gloves, clothing and a face shield are recommended when working with heated oil.

**IMPORTANT**

For all heavy fuel oil applications, i.e., any oil requiring heating for use, **oil piping must be heat traced** (electric or steam) **and insulated**. Self-regulating heat tracing is recommended to maintain the desired temperature of a given fuel oil to achieve 90 SSU ($1.8 \times 10^{-5}$ $m^2$/sec) or less at the burner. Electrical heat tracing with a nominal rating of 12W/ft (39W/m) covered with a nominal 2" (50mm) fiberglass type insulation is sufficient for most applications.

**NOTE**

Hauck recommends the use of oil manifolds that meet NFPA guidelines. NFPA requires two safety shutoff valves piped in series in the burner's main oil line. A low/high oil pressure switch must be interlocked with the burner's safety shutoff valves. When preheated oil is used, a low/high oil temperature limit switch must be interlocked with the burner's safety shutoff valves. Hauck oil manifolds have been designed to ensure compliance to NFPA requirements. Hauck recommends the use of a 'Heavy Oil Kit' whenever heavy fuel oil is used. The components of the heavy oil kit are identified in Figure 6.

1. For recommended piping sizes see Table 8. Before attaching fuel lines, purge the piping to remove scale and dirt that could clog and damage oil equipment. See Figure 6 for the suggested piping layout.

2. Heavy fuel oil must be 90 SSU ($1.8 \times 10^{-5}$ $m^2$/sec) or less for proper atomization and burning. Use a Hauck viscometer kit (order separately - Part No. 36931) to determine proper oil temperature to achieve this viscosity. Refer to the instructions that are supplied with the kit for proper use. In general, the viscosity can be lower than 90 SSU (which means higher oil temperature) if the fuel is not forming vapor (or steam) pockets in the oil lines. Vapor pockets can cavitate the pumps used on suction type oil heaters.

3. Set the fuel oil heater temperature set point and the indicating low oil temperature switch (located on the burner's oil manifold) to the temperature determined from step 2.

4. Adjust the bypass relief valve until the required oil pressure is achieved. See individual burner performance sheets for approximate settings. Final oil pressure will have to be adjusted to attain desired burner output and stack exhaust gas analysis.

5. The low/high oil pressure switch is factory set at a low set point of 15 psig (1.03 bar) and a high set point of 80 psig (5.5 bar). Set point adjustments may be required depending on the burner and fuel piping specifics.

6. Inspect the complete fuel oil system for oil leaks and repair as necessary. Do not operate the burner until all leaks are repaired.

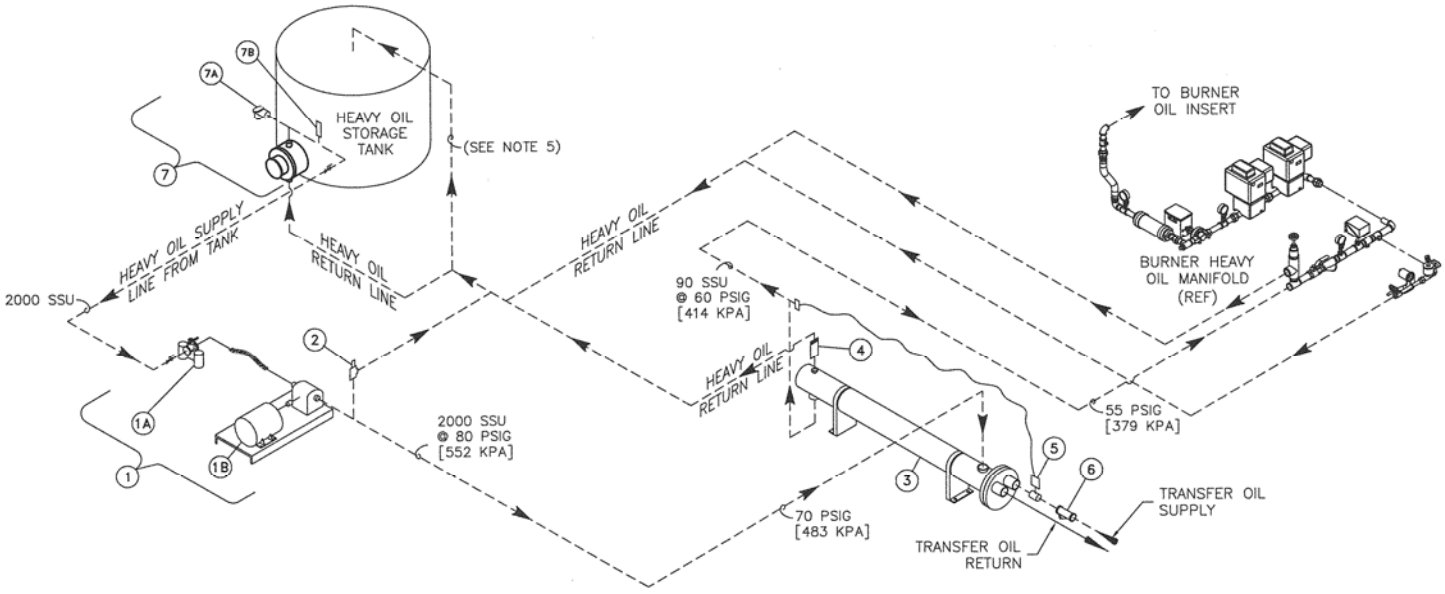
7. The burner oil flow control (metering) valve is preset to travel from position 2 to 11. The low fire oil flow setting can be changed by loosening the coupling connecting the oil valve to the control motor, adjusting the oil valve pointer, and re-tightening the coupling. The high fire oil flow setting can be changed via the burner control system, or if necessary, by increasing or decreasing fuel oil pressure. See the individual burner performance sheets for fuel oil flow data.

**CAUTION**

Any adjustment to the fuel oil flow settings should be made as a minor incremental change and verified that it has not resulted in any detrimental effect to plant operation prior to making another adjustment.

**NOTE**
Fuel oil flow settings per the individual burner performance sheets are for initial set-up only. Final settings may have to be readjusted for required operation.

8. Fuel oil flow rates can be checked with the in-line oil flow meter on the burner fuel oil manifold. The flow meter glass can be rotated to view the scale if required.




| ITEM NO. | DESCRIPTION |
|---|---|
| 1 | OIL SUPPLY PUMPING UNIT |
| 1A | DUAL OIL BASKET STRAINER |
| 1B | ROTARY PUMP AND MOTOR |
| 2 | BYPASS RELIEF VALVE |
| 3 | ELECTRIC LINE HEATER |
| 4 | OVER PRESSURE RELIEF VALVE |

| ITEM NO. | DESCRIPTION |
|---|---|
| 5 | TEMPERATURE REGULATOR VALVE W/ELEMENT AND CAPILLARY TUBE |
| 6 | STRAINER |
| 7 | ELECTRIC SUCTION HEATER |
| 7A | OIL TEMPERATURE CONTROL THERMOCOUPLE |
| 7B | OIL FLOW SWITCH |

NOTES:
1. PIPING SCHEMATIC SHOWS TYPICAL COMPONENTS AND NOMINAL VISCOSITIES AND PRESSURES FOR HEAVY FUEL OIL SUPPLY; ACTUAL REQUIREMENTS ARE DEPENDENT UPON THE SPECIFIC BURNER SYSTEM (CONSULT HAUCK).
2. OIL RETURN LINES TO BE SIZED ACCORDING TO DISTANCE TO PUMP – MINIMUM SIZE EQUAL TO TWO PIPE SIZES LARGER THAN OIL SUPPLY LINE (SEE GL88 FOR MINIMUM LINE SIZES FOR HAUCK OIL SUPPLY PUMPING UNITS).
3. FOR ALL HEAVY OIL APPLICATIONS, HEAVY OIL PIPING MUST BE HEAT TRACED (ELECTRIC OR STEAM) AND INSULATED. SELF–REGULATING HEAT TRACING IS RECOMMENDED TO MAINTAIN THE DESIRED TEMPERATURE OF A GIVEN FUEL OIL TO ACHIEVE 90 SSU ($1.8X10^{-5}$ $M^2$/SEC) OR LESS AT THE BURNER. ELECTRICAL HEAT TRACING WITH A NOMINAL RATING OF 12 W/FT (39W/M) COVERED WITH A NOMINAL 2" (50MM) FIBERGLASS TYPE INSULATION IS SUFFICIENT FOR MOST APPLICATIONS.
4. IF USING NO. 6 FUEL OIL AND THE PIPING BETWEEN THE SUPPLY PUMPING UNIT (ITEM 1) AND THE BURNER OIL MANIFOLD IS GREATER THAN 50FT (15M), AN ADDITIONAL BYPASS RELIEF VALVE (ITEM 2) MAY BE REQUIRED IN THE SUPPLY PIPING TO ACCOMMODATE COLD SYSTEM STARTUP (CONSULT HAUCK).
5. IF SUCTION HEATER IS NOT UTILIZED, OIL RETURN LINE SHOULD BE PIPED TO THE OIL STORAGE TANK.

**Figure 6. Typical Schematic of Burner Heavy Fuel Oil Piping**

## L. OIL MANIFOLD HEAT TRACING

For heavy, waste, or recycled oil applications, the oil manifold piping must be heat traced and insulated to maintain the desired temperature, and hence, viscosity, of the fuel oil (see Figure 7). The Hauck heat tracing kit installed on the heavy oil manifold will aid in viscosity control and reliable main flame ignition of the burner. The oil manifold heat tracing kit consists of heat tracing cable which is wrapped around all piping, and covered with fiberglass insulation and jacketing.

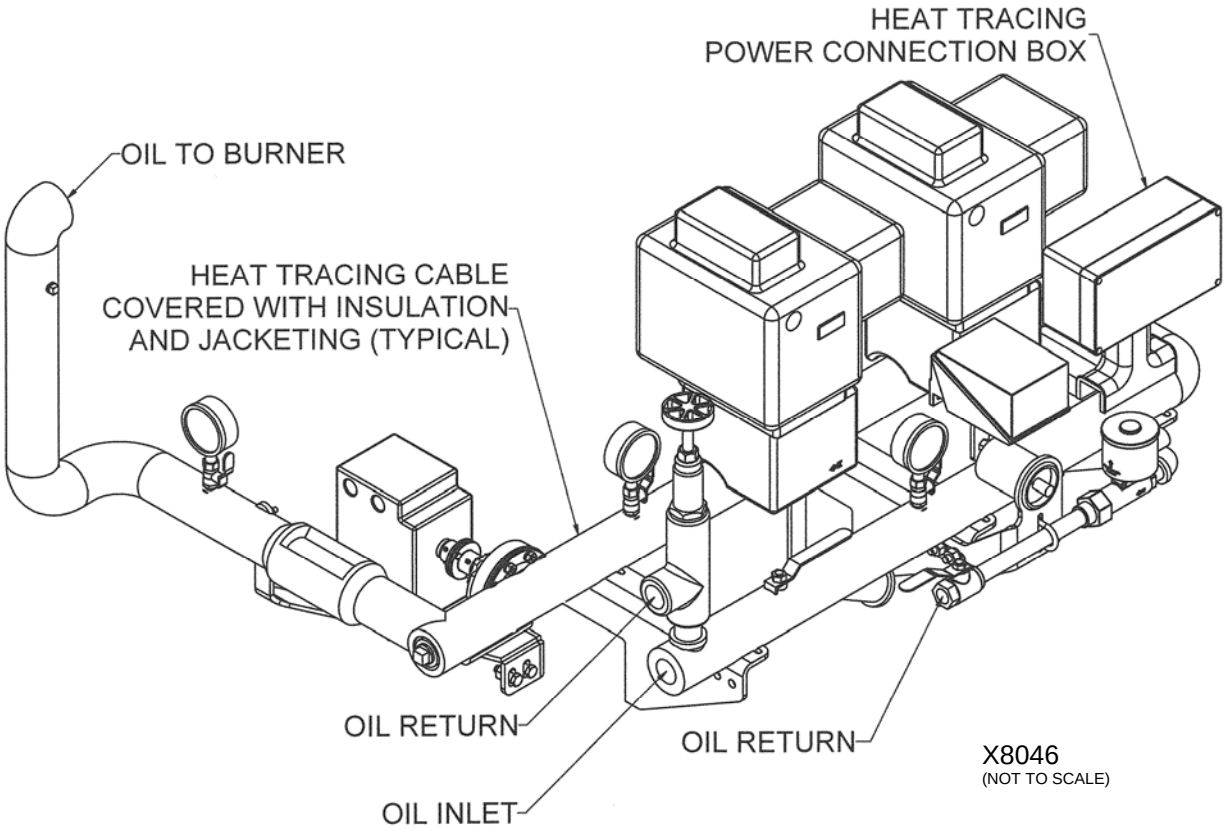



**Figure 7. Heavy Oil Manifold Heat Tracing Kit**

> **NOTE**
> 120V/60Hz power for the oil manifold heat tracing kit must be supplied separately by the customer and wired into the heat tracing power connection box.

The heat tracing cable is self-regulating with a nominal rating of 12 W/ft (39 W/m). When the circuit breaker switch to the oil manifold heat tracing kit is energized, the self-regulating heat tracing will automatically switch on and off based on heat demand.

## M. HEAVY OIL INSERT HEATER

Heavy, waste, or recycled fuel oils require some means of viscosity control. The Hauck heavy oil insert heater installed in the burner's oil tube (see Figure 8) is a perfect solution to the viscosity control problem and reliable main flame ignition of the burner at cold temperatures. The heavy oil insert heating element, in conjunction with the oil temperature indicating controller, will maintain an optimum oil temperature in the oil tube to ensure a reliable burner main flame ignition after an extended shutdown of the burner.

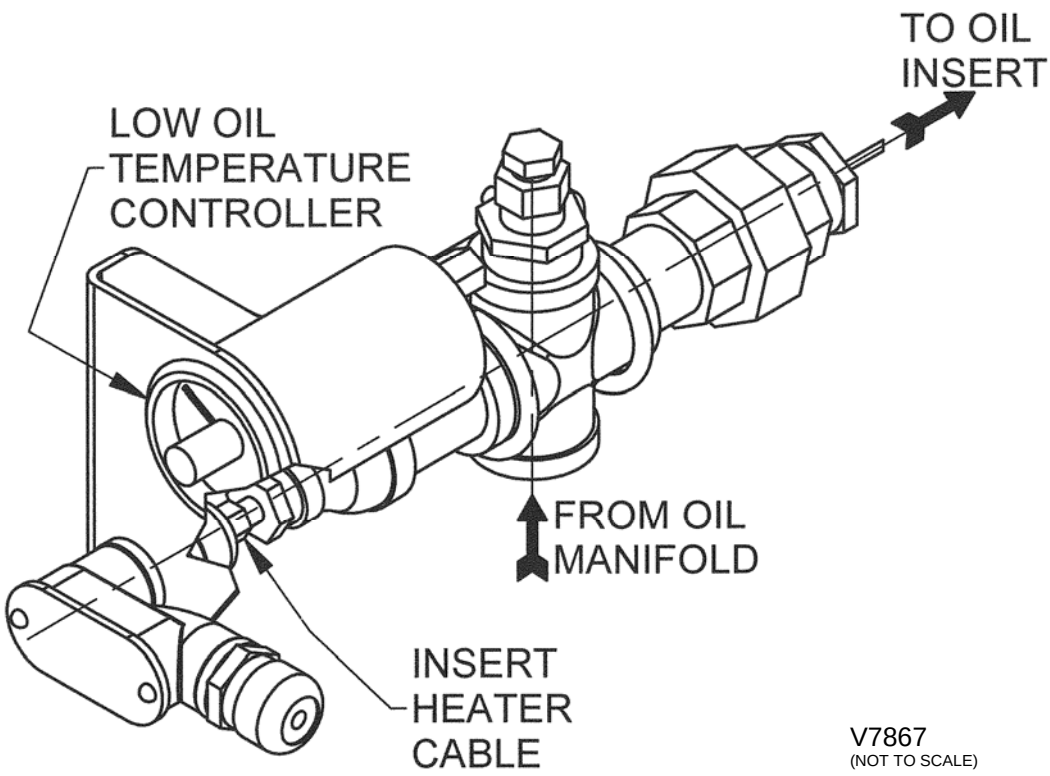



**Figure 8. Heavy Oil Insert Heater**

**NOTE**
120V/60Hz power for the heavy oil insert heater must be supplied separately by the customer and wired into the heater junction box.

Operation of the heavy oil insert kit is as follows (see Figure 8):

1. Adjust the low oil temperature controller to the desired temperature as determined in Section K from testing of the heavy fuel oil viscosity.

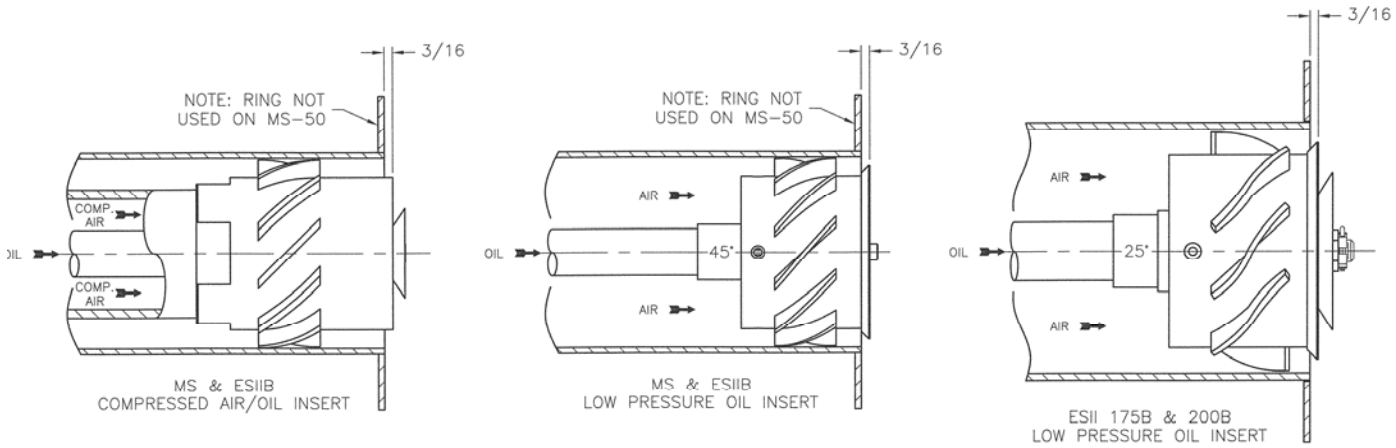
**NOTE**
Adjusting the trip setpoint above the required temperature, as determined by fuel oil viscosity testing, may result in coking of the fuel oil in the oil insert assembly piping.

2. Energize the insert heater circuit breaker switch.
3. When the oil temperature exceeds the setpoint on the oil temperature indicating controller, the oil temperature indicating controller switch contact will open and power to the heater element is removed.
4. When the oil temperature drops below the setpoint on the oil temperature indicating controller, the oil temperature indicating controller switch contact will close and the heater element will energize.

See ESII-9.2 Heavy Oil Insert Heater Kit Instructions for more specific detail on the operation and maintenance of the heavy oil insert heater.

## N. FUEL OIL NOZZLE

The position of the fuel oil atomizer affects its ability to atomize the oil. The compressed air atomizer or low pressure atomizer should be positioned as shown in Figure 9.




**CAUTION**
Ensure that the correct atomizer is being used when firing oil.

W7868
(NOT TO SCALE)

**Figure 9. Oil Nozzle Position**

To change the low pressure oil nozzle position:

1. Shut off the manual oil valve at the burner. The burner must not be firing and the atomizing air fan must be shut off.

2. If heated heavy oil is being used, allow the oil in the pipe to cool to avoid burns. Drain residual fuel into an appropriate container.

3. Note the present orientation of the oil nozzle in the burner. Determine if the oil nozzle must be retracted into or extended out of the primary air tube (see Figure 9).

4. Remove the bolts securing the backplate to the burner, and disconnect the pilot air pipe.

5. Loosen the jam nut on the backplate of the burner oil insert assembly.

6. Rotate the backplate to effect the required retraction or extension of the oil atomizer nozzle. One full rotation of the backplate will move the atomizer approximately 0.1" (2.5mm).

7. Once the proper positioning of the atomizer is completed:

    a. Tighten the jam nut.
    b. Attach the burner oil insert assembly to the oil manifold, using the union provided.
    c. Open the manual oil valve and check for leaks using accepted practices.

## O. COMPRESSED AIR/OIL ATOMIZER

The Hauck high pressure oil nozzle is designed to finely atomize No. 2 fuel oil and clean preheated No. 4, No. 5 and No. 6 fuel oil. Oil viscosity should be 90 SSU ($1.8 \times 10^{-5}$ $m^2$/sec) or less. Preheat fuel oil and heat trace piping using No. 4, No. 5 and No. 6 fuel oil to achieve 90 SSU oil at the burner (see Compressed Air/Oil Adjustment).

Care should be taken to insure that the air and oil supplied to the burner are free of dirt particles and water. Purge oil and air lines before connecting them to the compressed air/oil insert. The nozzle should be inspected and cleaned before the start of each session and possibly more depending on the cleanliness of the air and fuel.

### COMPRESSED AIR PIPING

1. The compressed air supply line must be of adequate size (see Table 10) and be a dedicated line from the compressor to the burner compressed air inlet. For longer runs than those listed in the table, increase the hose by one pipe size. Before attaching lines, purge the hose to remove any dirt that could clog and damage the oil atomizer.

| MegaStar™ Model No. | Min. Hose Size | Max. Hose Length |
|---|---|---|
| 75-100 | 3/4 NPT (DN20) | 70 ft (21m) |
| 125-150 | 1 NPT (DN25) | 160 ft (49m) |

**Table 10. Flexible Air Hose Size Requirements**

2. Compressed air requirements are listed in Table 11. Compressed air must be supplied to the inlet of the compressed air manifold at a minimum of 90 psig (620 kPa). The compressed air regulator modulates the compressed air flow as oil flow is modulated to reduce compressed air consumption at lower firing rates.

**NOTE**

The compressed air low supply pressure switch and low atomizing pressure switch must both be interlocked with the burner's oil safety shutoff valves.

The compressed air solenoid valve is normally wired in parallel with the burner's safety shutoff valves.

Reference the control panel drawings for wire and/or terminal numbers.

| MegaStar™ Model No. | Oil Flow | | Oil Pressure To Burner Nozzle | | Compressed Air Flow | | Compressed Air Pressure To Burner Nozzle | |
|---|---|---|---|---|---|---|---|---|
| | (gpm) | (lpm) | (psig) | (kPa) | (scfm) | ($nm^3$/min) | (psig) | (kPa) |
| 75/100 | 12 | 45.4 | 60 | 414 | 60 | 1.6 | 55 | 379 |
| | 9 | 34.1 | 50 | 345 | 52 | 1.4 | 44 | 303 |
| | 6 | 22.7 | 38 | 262 | 48 | 1.3 | 32 | 221 |
| | 1.25 | 4.7 | 24 | 165 | 42 | 1.1 | 17 | 117 |
| 125/150 | 18 | 68.1 | 60 | 414 | 90 | 2.4 | 50 | 345 |
| | 10 | 37.9 | 36 | 248 | 85 | 2.3 | 30 | 207 |
| | 5 | 18.9 | 23 | 159 | 82 | 2.2 | 20 | 138 |
| | 3 | 11.4 | 20 | 138 | 80 | 2.1 | 19 | 131 |

**Table 11. Compressed Air and Oil Requirements**

3. When firing the burner with the compressed air atomizer, the threaded pipe plug must be **removed** from the primary air tube. If using the low pressure oil or liquid propane nozzles, the pipe plug **must be installed** in the primary air tube. When firing natural gas the pipe plug **can be installed or removed**. The pipe plug is accessible through the main fan housing access door (see Figure 11).

**COMPRESSED AIR/OIL ADJUSTMENT**

1. Air and fuel flows and pressures can be observed at the burner using the compressed air and fuel flow meters and corresponding pressure gauges (see Figure 10). For compressed air data in addition to Table 11, see individual MegaStar™ capacity and performance sheets.

2. Compressed air supply pressure to the inlet of the compressed air manifold must be 90 psig (620 kPa) or greater. The supply pressure is measured via the gauge on the inlet to the compressed air flow meter (see Figure 10). The compressed air low supply pressure switch is preset at 60 psig (414 kPa). Set point adjustment may be required depending on the burner and compressed air piping specifics.

3. For the compressed air manifold with regulator to function properly, the impulse line and upper chamber of the pressure reducing regulator must be loaded with oil by opening the vent valve on the regulator until oil vents then closing the vent valve.

4. Final compressed air flow and pressure adjustment is made via the compressed air trim valve (see Figure 10). With the burner at high fire, adjust the trim valve until the compressed air burner inlet pressure gauge, located downstream of the trim valve, reads approximately 60 psig (414 kPa). The compressed air low atomizing air switch is preset at 5 psig (34.5 kPa). Set point adjustment may be required depending on the burner and compressed air piping specifics.

5. Compressed air flow can be read directly from the compressed air flow meter (see Figure 10). Refer to Figure 12 for detailed instructions on how to head the compressed air flow meter. Verify that both the compressed air flow and burner inlet pressure, from step 4, meet or exceed the values given in Table 11 and/or the additional burner capacity and performance data sheets.

**IMPORTANT**

For all heavy fuel oil applications, i.e., any oil requiring heating for use, **oil piping must be heat traced** (electric or steam) **and insulated**. Self-regulating heat tracing is recommended to maintain the desired temperature of a given fuel oil to achieve 90 SSU ($1.8 \times 10^{-5}$ $m^2$/sec) or less at the burner. Electrical heat tracing with a nominal rating of 12W/ft (39W/m) covered with a nominal 2" (50mm) fiberglass type insulation is sufficient for most applications.

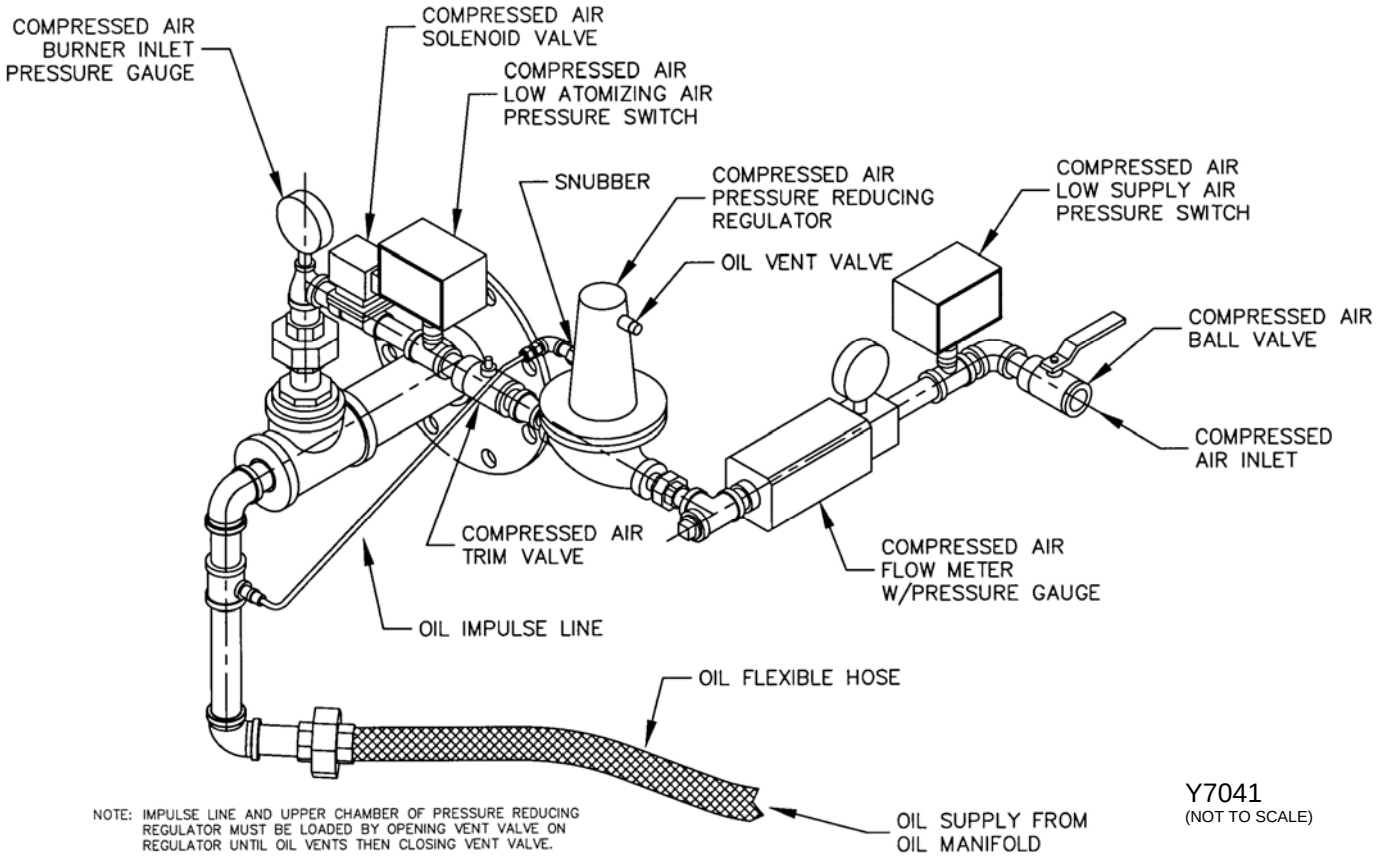



**Figure 10. Compressed Air Manifold Detail**

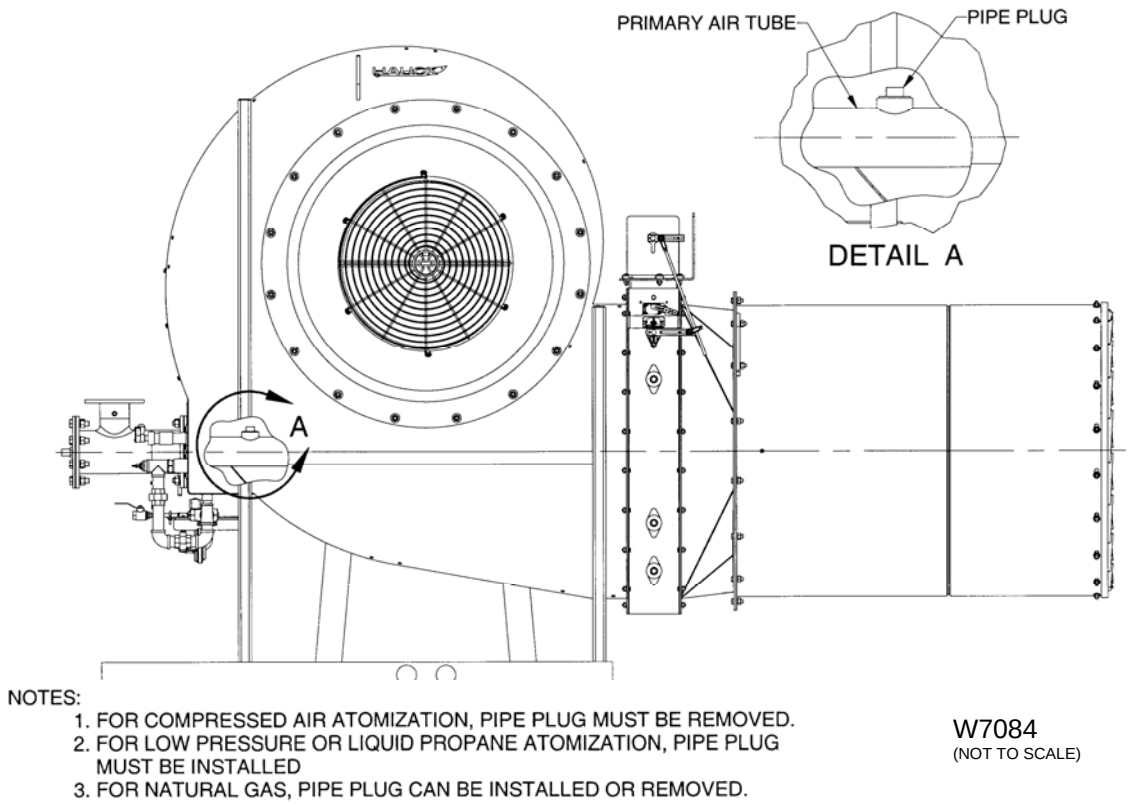



**Figure 11. Primary Air Tube Pipe Plug Location**

**COMPRESSED AIR FLOW METER**

The compressed air flow meter is offered with a standard multi-pressure flow scale. The multi-pressure flow scale has a vertically graduated scale, calibrated for air in standard cubic feet per minute (scfm) at 1.0 s.g. (70°F at 100 psig), or liters per second (lps) at 1.0 s.g. (21°C at 6.9 bar). The multi-pressure scale design allows for use at supply pressures from 40 - 130 psig in 10 psig increments (3.0 - 9.0 bar in 1 bar increments) .

To determine the compressed air flow rate, refer to Figure 12 and proceed as follows:

1. Read the inlet pressure on the pressure gauge of the compressed air flow meter.

2. Select the appropriate inlet pressure (psig) vertical line, or interpolated value closest to the gauge reading, and follow the line upward until it intersects the brightly colored horizontal indicator bar.

3. From the intersecting point on the horizontal indicator bar, follow the slope as shown on the diagonal lines to the 100 psig inlet pressure vertical line and interpolate the scfm or lps flow rate (Note for the example shown in Figure 12, with an inlet pressure of 60 psig, the compressed air flow rate is approximately 40 scfm).

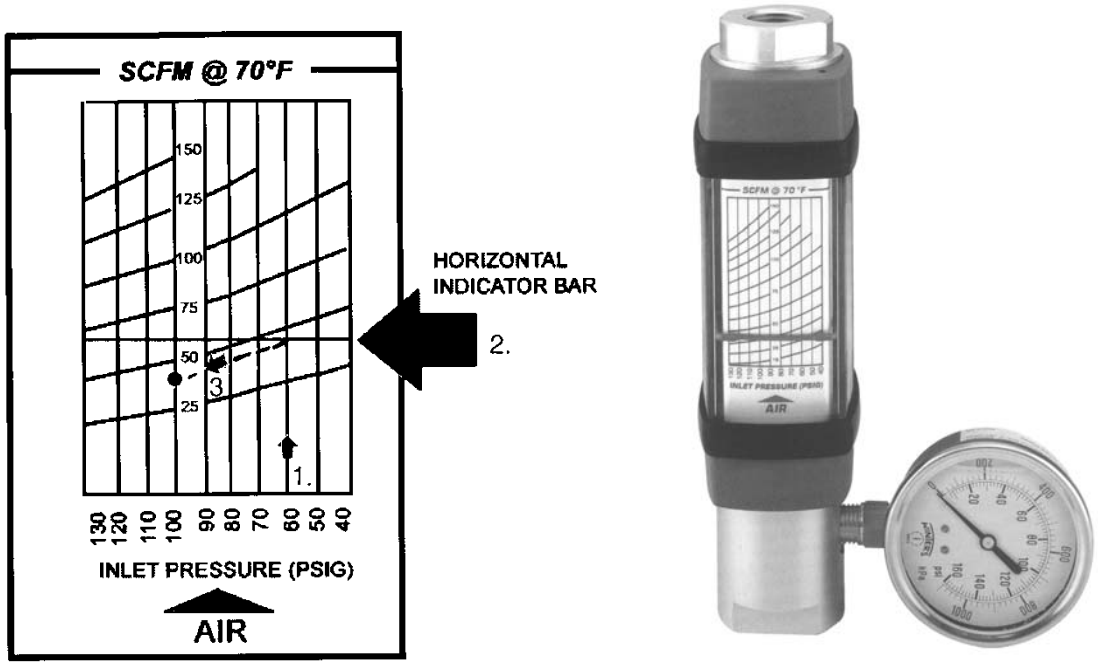



**Figure 12. Compressed Air Flow Meter and Scale**

To change the compressed air/oil nozzle position.

1. Ensure that the burner is not firing, then close the manual oil valve and the manual compressed air ball valve at the burner. The burner must not be firing

2. If heated heavy oil is being used, allow the oil in the pipe to cool to avoid burns. Drain residual fuel into an appropriate container.

3. Note the present orientation of the air/oil nozzle in the burner. Determine if the air/oil nozzle must be retracted into or extended out of the primary air tube (see Figure 9).

4. Loosen the two set screws on the backplate lock collar of the air/oil insert assembly.

5. Slide the insert assembly to effect the required retraction or extension of the air/oil nozzle.

6. Once the proper positioning of the air/oil nozzle is completed:

   a. Tighten the two setscrews in the backplate lock collar.
   b. Attach the air/oil insert assembly to the oil manifold, using the union provided.
   c. Open the manual oil valve. Check for leaks using accepted leak check practices.

## P. LIQUID PROPANE (LP) FUEL PIPING SYSTEM

**WARNING**

Adjustment of this equipment and its components by unqualified personnel can result in fire, explosion, severe personal injury, or even death.

LP is highly flammable and heavier than air. It will accumulate near the ground in the area of a leak and will dissipate relatively slowly. LP or Butane in its liquid state can cause freezing and severe injury.

Hauck **does not recommend** installation of a line-reducing regulator in the LP supply line. If the regulator diaphragm were to total system pressure would be applied to the burner and could result in damage to equipment, including the baghouse, and **result in serious injury to personnel.**

**NOTE**

Hauck recommends the use of LP manifolds that meet NFPA guidelines. NFPA requires two safety shutoff valves piped in series in the burner's main LP line. A low/high pressure LP switch must be interlocked with the burner's safety shutoff valves. Hauck's LP manifolds have been designed to ensure compliance to NFPA requirements. All piping must be installed in compliance with applicable piping codes and regulations. Equipment must meet the ratings for service as indicated in NFPA 58.

1. LP or butane is supplied to the MegaStar™ burner in a liquid form and is vaporized as the fuel exits the burner nozzles.

2. Hauck recommends using a flexible connection to connect the LP line to the burner. A flexible connection will reduce vibration stress on the LP connection. Refer to Table 12 for recommended flex connection. Follow Figure 13 for the suggested piping layout.

| MegaStar™ Model No. | 50 | 75-100 | 125-150 |
|---|---|---|---|
| Flexible LP Hose Part No. | 45754 | 45755 | 47533 |
| Size | 3/4" NPT (DN15) | 1" (DN25) | 1¼" (DN32) |

**Table 12. Recommended LP Flexible Hose Size**

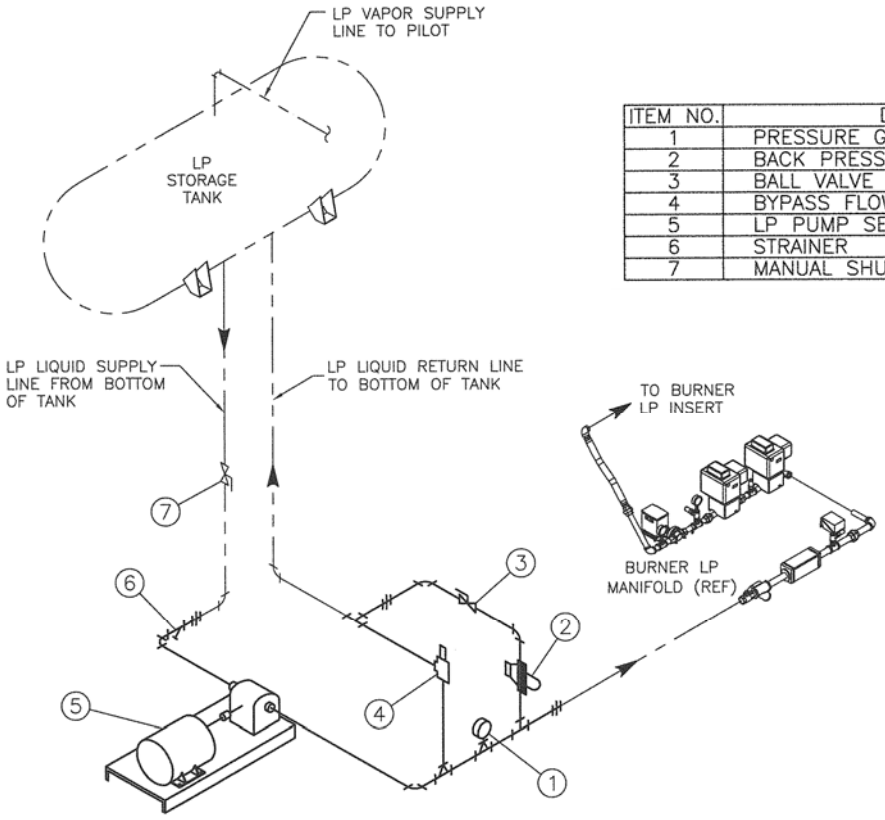
3. Before attaching LP fuel lines, purge the lines with compressed air. Then, leak test piping with compressed air.

4. Connect the main LP line at the appropriate connection on the burner skid. The capacity of the LP fuel system should be 1.5 times the rated capacity of the burner.

5. If Hauck has supplied the LP pump set for this application, consult the pump installation instructions for information on the unit.

**NOTE**

If the burner is being converted from natural gas or oil to LP firing, the diverter ring located on the end of the primary air tube assembly **must be removed** (consult Hauck for details). Also, the LP nozzle **must be removed** prior to converting the burner to natural gas firing to avoid damage to the LP nozzle.




| ITEM NO. | DESCRIPTION |
|---|---|
| 1 | PRESSURE GAUGE |
| 2 | BACK PRESSURE REGULATOR |
| 3 | BALL VALVE |
| 4 | BYPASS FLOW CONTROL VALVE |
| 5 | LP PUMP SET |
| 6 | STRAINER |
| 7 | MANUAL SHUTOFF VALVE |

NOTES:
1. PUMP H.P. MAY VARY WITH PUMP MANUFACTURER.
2. SPRING PRESSURE PLUS TANK PRESSURE.
3. ALL PIPING TO BE SCH. 80 BLACK IRON PIPE.
4. CONSULT NFPA 58 FOR APPLICABLE EQUIPMENT RATINGS AND INSTALLATION.
5. PUMP INLET MUST BE INSTALLED BELOW BOTTOM OF LP STORAGE TANK.
6. USE RECOMMENDED PIPE SIZE OR LARGER BETWEEN PUMP SET AND BURNER MANIFOLD.
7. STANDARD PILOT IS USED WITH LP VAPOR, SUPPLY FROM TOP OF STORAGE TANK (LP VAPOR CONNECTION) OR OTHER SOURCE.

| MODEL NO. | MAX. LIQ. PROPANE (GPH) | MAX. ΔP (PSIG) | APPROX. PUMP H.P. (NOTE 2) | INITIAL START-UP PRESSURE SETTINGS (NOTE 2) BYPASS FLOW CONTROL VALVE (50-150 PSIG SPRING) | INITIAL START-UP PRESSURE SETTINGS (NOTE 2) BACK PRESSURE REGULATOR (50-230 PSIG SPRING) | PUMP TO BURNER SUPPLY PIPING MIN. PIPE SIZE |
|---|---|---|---|---|---|---|
| MS-50 | 550 | 125 | 2 | 100% PROPANE 235 PSIG<br>50% PROPANE 50% BUTANE 170 PSIG | 100% PROPANE 210 PSIG<br>50% PROPANE 50% BUTANE 145 PSIG | 1 1/2 |
| ESII-75B MS-75 | 825 | | 3 | | | 1 1/4 |
| ESII-100B MS-100 | 1045 | | | | | |
| ESII-125B MS-125 | 1320 | | | | | |
| ESII-150B MS-150 | 1550 | | 5 | 100% BUTANE 95 PSIG | 100% BUTANE 70 PSIG | 1 1/2 |
| ESII-175B | 1810 | | 6 | | | |
| ESII-200B | 1980 | | 7.5 | | | |

**Figure 13. Typical Schematic of LP Piping**

**NOTE**

The LP piping system shown in Figure 13 is designed for optimum performance at ambient air temperatures above 40°F (5°C). For operation in ambient temperatures below 40°F, consult Hauck for recommendations.

**CAUTION**

Hauck **strongly recommends** that a bypass flow control valve **and** a backpressure regulator be installed in all LP systems and piped as shown in Figure 13.

6. After completing piping, check all LP lines and connections for leaks following accepted standards and practices. **Do not operate the system until all leaks are repaired.**

**WARNING**

Frost or icing is an indication of an LP leak. It is possible for a leak to occur without such evidence. Although the LP supply is initially in a liquid state, as it is vaporized it becomes heavier than air and accumulates near the ground and dissipates relatively slowly, becoming highly flammable. Extreme care should be exercised with LP fuels and systems.

7. Adjustment of LP supply pressure: (see Table 13 for recommended settings).

   a. Install an amp probe on the LP pump power supply line.

**CAUTION**

Do not exceed the minimum LP pump motor nameplate amp load at any time while making adjustments.

   b. Close the ball valve between the back pressure regulator and the tank to temporarily take the regulator out of the system (see Figure 13).

   c. The bypass flow control valve is used as a system safety. Normally set at 50 psig (345 kPa) above the maximum expected tank pressure, it operates only in the case of a back pressure regulator failure.

   d. Adjust the bypass flow control valve to the following initial settings:

| | |
|---|---|
| 100% Commercial Propane | 235 psig (16.20 bar) |
| 50/50 Propane/Butane | 170 psig (11.70 bar) |
| 100% Butane | 95 psig (6.55 bar) |

**NOTE**

If pump motor nameplate amperage is exceeded, reduce pressure in Step 7.d to below nameplate amp rating.

   e. The back pressure regulator functions as the primary control in setting the LP supply pressure to the burner. To adjust the back pressure regulator, open the ball valve between of the back pressure regulator and the tank, and adjust the regulator to an initial setting of 25 psig (172 kPa) below the flow control valve setting.

   f. Adjust the back pressure regulator to the following initial settings:

| | |
|---|---|
| 100% Commercial Propane | 210 psig (14.50 bar) |
| 50/50 Propane/Butane | 145 psig (10.00 bar) |
| 100% Butane | 70 psig (4.80 bar) |

g. The low/high LP pressure switch is factory set at a low set point of 165 psig (1140 kPa) and a high set point of 230 psig (15.9 bar). The low pressure switch setting should be approximately 15 psig (1.03 bar) below the back pressure regulator setting.

h. Check with your LP supplier for the exact maximum expected tank pressure for your fuel.

8. The burner LP flow control (metering) valve is preset based on flow required from low to high fire. The low fire LP setting can be changed by loosening the coupling connecting the LP valve to the control motor, adjusting the LP valve pointer, and re-tightening the coupling. The high fire LP flow can be changed via the burner control system, or if necessary , by increasing or decreasing LP pressure. See the individual burner performance sheets for LP fuel flow data and settings. If the burner LP fuel control valve continually freezes at low fire, increases LP flow slightly until freezing stops. If the burner LP nozzle continually freezes it usually indicates that water is in the fuel. Contact your LP fuel supplier about the addition of methanol to your LP fuel tank.

**CAUTION**

Any adjustment to the LP fuel flow settings should be made as a minor incremental change and verified that it has not resulted in any detrimental effect to plant operation prior to making another adjustment.

**NOTE**

LP fuel flow settings per the individual burner performance sheets are for initial set-up only. Final settings may have to be readjusted for required operation.

9. Different size nozzle holes are required on propane, butane, or mixtures of both to assure optimum vaporization and combustion. If using a butane or propane / butane mixture, be sure to specify the fuel when ordering and consult Hauck for specific nozzle hole sizes.

10. The MegaStar™ utilizes a multi-port LP nozzle assembly positioned around the primary air tube. Atomizing air supplied from an auxiliary blower assists in mixing and vaporizing the propane. The nozzle assembly incorporates a series of holes and nozzles to control the LP flow. Check for plugged nozzle holes by removing the nozzle from the burner and running water through it to make sure all the holes are clear. Clean any blocked holes and return the nozzle to its original position.

| Max. Tank Temp. | | 100% Propane | | 50% Propane 50% Butane | | 100% Butane | |
|---|---|---|---|---|---|---|---|
| (°F) | (°C) | (psig) | (bar) | (psig) | (bar) | (psig) | (bar) |
| 70 | 21 | 175 | 12.10 | 125 | 860 | 75 | 520 |
| 80 | 27 | 190 | 13.10 | 140 | 965 | 80 | 550 |
| 90 | 32 | 215 | 14.80 | 160 | 1,100 | 85 | 585 |
| 100 | 38 | 230 | 15.90 | 170 | 1,170 | 95 | 655 |

**Table 13. Recommended Burner Supply Fuel Pressures**

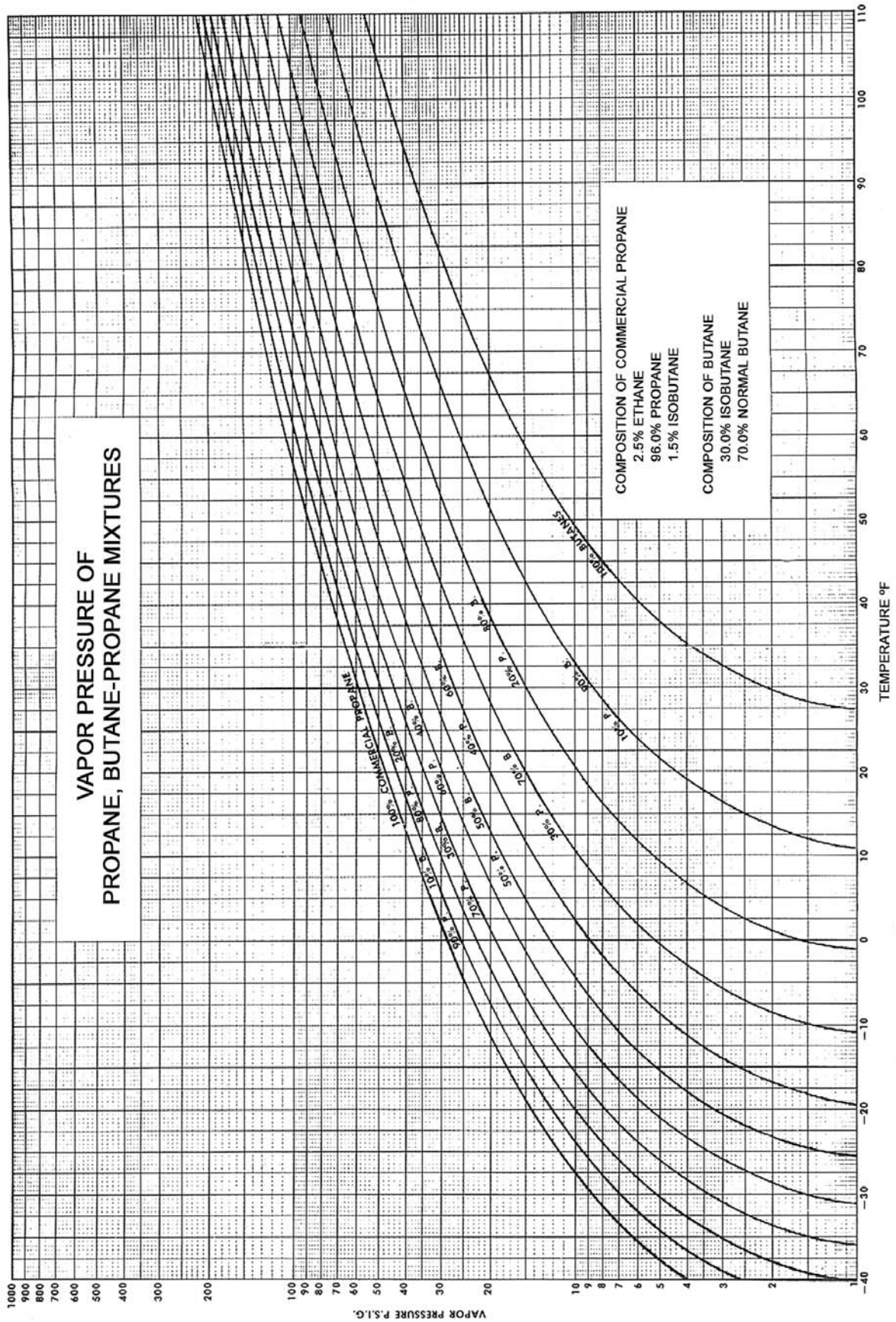



**Figure 14. Vapor Pressures of Propane, Butane and Butane-Propane Mixtures**

## Q. LIQUID PROPANE (LP) NOZZLE

To install the liquid propane (LP) nozzle, it is necessary to work on both the front and rear of the burner. All necessary safety procedures should be followed to ensure that work can be performed on both ends of the burner. The LP nozzle will appear different depending on the operating capacity of the burner, see figure 15 for details. The following procedure should be followed when installing the LP nozzle.

1. Check the primary tube for a choke ring (Figure 16). If the choke ring is present, it must be removed to accept the LP nozzle.

2. Remove the access door from the rear of the burner air housing. Verify that a 2" NPT pipe plug is installed in the primary air tube. (see Figure 17)

3. Loosen the lock nut and insert backplate from the LP insert.

4. From the front end of the burner, insert the nozzle and feed piping from the primary tube.

5. When properly installed, LP nozzle rests against the secondary air tube (Figure 16). NOTE: On the ESII175B and ESII200B, the primary tube will contact a stop in the nozzle.

6. Align the nozzle as shown in Figure 16. Tighten setscrews on the nozzle and reinstall the insert backplate and lock nut.

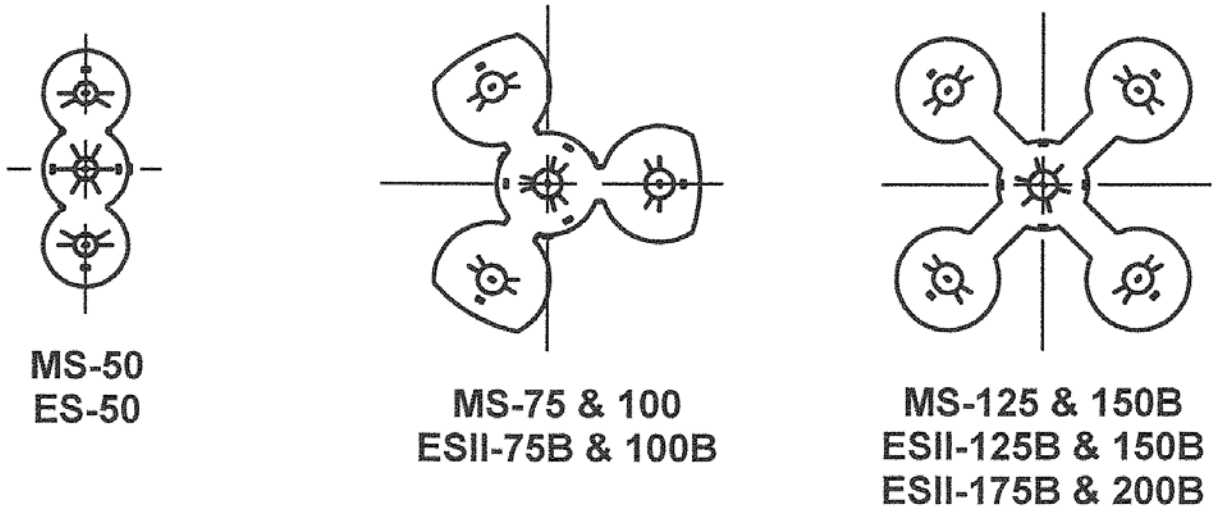



**Figure 15. LP Nozzle Orientation**

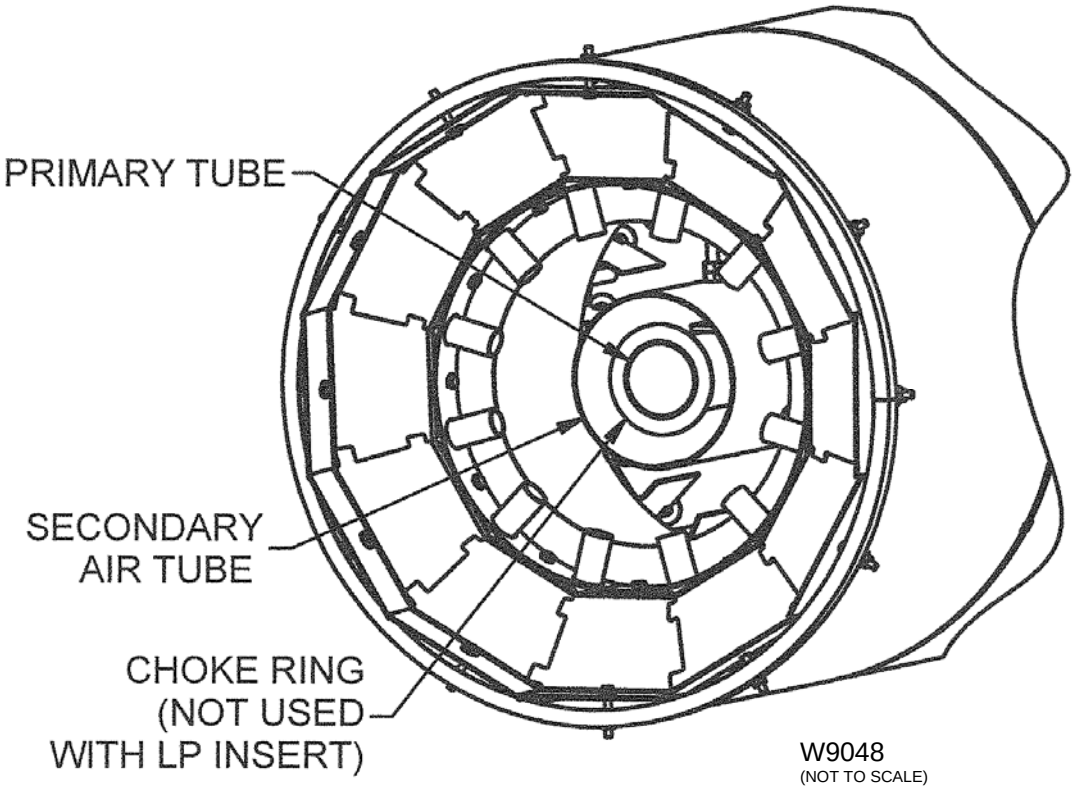



**Figure 16. Burner Front End**

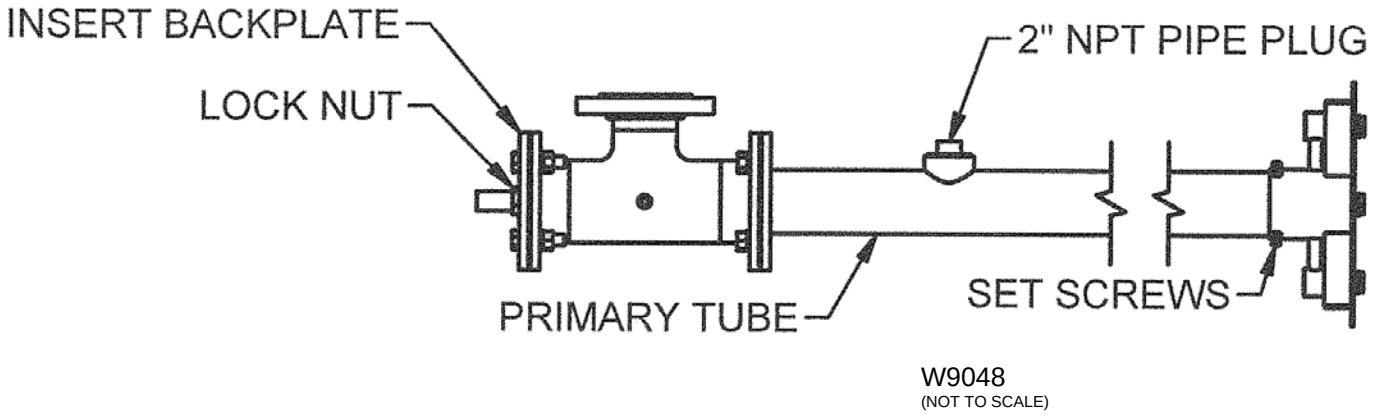



**Figure 17. LP Insert**

## R. BURNER PILOT SYSTEM

The MegaStar™ incorporates a gas pilot with induced air (see Figure 18). The pilot is detected by the main burner UV scanner which is factory mounted and wired. The pilot is properly installed as delivered and should not need to be moved or adjusted. Note, UV scanner is shipped loose.

1. Before connecting to the pilot assembly gas line, the gas line should be purged to remove any dirt. Pipe the pilot gas supply line to the inlet of the pilot gas shutoff valve and check for leaks. **Size the pilot gas supply line to avoid excessive pressure drops.** For pilot gas supply lines up to 25 ft (7.6m), use 1/2 NPT (DN 15) or larger piping.

2. Constant gas pressures ranging from 15 psig (1.03 bar) minimum to 25 psig (1.72 bar) maximum must be available at the inlet of the Hauck gas pilot manifold. Pilot capacity should not exceed 150,000 Btu/hr (44kW).

3. The spark wire gap is factory set at 1/8" (3mm). This gap can be changed by carefully removing the pilot internals. Bend the spark wire to adjust, reinsert, and check the gap. For field adjustment, a U.S. 5¢ coin with 0.08" (2mm) thickness can be used as a gauge for adjusting the spark gap.

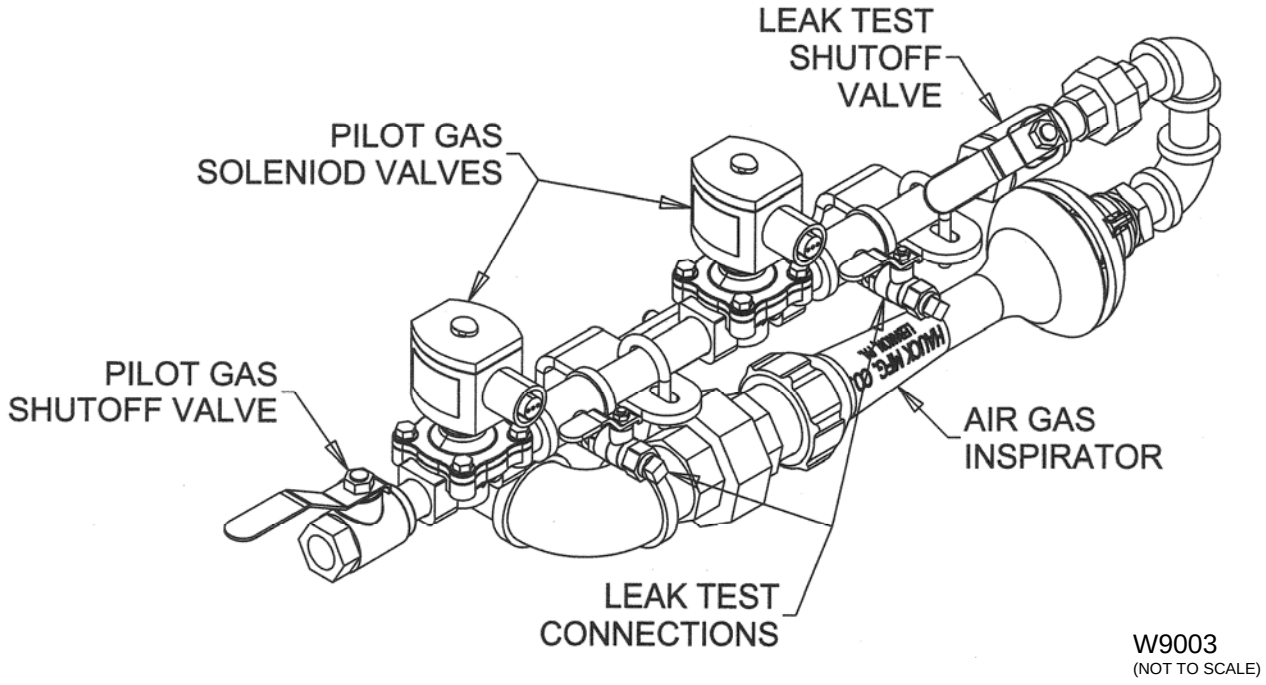



**Figure 18. Pilot Manifold Detail**

4. Complete the initial pilot adjustment of the air shutter as follows (see Figure 18):
   a. Loosen, but do not remove, the locking thumbscrew.
   b. Adjust the air shutter to approximately 1/4" (6.4mm) gap opening.
   c. Securely tighten the locking thumbscrew.
   d. Slowly open the gas flow valve and light the pilot by means of electric ignition.

**CAUTION**

The pilot ignition transformer can cause an electric shock - use care around the ignition cable. When test firing the pilot, leave pilot gas on briefly. If pilot does not light quickly, shut it off and repurge before attempting to relight.

## S. PRIMARY AIR

Primary air is used for improved mixing at low fire on LP fuel, and for the optional low pressure atomization of oil fuel. Hauck offers a TBA blower for primary air supply. The primary air blower is supplied with an outlet flange to mate to the air connection on the burner. Piping between the blower and the burner is not supplied with the burner. Once installed, verify that no air leaks exist between the blower and the burner. If leaks exist, burner efficiency will be reduced.

## T. BURNER SETUP

**WARNING**

Adjustment of this equipment by unqualified personnel can result in fire, explosion, severe personal injury, or even death.

**NOTE**

These settings are for initial setup only. Final settings will have to be readjusted for required operating conditions.

Use of individual control motors allows the fuel valves to be characterized via the BCS6000 control panel to maintain a tighter air/fuel ratio over the entire burner operating range. Starting points for fuel control valves are shown in Figure 19 and in the individual burner capacity and performance data sheets. Final settings of the fuel valves can then be set at multiple control points using the BCS6000 control panel.

### Nominal Settings (see Figure 19)

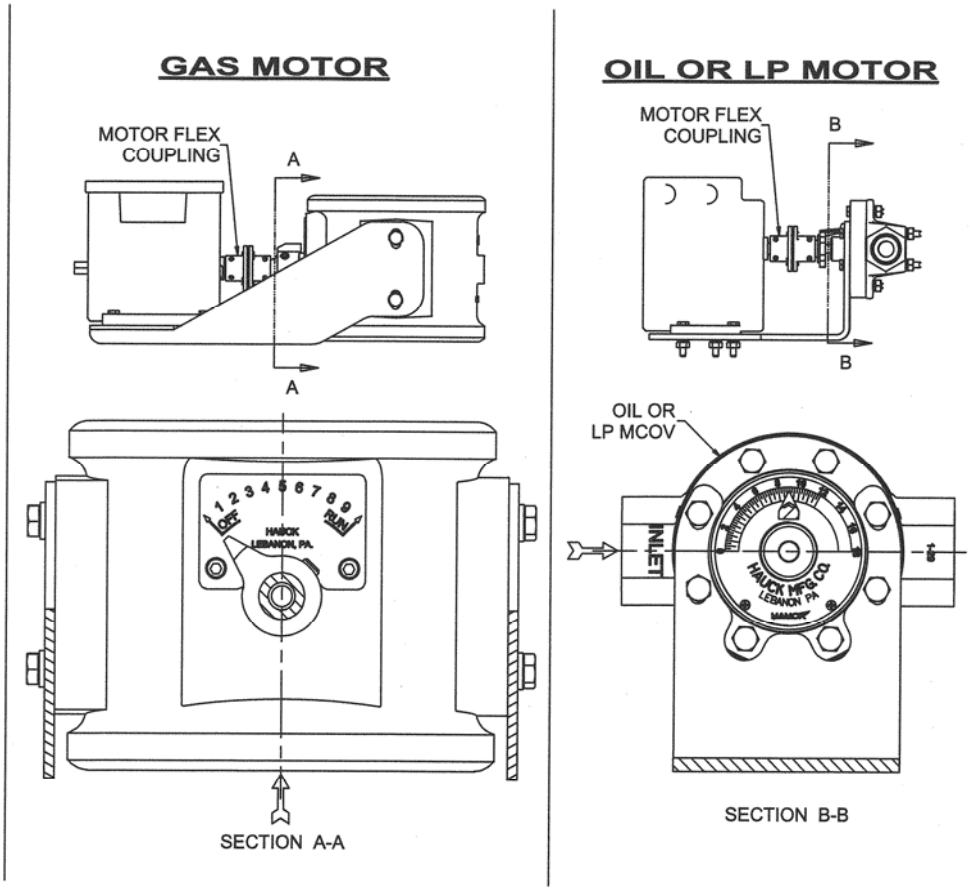
1. All control motors have a travel of 90°.

2. The low fire starting frequency for the combustion air blower is 16Hz. Always be sure that the combustion air blower is operating at 16Hz prior to pilot and main flame ignition. During operation, the blower frequency will need to modulate between 16 and 60Hz as required to maintain process temperature.

3. Natural Gas Valve. Low fire is adjusted at the main gas valve. Adjust using the gas metering orifice (see Orifice Meter Capacity Chart in Figure 4). The natural gas valve has a nominal travel from the off position (low fire) to 9 (high fire) on the valve position indicator dial plate.

4. Oil Metering Valve . The valve has a nominal travel from position 2 to 11 (see capacity and performance data sheets).

5. Propane Metering Valve. Low fire is adjusted at the main LP fuel valve. Adjust while watching the LP fuel flow meter. If freezing occurs, open the low fire setting ¼ of a position at a time until the freezing stops. The valve travel varies for a given burner model (see individual burner capacity and performance data sheets).




NOMINAL TRAVEL

| | LOW FIRE | HIGH FIRE |
|---|---|---|
| AIR DAMPER | OFF | 6 |
| GAS BVA | OFF | 9 |
| OIL MCOV | 2 | 11 |
| LP MCOV | 1 | 10 |

X7870
(NOT TO SCALE)

**Figure 19. Individual Control Motor Settings**

## U. OPERATION

**WARNING**

Adjustment of this equipment by unqualified personnel can result in fire, explosion, severe personal injury, or even death.

1. The MegaStar™ uses individual control motors directly coupled for each fuel control valve. The optional remote rack mounted fuel manifold includes a separate control motor for the fuel control valves, which is electronically linked to the air control. Air control is performed with a VFD, modulating the output frequency between 16 Hz and 60 Hz to achieve a precise air flow.

2. The combustion air must cycle to 60 Hz for purging the system before light off, the safety limits must be satisfied, and the purge air pressure switch must be made for the purge to begin. The plant exhaust fan must be running with its damper open sufficiently for the proper purge time. The minimum purge time is the time required for four volumes of air to flow through the entire combustion and exhaust system (including the baghouse and flue stack). For most applications, the combustion air blower will modulate from 16Hz at low fire to 60Hz at high fire.

3. Set the low gas pressure switch to an initial setting of 0.5 psig (3.4 kPa).

4. Set the high gas pressure switch to an initial setting of 5 psig (34.5 kPa).

5. The fuel valve must be adjusted for proper flow control. See individual burner performance sheets for fuel flows. Adjustment can be electronically performed with bias points characterizing the valve position, or it can be set manually so that the closed position provides the correct flow rate for low fire.

6. Before light off, the combustion air blower must be running at 16Hz; the contacts in the combustion air switch must be set to close at 1" wc (25 mm wc). The low fire fuel limit switches, located on the fuel manifold, must be set to have closed contacts when the fuel valve is at low fire. **Do not attempt to ignite the burner unless it is at low fire.**

## V. ADJUSTMENTS

1. In order to drive each control motor, consult burner control panel instructions.

2. The spin vane adjustment affects the flame shape and combustion intensity. Spin set at 0° will produce a long narrow flame; a spin setting of 50° will produce a short wide flame (see individual burner capacity and performance data sheets). For most applications, the spin should be set in the mid range (30° - 45° on indicator). For a very short flame, in a large diameter combustion zone, the spin can be set on maximum (50° on indicator). Caution is advised as overheating of the combustion flights or drum could occur when using maximum spin. When adjusting the spin to less than 30° for a long flame, check the exhaust gas to make sure the flame is not too long that it extends into the veiling zone of the dryer (this can lead to incomplete combustion resulting in high CO and unburned hydrocarbon emissions in the flue gas).

**WARNING**

The MegaStar™ Burner flame is very intense. It is designed to burn quickly and completely in the recommended combustion space. Flame adjustments on new installations should be started with a narrow flame (30°) spin setting. Drum temperatures should be checked using a hand held non-contact infra-red thermometer particularly in the combustion zone area. The flame shape can then be widened while observing drum temperature in the combustion zone.

3. During the adjustment process take exhaust gas measurements to verify that complete combustion is taking place (see Application Sheet GJ73 for general information on conducting exhaust gas analysis).

## W. MAINTENANCE

The Hauck MegaStar™ burner has minimal internal moving parts and is relatively maintenance free. However, there are a few items that should be periodically checked.

1. Check the fuel control valves for proper operation.

2. For burners fired on oil:
   Dirt can clog the atomizing air nozzle, as well as cause problems firing the burner. If the nozzle is dirty, fuel oil will not atomize properly and will result in lower combustion efficiency. Twice a year (or more frequently when firing heavy fuel oil, waste oil or in dusty conditions), remove and clean the burner oil insert tube and nozzle assembly as described below:

   a. Shut off the oil flow to the burner.
   b. Note the relative location of the oil atomization nozzle with respect to the primary air tube.
   c. Remove the bolts that secure the atomizing air backplate and remove the backplate and its attached fuel tube and atomizing oil nozzle.
   d. Disassemble the nozzle. Clean all the components of oil and other foreign material that may be plugging the nozzle holes. If used on heavy fuel oil, remove the nozzle and soak it in a solvent to loosen the oil deposits. Scrape the nozzle body and holes (if necessary) **using wooden tools or a plastic bristle brush only, being careful not to damage machined parts**.
   e. Reassemble the oil nozzle, reattach the nozzle to primary air tube, and then attach the burner backplate to the burner body.
   f. Check to ensure that the atomizing oil nozzle is at the proper position inside the burner (see Section N).

3. Periodically check all safety equipment, such as pressure switches, solenoid valves, and safety shutoff valves to ensure they are not clogged with dirt, or in any way inoperative.

4. Check and clean UV scanner lens as conditions dictate to keep it clean of dirt and dust.

**NOTE**
If the fan motor or impeller are removed or replaced, the fan vibration should be checked upon reassembly. If vibration levels are excessive, the fan should be trim balanced to minimize motor bearing wear.

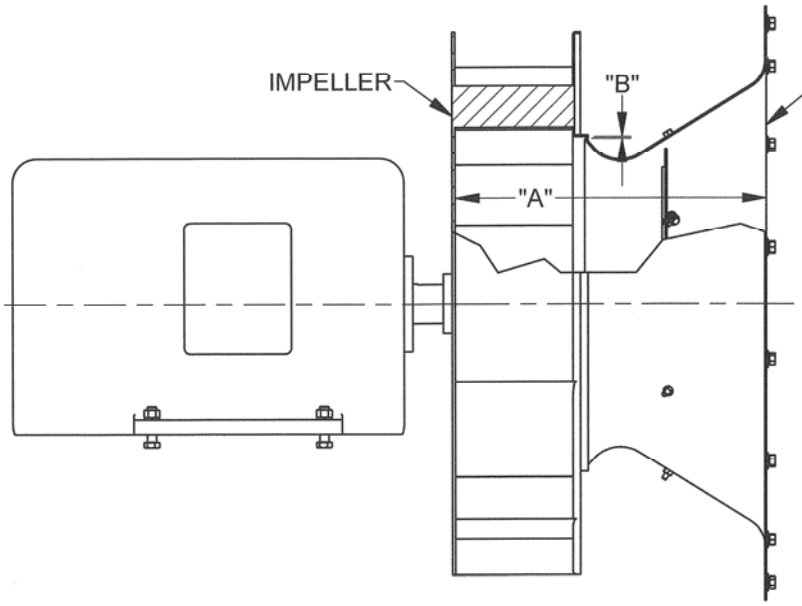
5. A yearly check of the fan (impeller/motor) vibration, measured in the vertical direction at the motor bearings, is recommended. Consult Hauck for acceptable vibration levels.

6. MegaStar™ fan impellers are equipped with wear resistant impeller blades. However, every effort should be made to minimize dust entering into the fan impeller. Excessive dust may cause premature wearing of impeller blades and burner parts in addition to unbalance of the fan.

7. Should it be necessary to remove the fan impeller from the motor shaft, it is important to replace the fan impeller in the proper position. See Figure 20 for installation instructions.

**IMPORTANT**
If the fan wheel is not installed properly, air capacity of the main fan will be reduced, diminishing burner capacity and efficiency.

8. Periodically check air/fuel ratio to ensure that the burner is operating at peak efficiency. Exhaust gas analysis can be performed with most commercially available gas analyzers.




| MODEL | "A" | "B" |
|---|---|---|
| MS-50 | 13 11/16±1/8 | 3/32±1/8 |
| ESII-75B & 100B<br>MS-75 & 100 | 23 5/8±1/8 | 5/32±1/8 |
| ESII-125B & 150B<br>MS-125 & 150 | 26 3/16±1/8 | 5/32±1/8 |
| ESII-175B & 200B | 27 7/8±7/8 | 5/32±1/8 |

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(NOT TO SCALE)

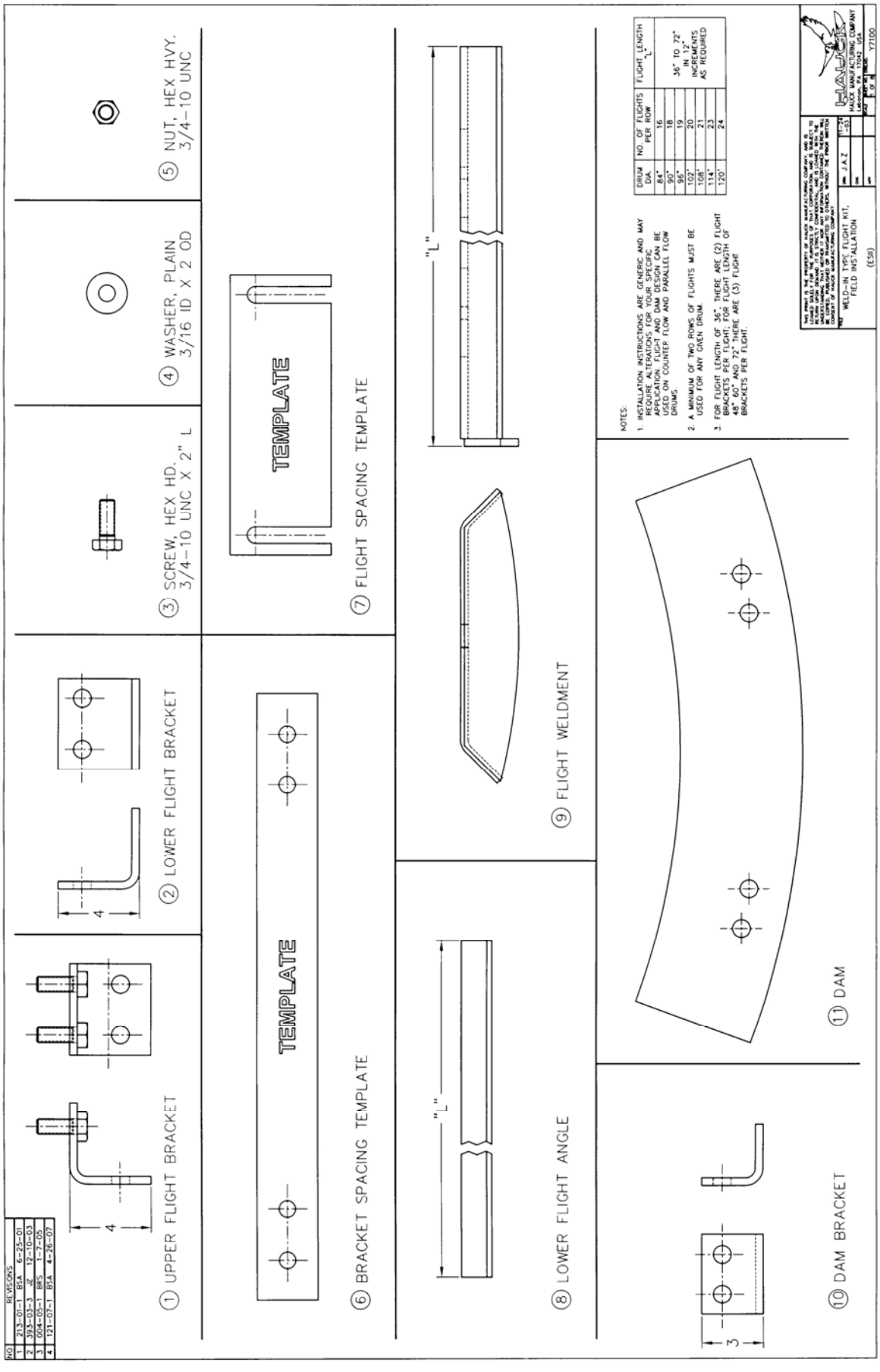
**Figure 20. Proper Impeller Position On Motor Shaft**

## X. RECOMMENDED SPARE PARTS

| ITEM | QTY. | PART NO. | DESCRIPTION |
|---|---|---|---|
| 1 | 1 | 20627 | Control Motor, Air, High Torque |
| 1A | 1 | 62960 | Control Motor, Fuel, Medium Torque |
| 2 | 1 | 20579 | UV Scanner |
| 3 | 2 | 84447812 | Air Pressure Switch, Combustion Air & Purge Air,<br>1 - 20" wc (25-508mm wc) (LP & Low Pressure Oil Only) |
| 4 | 1 | 84447832 | Air Pressure Switch, Primary Air, 12-60"wc (405-1520mm wc) |
| 5 | 1 | 61020 | Air Pressure Switch, Compressed Air, 30 psig (207 kPa) |

**Table 14. Recommended Spare Parts**

**APPENDIX:**


REVISIONS
NO
1 213-01-1 BJA 6-25-01
2 393-03-3 JC 12-10-03
3 004-05-1 BHS 1-31-05
4 121-07-1 BJA 4-26-07
① UPPER FLIGHT BRACKET
② LOWER FLIGHT BRACKET
③ SCREW, HEX HD. 3/4-10 UNC X 2" L
④ WASHER, PLAIN 3/16 ID X 2 OD
⑤ NUT, HEX HVY. 3/4-10 UNC
⑥ BRACKET SPACING TEMPLATE
TEMPLATE
⑦ FLIGHT SPACING TEMPLATE
TEMPLATE
⑧ LOWER FLIGHT ANGLE
"L"
⑨ FLIGHT WELDMENT
"L"
⑩ DAM BRACKET
⑪ DAM
NOTES:
1. INSTALLATION INSTRUCTIONS ARE GENERIC AND MAY REQUIRE ALTERATIONS FOR YOUR SPECIFIC APPLICATION. FLIGHT AND DAM DESIGN CAN BE USED ON COUNTER FLOW AND PARALLEL FLOW DRUMS.
2. A MINIMUM OF TWO ROWS OF FLIGHTS MUST BE USED FOR ANY GIVEN DRUM.
3. FOR FLIGHT LENGTH OF 36", THERE ARE (2) FLIGHT BRACKETS PER FLIGHT; FOR FLIGHT LENGTH OF 48", 60" AND 72", THERE ARE (3) FLIGHT BRACKETS PER FLIGHT.
DRUM DIA. | NO. OF FLIGHTS PER ROW | FLIGHT LENGTH "L"
84" 16
90" 18
96" 19
102" 20
108" 21
114" 23
120" 24
36" TO 72" IN 12" INCREMENTS AS REQUIRED
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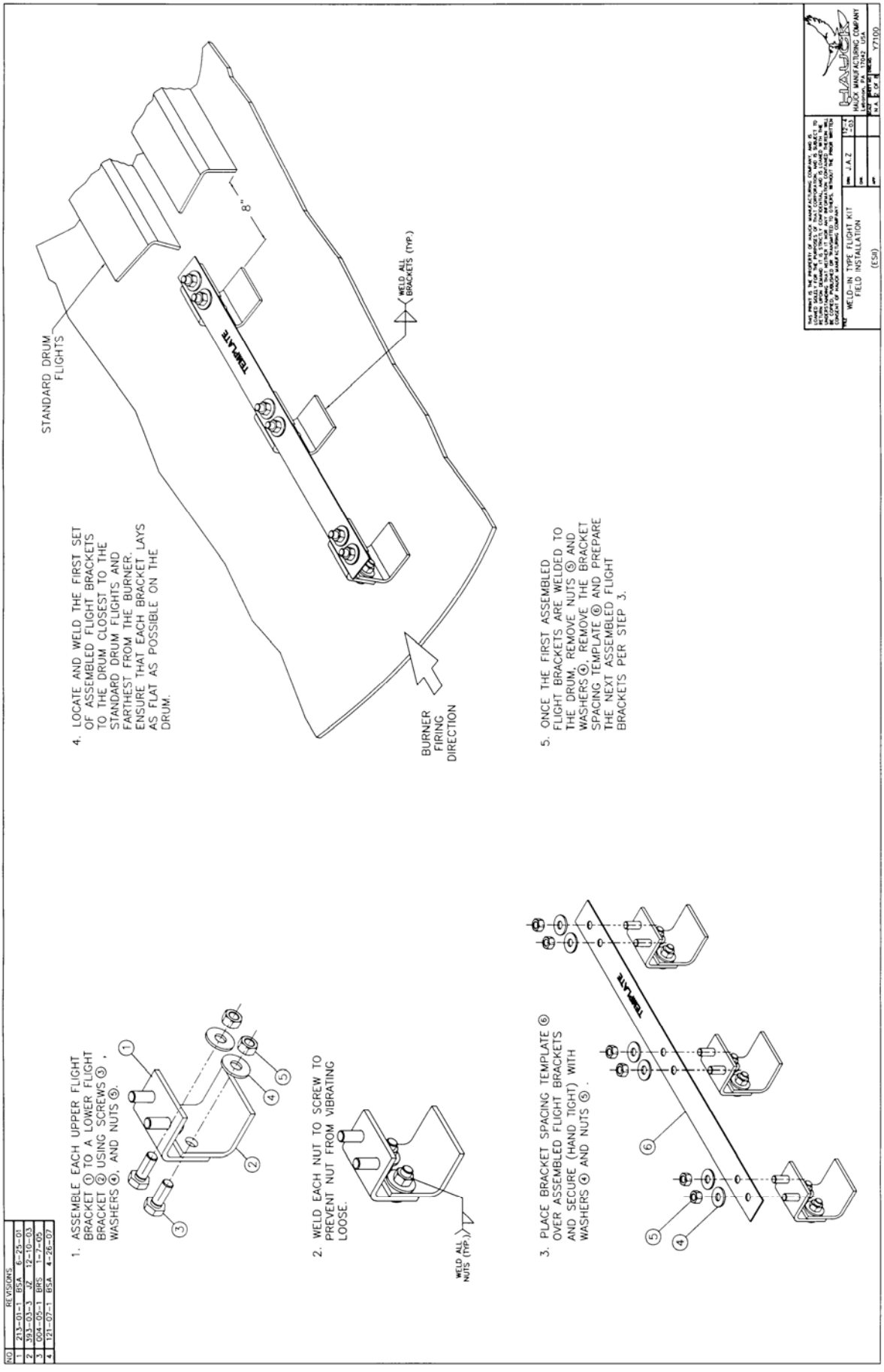
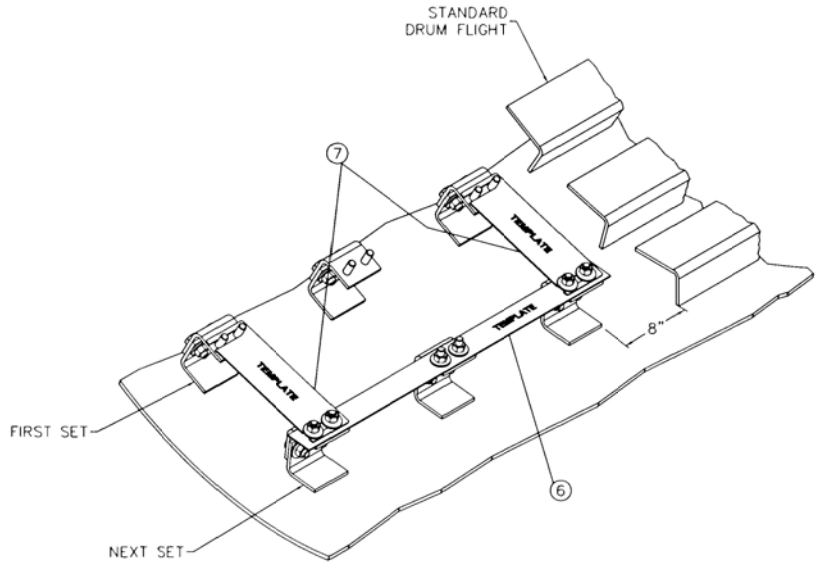
WELD-IN TYPE FLIGHT KIT, FIELD INSTALLATION
(ES6)
DR. J.A.Z 11-7-97
CH.
APP.
HAUCK MANUFACTURING COMPANY
LEMOYNE, PA 17043 USA
SIZE D SHEET 1 OF 4
Y7100

**APPENDIX:**

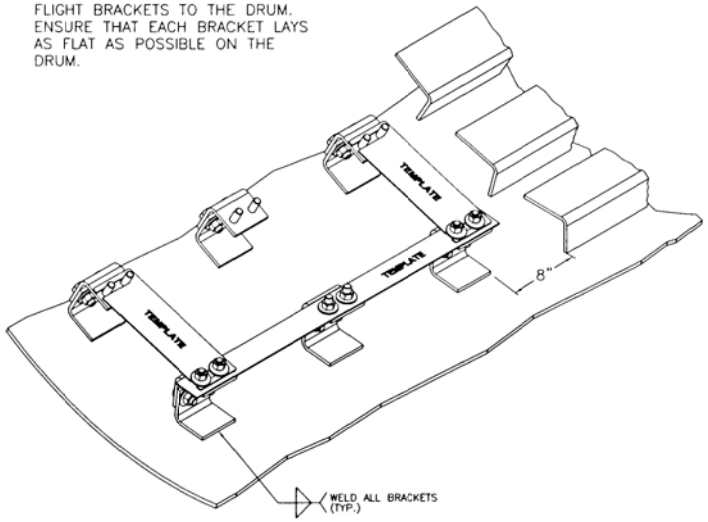

STANDARD DRUM FLIGHTS
8"
TEMPLATE
WELD ALL BRACKETS (TYP.)
BURNER FIRING DIRECTION
4. LOCATE AND WELD THE FIRST SET OF ASSEMBLED FLIGHT BRACKETS TO THE DRUM CLOSEST TO THE STANDARD DRUM FLIGHTS AND FARTHEST FROM THE BURNER. ENSURE THAT EACH BRACKET LAYS AS FLAT AS POSSIBLE ON THE DRUM.
5. ONCE THE FIRST ASSEMBLED FLIGHT BRACKETS ARE WELDED TO THE DRUM, REMOVE NUTS ⑤ AND WASHERS ④, REMOVE THE BRACKET SPACING TEMPLATE ⑥ AND PREPARE THE NEXT ASSEMBLED FLIGHT BRACKETS PER STEP 3.
1. ASSEMBLE EACH UPPER FLIGHT BRACKET ① TO A LOWER FLIGHT BRACKET ② USING SCREWS ③, WASHERS ④, AND NUTS ⑤.
2. WELD EACH NUT TO SCREW TO PREVENT NUT FROM VIBRATING LOOSE.
WELD ALL NUTS (TYP.)
3. PLACE BRACKET SPACING TEMPLATE ⑥ OVER ASSEMBLED FLIGHT BRACKETS AND SECURE (HAND TIGHT) WITH WASHERS ④ AND NUTS ⑤.
TEMPLATE
NO. REVISIONS
1 213-01-1 BSA 6-25-01
2 393-03-3 JZ 12-10-03
3 004-05-1 BRS 1-7-05
4 121-07-1 BSA 4-26-07
WELD-IN TYPE FLIGHT KIT FIELD INSTALLATION (ESII)
HAUCK MANUFACTURING COMPANY
Y7100

| NO | REVISIONS | | |
|---|---|---|---|
| 1 | 213-01-1 | BSA | 6-25-01 |
| 2 | 393-03-3 | JZ | 12-10-03 |
| 3 | 004-05-1 | BRS | 1-7-05 |
| 4 | 121-07-1 | BSA | 4-26-07 |

6. LOCATE THE NEXT SET OF ASSEMBLED FLIGHT BRACKETS ADJACENT TO THE FIRST SET BY PLACING (2) FLIGHT SPACING TEMPLATES ⑦, ONE AT EACH END, OVER THE BOLTS OF THE FIRST SET OF ASSEMBLED FLIGHT BRACKETS AND THE BOLTS OF THE NEXT SET OF ASSEMBLED FLIGHT BRACKETS.




7. WELD THE NEXT SET OF ASSEMBLED FLIGHT BRACKETS TO THE DRUM. ENSURE THAT EACH BRACKET LAYS AS FLAT AS POSSIBLE ON THE DRUM.



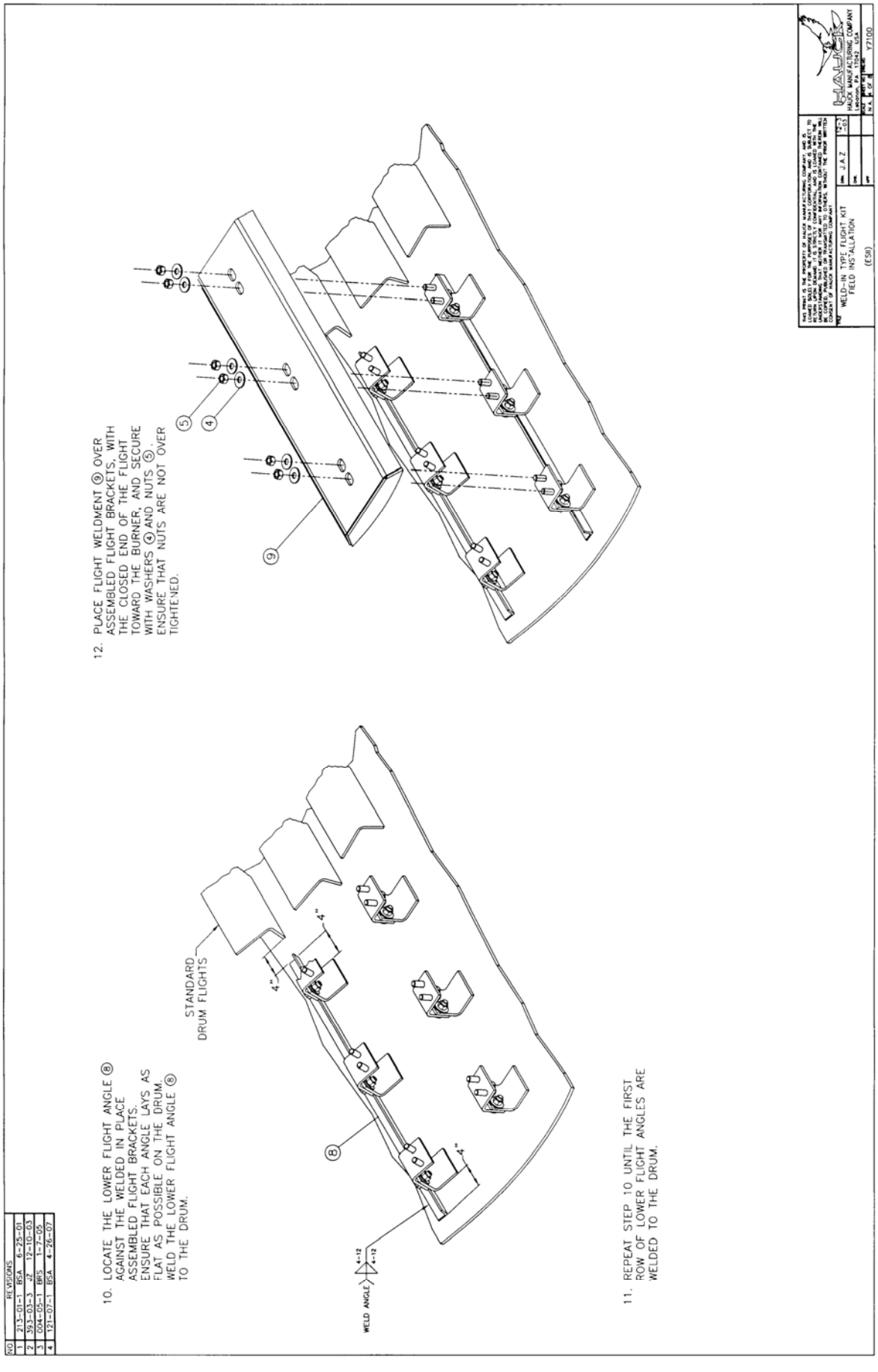

8. REMOVE THE (2) FLIGHT SPACING TEMPLATES ⑦ CONNECTING THE FIRST AND NEXT SET. THEN REMOVE NUTS ⑤, WASHERS ④, AND THE BRACKET SPACING TEMPLATE ⑥ FROM THE NEXT SET.

9. REPEAT STEPS 3, 6, 7 AND 8 UNTIL THE ROW OF ASSEMBLED FLIGHT BRACKETS ARE WELDED TO THE DRUM.

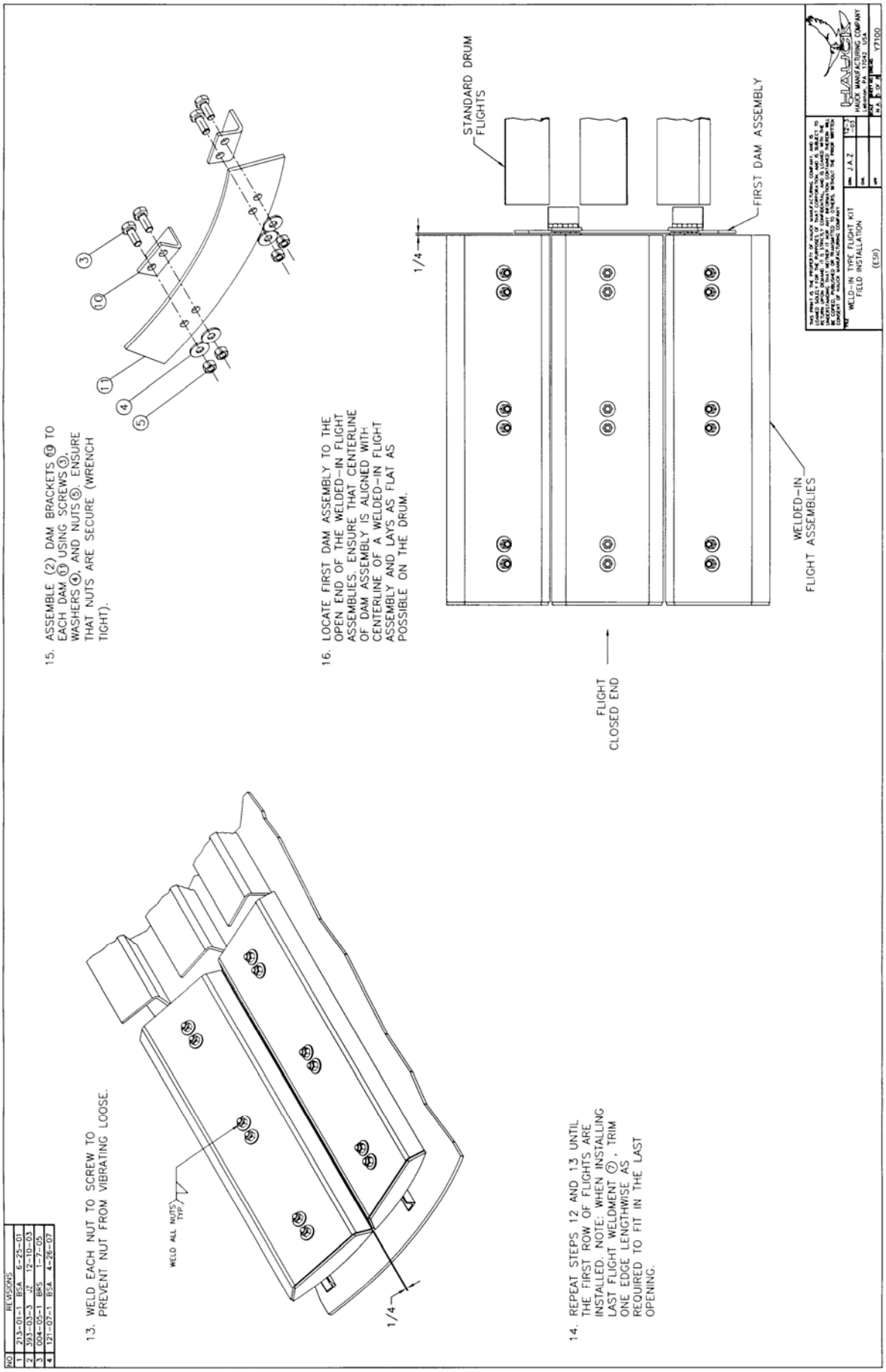


| | | | |
|---|---|---|---|
| TITLE: WELD-IN TYPE FLIGHT KIT FIELD INSTALLATION (ESII) | DRN. J.A.Z | 12-1-03 | HAUCK MANUFACTURING COMPANY Lebanon, PA 17042 USA |
| | CHK. | | |
| | APP. | | SCALE: N.A. SHEET NO: 5 OF 8 DRAWING: Y7100 |

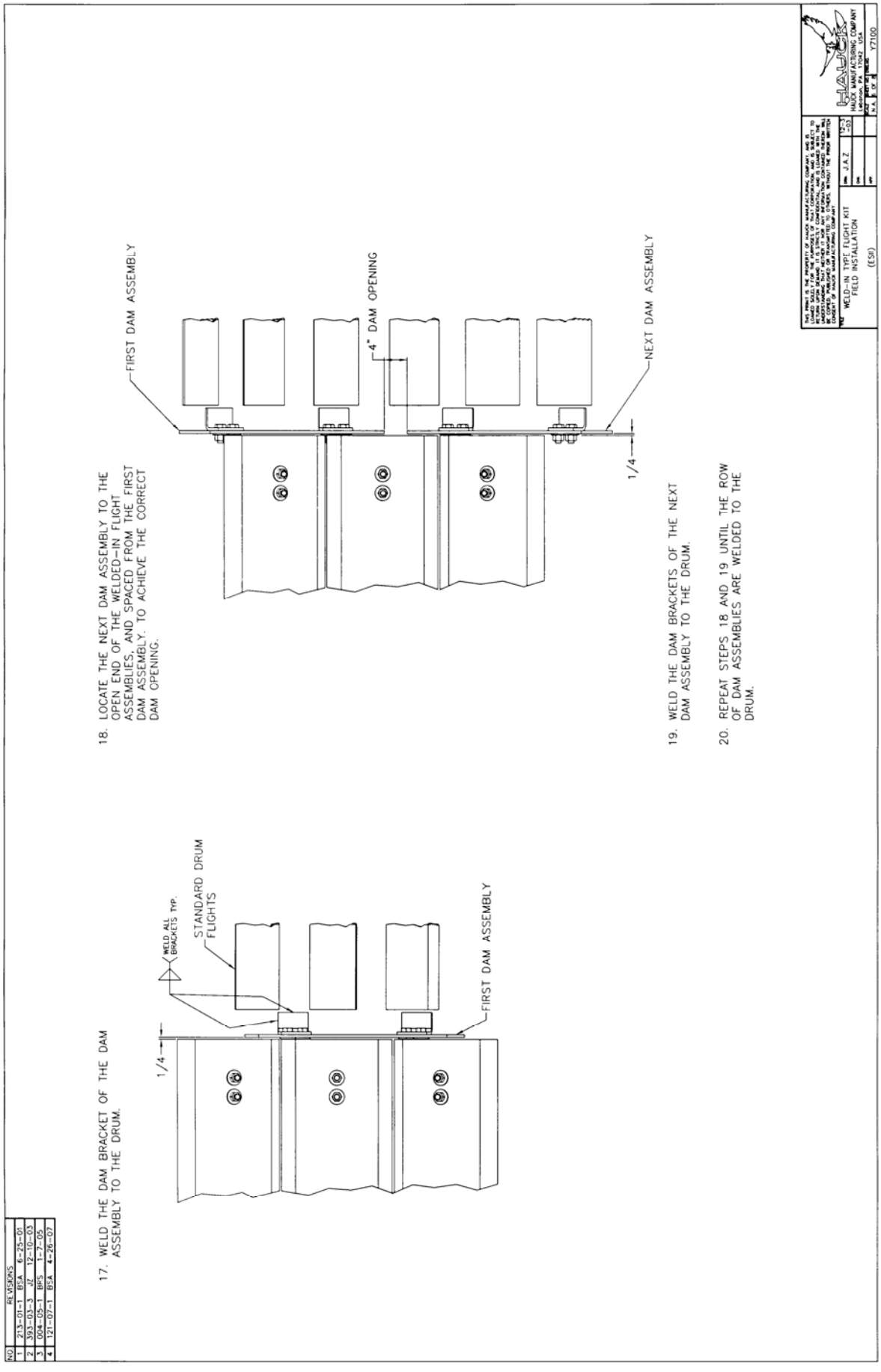
**APPENDIX:**


NO
REVISIONS
1 213-01-1 BSA 6-25-01
2 393-03-3 JF 12-10-03
3 004-05-1 BRS 1-7-05
4 121-07-1 BSA 4-26-07
10. LOCATE THE LOWER FLIGHT ANGLE ⑧ AGAINST THE WELDED IN PLACE ASSEMBLED FLIGHT BRACKETS. ENSURE THAT EACH ANGLE LAYS AS FLAT AS POSSIBLE ON THE DRUM. WELD THE LOWER FLIGHT ANGLE ⑧ TO THE DRUM.
STANDARD DRUM FLIGHTS
4"
4"
4"
⑧
WELD ANGLE
4-12
4-12
11. REPEAT STEP 10 UNTIL THE FIRST ROW OF LOWER FLIGHT ANGLES ARE WELDED TO THE DRUM.
12. PLACE FLIGHT WELDMENT ⑨ OVER ASSEMBLED FLIGHT BRACKETS, WITH THE CLOSED END OF THE FLIGHT TOWARD THE BURNER, AND SECURE WITH WASHERS ④ AND NUTS ⑤. ENSURE THAT NUTS ARE NOT OVER TIGHTENED.
⑤
④
⑨
WELD-IN TYPE FLIGHT KIT
FIELD INSTALLATION
(ESI)
DR. J.A.Z.
12-2-03
HAUCK MANUFACTURING COMPANY
Y2100

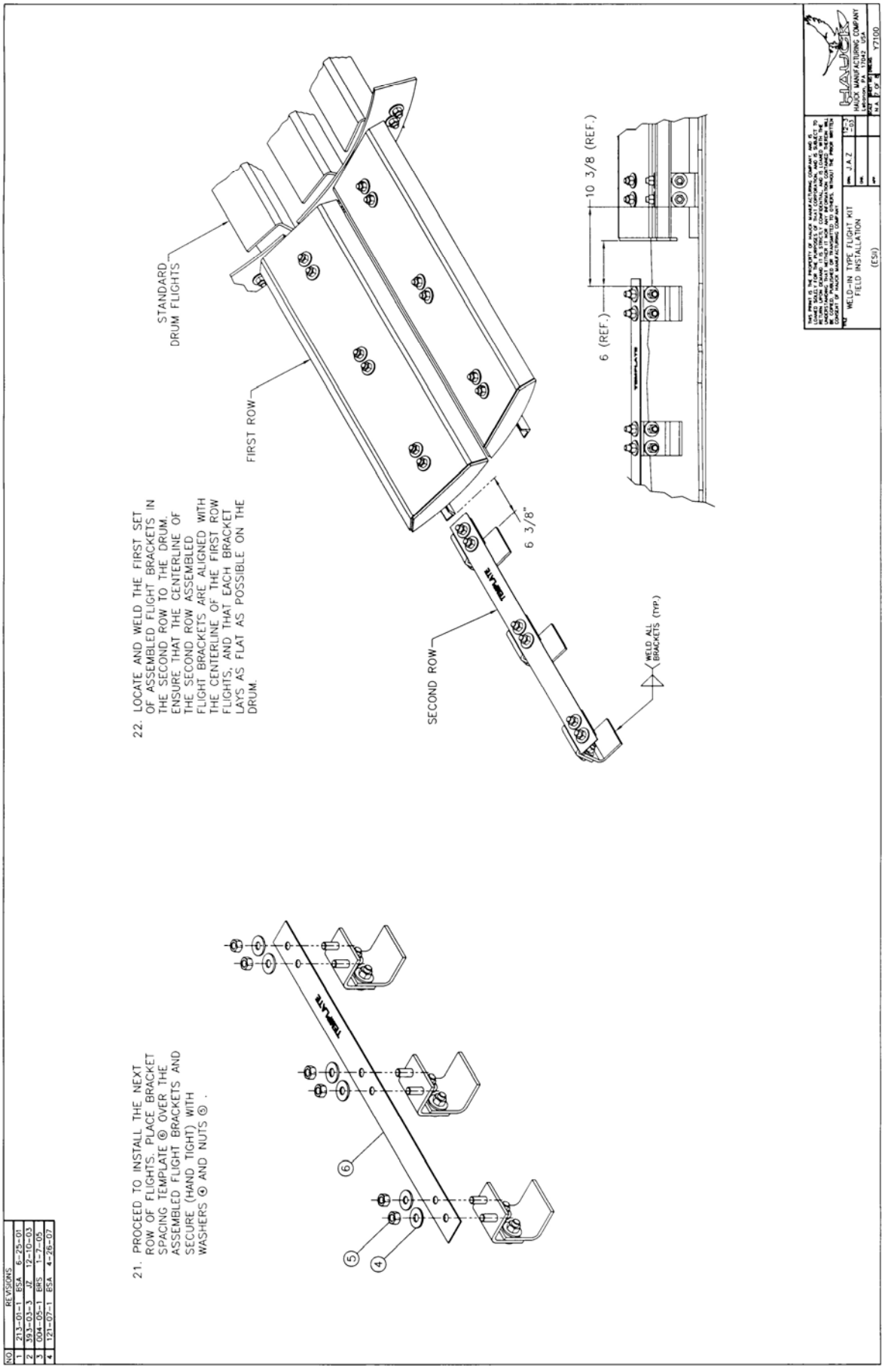
**APPENDIX:**


REVISIONS
NO 1 213-01-1 BSA 6-25-01
2 393-03-3 JZ 12-10-03
3 004-05-1 BKS 1-7-05
4 121-07-1 BSA 4-26-07
13. WELD EACH NUT TO SCREW TO PREVENT NUT FROM VIBRATING LOOSE.
WELD ALL NUTS TYP.
1/4
14. REPEAT STEPS 12 AND 13 UNTIL THE FIRST ROW OF FLIGHTS ARE INSTALLED. NOTE: WHEN INSTALLING LAST FLIGHT WELDMENT (7), TRIM ONE EDGE LENGTHWISE AS REQUIRED TO FIT IN THE LAST OPENING.
15. ASSEMBLE (2) DAM BRACKETS (9) TO EACH DAM (1) USING SCREWS (3), WASHERS (4) AND NUTS (5). ENSURE THAT NUTS ARE SECURE (WRENCH TIGHT).
16. LOCATE FIRST DAM ASSEMBLY TO THE OPEN END OF THE WELDED-IN FLIGHT ASSEMBLIES. ENSURE THAT CENTERLINE OF DAM ASSEMBLY IS ALIGNED WITH CENTERLINE OF A WELDED-IN FLIGHT ASSEMBLY AND LAYS AS FLAT AS POSSIBLE ON THE DRUM.
STANDARD DRUM FLIGHTS
FIRST DAM ASSEMBLY
1/4
FLIGHT CLOSED END
WELDED-IN FLIGHT ASSEMBLIES
WELD-IN TYPE FLIGHT KIT FIELD INSTALLATION (ESI)
HARMAN MANUFACTURING COMPANY
Y7100

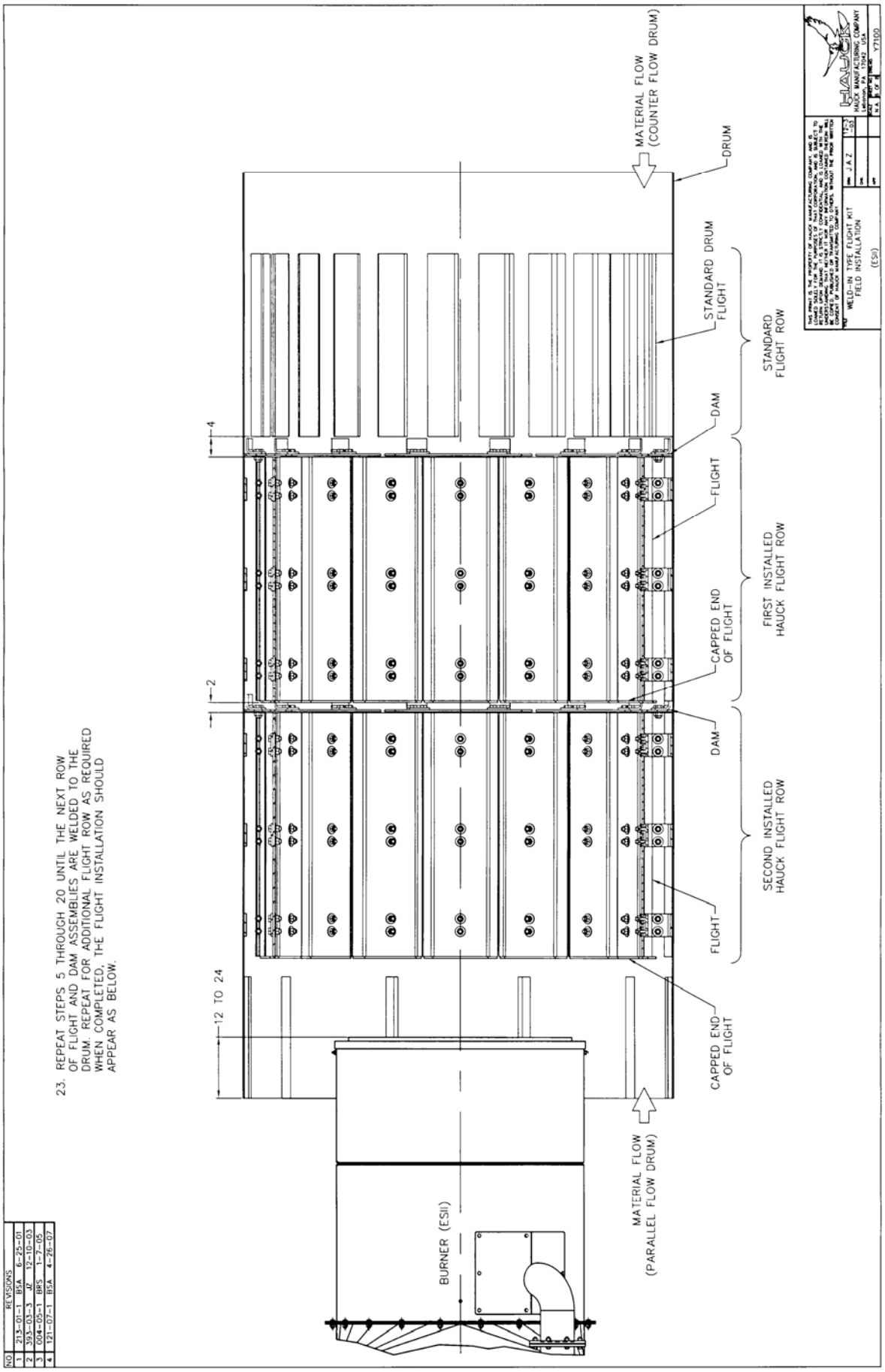
**APPENDIX:**


NO
REVISIONS
1 213-01-1 BSA 6-25-01
2 393-03-3 JZ 12-10-03
3 004-05-1 BPS 1-7-05
4 121-07-1 BSA 4-26-07
17. WELD THE DAM BRACKET OF THE DAM ASSEMBLY TO THE DRUM.
WELD ALL BRACKETS TYP.
STANDARD DRUM FLIGHTS
FIRST DAM ASSEMBLY
1/4
18. LOCATE THE NEXT DAM ASSEMBLY TO THE OPEN END OF THE WELDED-IN FLIGHT ASSEMBLIES, AND SPACED FROM THE FIRST DAM ASSEMBLY. TO ACHIEVE THE CORRECT DAM OPENING.
FIRST DAM ASSEMBLY
4" DAM OPENING
NEXT DAM ASSEMBLY
1/4
19. WELD THE DAM BRACKETS OF THE NEXT DAM ASSEMBLY TO THE DRUM.
20. REPEAT STEPS 18 AND 19 UNTIL THE ROW OF DAM ASSEMBLIES ARE WELDED TO THE DRUM.
WELD-IN TYPE FLIGHT KIT FIELD INSTALLATION (ESI)
HAUCK MANUFACTURING COMPANY
Y7100

**APPENDIX:**


STANDARD DRUM FLIGHTS
FIRST ROW
SECOND ROW
6 3/8"
10 3/8 (REF.)
6 (REF.)
WELD ALL BRACKETS (TYP.)
TEMPLATE
22. LOCATE AND WELD THE FIRST SET OF ASSEMBLED FLIGHT BRACKETS IN THE SECOND ROW TO THE DRUM. ENSURE THAT THE CENTERLINE OF THE SECOND ROW ASSEMBLED FLIGHT BRACKETS ARE ALIGNED WITH THE CENTERLINE OF THE FIRST ROW FLIGHTS, AND THAT EACH BRACKET LAYS AS FLAT AS POSSIBLE ON THE DRUM.
21. PROCEED TO INSTALL THE NEXT ROW OF FLIGHTS. PLACE BRACKET SPACING TEMPLATE ⑥ OVER THE ASSEMBLED FLIGHT BRACKETS AND SECURE (HAND TIGHT) WITH WASHERS ⑤ AND NUTS ④ .
REVISIONS
NO. 1 213-01-1 BSA 6-25-01
2 393-03-3 JZ 12-10-03
3 004-05-1 BRS 1-7-05
4 121-07-1 BSA 4-26-07
MELD-IN TYPE FLIGHT KIT
FIELD INSTALLATION
(ESI)
J.A.Z
HAUCK MANUFACTURING COMPANY
Y7100

**APPENDIX:**


MATERIAL FLOW
(COUNTER FLOW DRUM)
DRUM
STANDARD DRUM
FLIGHT
STANDARD
FLIGHT ROW
DAM
FLIGHT
CAPPED END
OF FLIGHT
FIRST INSTALLED
HAUCK FLIGHT ROW
DAM
FLIGHT
SECOND INSTALLED
HAUCK FLIGHT ROW
CAPPED END
OF FLIGHT
MATERIAL FLOW
(PARALLEL FLOW DRUM)
BURNER (ESII)
12 TO 24
4
2
23. REPEAT STEPS 5 THROUGH 20 UNTIL THE NEXT ROW OF FLIGHT AND DAM ASSEMBLIES ARE WELDED TO THE DRUM. REPEAT FOR ADDITIONAL FLIGHT ROW AS REQUIRED WHEN COMPLETED, THE FLIGHT INSTALLATION SHOULD APPEAR AS BELOW.
REVISIONS
NO
1 213-01-1 BSA 6-25-01
2 393-03-3 JZ 12-10-03
3 004-05-1 BRS 1-7-05
4 121-07-1 BSA 4-26-07
HAUCK MANUFACTURING COMPANY
WELD-IN TYPE FLIGHT KIT
FIELD INSTALLATION
(ESII)
Y7100

# DRYER DRUM GAS ANALYSIS FOR NATURAL GAS, OIL AND LP

Gas analyses are used to indicate the air/fuel ratio and to indicate the degree of completeness of combustion. If the mixing is poor, an excess of air must be supplied so that every particle of fuel will contact some air and burn. Unburned fuel is simply wasted since it does not contribute heat to the process.

A critical step in every dryer drum gas analysis is the placement of the sample tube. The applicability of the readings depends directly on the location from which the sample is drawn. To give you an idea of the recommended placement, we have included a drawing in this section. Refer to “Typical Sample Tube Installation for Dryer Drum Gas Analysis”.

The procedures used to make an accurate gas analysis vary not only with the method employed but also with the manufacturer of the equipment. In most instances good readings require that the manufacturers instructions be adhered to rigidly.

Conditions to perform a good analysis.

1. Use a reliable gas analyzer.
2. Sample pipe **must** be installed in the dryer drum to eliminate reading stray $O_2$, overheated RAP, or overheated AC.
3. Sample should be taken with average tonnage, moisture and firing rates.
4. Allow at least 10 to 15 minutes running time at production rates before taking readings.
5. Sample tubing from the sample pipe to the analyzer should be as short as possible. Tubing should be approximately 1/4 inch (6.4 mm) I.D. rubber, plastic, or silicone.
6. Gases should be sampled until instrument settles out, normally a few minutes depending on sample line size, length, and pump volume.

Interpretation of Gas Readings.

**EXAMPLE**

Assuming a drum gas analysis is taken at production rates.
Readings Taken: $O_2$ - 4%
CO - 2000 PPM
Combustibles - 2%

Problem: 4% $O_2$ - is too low
CO - is too high
Combustibles are too high

Solution: **Gradually** reduce fuel flow or increase air flow while watching $O_2$, CO, and combustibles. Typically the following will occur – $O_2$ will increase, CO will decrease, and combustibles will decrease. Reduce fuel until minimal amount of combustibles are present. Then reduce fuel by a small amount for a safety margin.

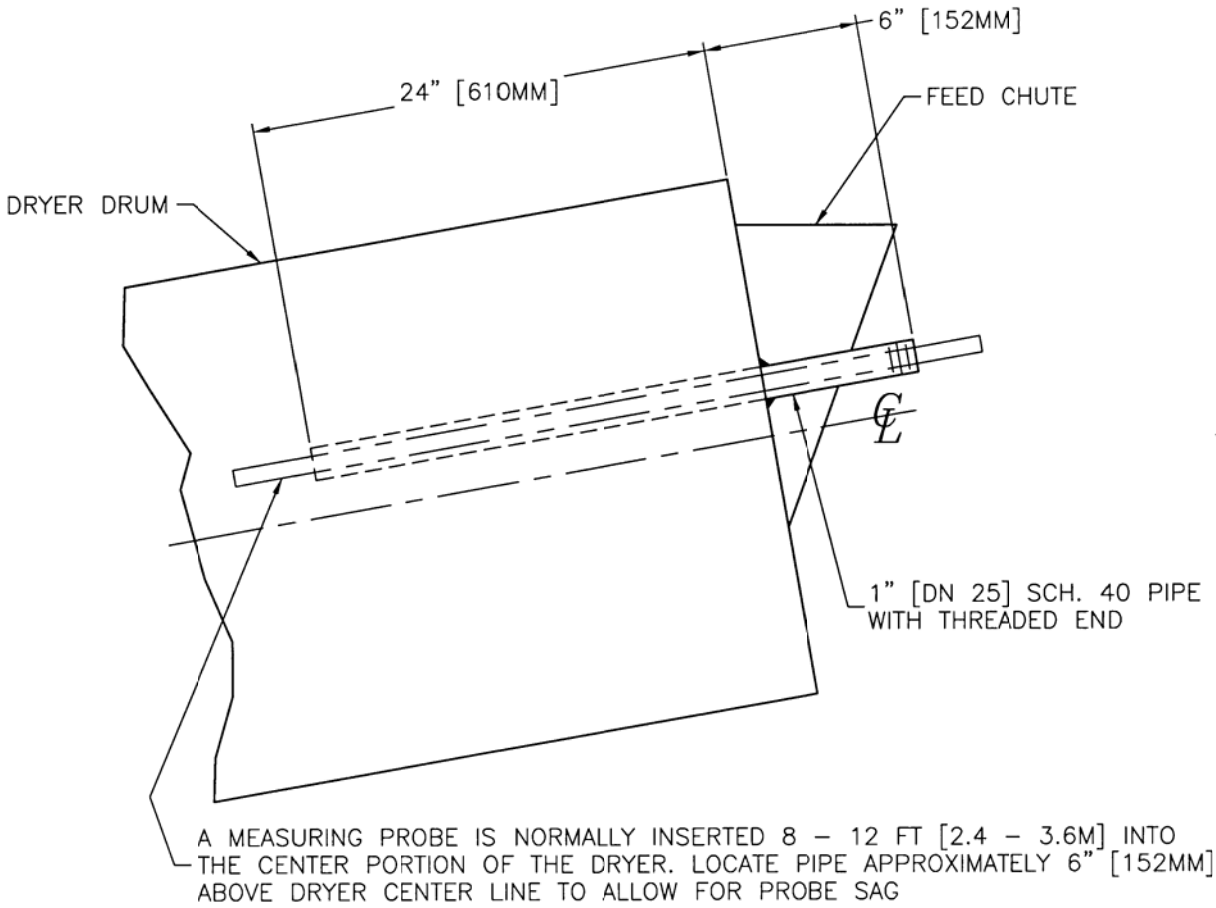
NOTE: Typically some CO and combustibles will always be present.

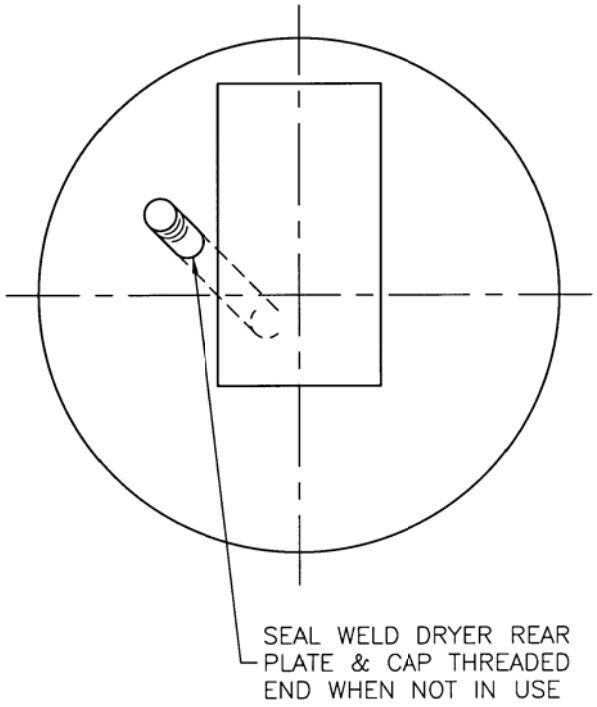
Variables Affecting the Combustion Process.

1. Poor atomization of fuel: Atomizer contamination with particulate. Air passages clogged.
2. Poor oil: Oil laden with particulate and unburnables.
3. Switching fuels: Light to heavy oils, LP to butane.
4. Flame shape.
5. Stray air: Poor drum seals, larger than necessary feed openings, draft to high.
6. Inadequate combustion zone.
7. Material veiling thru flame: Interrupts burning, creating high CO and high combustibles.
8. Overheating RAP or AC.
9. Contaminated material.

# BATCH PLANT

TYPICAL SAMPLE TUBE INSTALLATION FOR DRYER DRUM GAS ANALYSIS



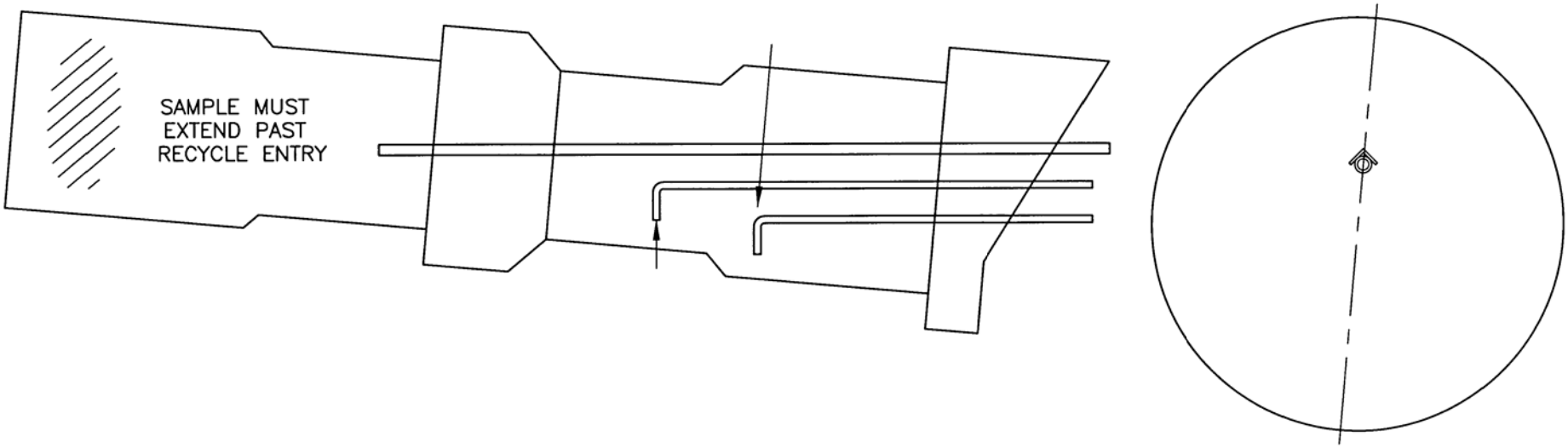




NOTE: 1. IF RECYCLE IN BEING USED, THE SAMPLE PIPE SHOULD BE AHEAD OF THE ENTRY 18 – 24" [460 – 610MM]

W7406
(NOT TO SCALE)

# DRUM MIX PLANT

TYPICAL SAMPLE TUBE INSTALLATION FOR DRYER DRUM GAS ANALYSIS




WELD 1/2" [DN 15] SAMPLE PIPE DIRECTLY ABOVE ASPHALT INJECTION USING 2 – 4" [51 – 102MM] STANDOFFS. EXTEND END OF PIPE 18 – 24" [460 – 610MM] PAST ASPHALT INJECTION, LEAVE APPROXIMATELY 12" [305MM] OF PIPE EXPOSED TO OUTSIDE. BOTH ENDS OF PIPE SHOULD BE THREADED, END INSIDE OF DRYER SHOULD HAVE A 90° ELBOW POINTING DOWN. OUTSIDE END CAN BE CAPPED WHEN NOT IN USE. ANGLE WELDED TO SAMPLE PIPE FROM ASPHALT INJECTION TO 4" [102MM] PAST ELBOW WILL PREVENT WEAR.

NOTE: IF RECYCLE IS BEING USED, THE SAMPLE PIPE SHOULD BE AHEAD OF THE RECYCLE ENTRY 18 – 24" [460 – 610MM].

W7407
(NOT TO SCALE)

# APPLICATION OF ECO-STARII™ OR MEGASTAR™ BURNERS WITHOUT COMBUSTION CHAMBERS ON ROTARY AGGREGATE DRYERS

The dryer combustion zone must be sized to allow full development of the Eco-StarII™ or MegaStar™ burner flame. The burner main air spin adjustment provides flame shaping to meet a variety of combustion zone sizes.

**Combustion Volume**

When applying an Eco-StarII™ or MegaStar™ to a rotary dryer, the flame must not only have the correct volume to burn, but also must be free from any material falling into or through the flame. If material veils or showers through the flame, the fire cools and results in incomplete combustion. Cooling the flame from material impingment is commonly called flame quenching. Quenching will result in several undesirable outcomes. In situations where quenching exists, fuel will not be fully burned. When fuel is not fully burned, efficiency is reduced and emissions of Total Hydrocarbon (THC) and Carbon Monoxide (CO) are significantly increased. Furthermore, on oil fired applications, material contamination can occur if material falls through the oil flame. In short, a combustion zone that has material veil can result in elevated operating costs, increased pollutant emissions and result in scrapped material. Solutions to problems of combustion zone size and material veiling will be addressed in this application sheet.

To prevent veiling, combustion zone flights are required. Welded-in flights are recommended for aggregate dryers. The recommended combustion flights are designed to be low profile for prevention of flight overheating and they provide full radiation shielding to keep the drum temperature to a minimum. Typically, the combustion zone flights are installed in two sets. In long combustion zones, however, additional sets might be needed to keep the individual flight length down to a manageable length (6 ft or less). Hauck does not recommend carrying material. The dam installed in front of each set of combustion zone flights have a 4 inch opening between the dam sections. These openings allow a portion of material to go under the flights to help cool the drum. Flights are available from Hauck to optimize performance of the Eco-StarII™ or MegaStar™ on a rotary dryer; for detailed installation instructions of Hauck weld-in type flights, see Y7100.

On most drums using the recommended combustion flighting, the hottest section of the drum is at the first set of material drying veiling flights. Due to the veiling flights being higher than the combustion flights, little radiation protection exists for that section of the dryer. Temperatures in this area can vary depending on drum diameters and amount of burner spin used. Typically the temperature in this section will be around 500°F and has been successful installed on parallel flow and counter-flow applications. If the application has an overheating problem, a dam or radiation plate can be installed in this area to help reduce temperatures. Drum temperatures in the combustion zone are usually less 500°F to 750°F. Considering that the Eco-StarII™ or MegaStar™ efficiently operates with a slight amount of excess air and produces a 3000°F flame, the recommended combustion flighting works well.

**Combustion Zone Sizing**

The following example demonstrates how to calculate the necessary combustion zone length. (Hauck's e-Solutions for Combustion® Asphalt Heat Balance program is also available).

1. Determine the maximum Btu/hr from the burner capacity sheet necessary; assume burner capacity of 100,000,000 Btu/hr for this example.

2. Take the Btu/hr and divide it by the combustion zone intensity that is desired. (In a normal case, use 250,000 Btu/$ft^3$ ·hr)

   **100,000,000 Btu/hr ÷ 250,000 Btu/$ft^3$ • hr = 400 $ft^3$ of combustion space required.**

3. Determine the effective combustion zone inside diameter(ID). Use the drum diameter in inches minus two times the height of the combustion flights.

   If the drum is 96" in diameter and the flight height is 6", the effective drum inside diameter is:

   **96" - (2 x 6") = 84" effective combustion zone ID.**

4. Use the effective combustion zone ID to calculate the amount of cubic feet per foot of drum length.

   (Effective Combustion Zone ID÷2)$^2$ x 0.02181

   **In The Example:**
   **(84"÷2)$^2$ X 0.02181 = 38.5 $ft^3$ combustion volume / ft drum length.**

5. To determine the drum length required in feet, divide the combustion volume required (see step 2) by the cubic feet per foot of drum (Step 4).

   **400 $ft^3$ ÷ 38.5 $ft^3$ / ft drum length = 10.4ft combustion flighting required.**

For most applications this method produces good results, however for unusual configurations or firing rates the flame lengths for the burners should be checked to ensure that the planned combustion length and diameter is within the burner's capability. (see attached flame length tables).

**Combustion Zone Produces Flame Intensity**

The Eco-StarII™ or MegaStar™ is capable of high flame intensities. Flame intensity is defined as Btu/hr ·$ft^3$ of combustion space. This is determined by finding the Btu/hr firing rate that is used and dividing it by the cubic feet of combustion space available. A normal maximum flame zone intensity is 250,000 to 300,000 Btu/$ft^3$ on natural gas and 175,000 to 250,000 Btu/$ft^3$ on oil firing. Propane fired burners require 150,000 to 200,000 Btu/$ft^3$. This intensity can be higher under ideal conditions, or lower if pollution requirements necessitate very low CO and THC levels. **Ideal conditions mean that the burner chosen will run near its maximum firing capability**. **Running the burner near its maximum capacity will allow for higher efficiency, promote optimum mixing and result in lowest emissions.** Due to the variety of rotary drying applications, the proper number to use for sizing the combustion zone is based somewhat on experience. It is a good idea to consider normal available flame shapes for the size burner that is desired as well.

When sizing a burner and combustion zone for stringent emission regulation applications, allow extra space for the flame to fully combust. Applications that require low CO and THC benefit from larger combustion zones. In situations where (flue gas recirculation) is added to reduce NOx, a larger combustion zone is also helpful. Combustion intensities in these cases will be lower. Do not be concerned when removing several more feet of veiling flighting to complete the combustion flighting as the new combustion flights will allow extra material heating and drying from conductive heat transfer. Veiling flights can be added to make up the difference in the balance of the drum (Consult Hauck).

For example, consider an ESII-100 firing natural gas at 100 MMbtu/hr in an 8 ft diameter drum. First, use 250,000 Btu/$ft^3$ as the combustion intensity and then check to see if the flame fits into the available combustion zone. This is a 9 ft long x 5 ft diameter flame @ 30° spin in an 8 ft. diameter dryer which appears reasonable. Consideration must be made for combustion flights. For instance, an 8 ft. drum becomes 7 ft if the combustion flights are 6 inches high. Thus the required combustion length using 7 ft diameter = 10.4 ft long (see combustion zone sizing example). This arrangement will probably produce 300 to 600 ppm of CO @ 7% $0_2$. In a 10 ft diameter drum, the calculated combustion zone would be too short at only 6.3 ft long. A length of 6.3 ft is shorter than the recorded flame length at full spin of 8ft. long for natural gas (See Flame Dimension sheets for the Eco-StarII™ or MegaStar™). If on the same example the CO requirement was below 500 ppm, then the combustion zone should be more generous to ensure that all the flame is contained in the non-veiling zone. The maximum flame length must be checked against the calculated combustion zone length.

Burner mounting is determined by the type of plant and the fuel used. The Eco-StarII™ or MegaStar™ comes standard with a nose that can be inserted into most drums to prevent overheating of the breech plate. Insertion depth depends on the fuel and the configuration of the inside of the dryer. If there are any inside projections, such as an overhead discharge, make sure the burner is inserted far enough to be even with or slightly past the overhead discharge. On oil, the burner may need to be inserted 6 to 12 inches past the internal discharge chute, or on gas, it is possible to insert the burner even with the chute. For dryers without internal projections, the Eco-StarII™ or MegaStar™ only needs to be installed 12 to 18 inches past the breech plate on gas or propane firing. Oil fired burners should be inserted 18 to 24 inches from the breech plate. These distances, on most plants, produce acceptable breech plate temperatures in the 300-550°F range except on extremely well sealed plants, or when the high swirl (Shortest) flame is required. Breech overheating can be usually remedied by sliding the burner further into the drum or by installing stainless steel radiation shielding plates on the inside of the breech plate if the burner cannot be moved into the drum. Make provisions to slide the burner into the dryer when installing the burner on the drum.

**Please Note The Following Important Considerations:**

1. Flight spacing of 1/4 inch between flights is important in keeping the combustion zone drum shell temperatures to a minimum. The drum shell should not be exposed directly to the flame. If the drum is exposed, as in the case of uneven flight spacing or missing flights the drum shell temperature in that area could run over 600°F.

2. Dams must be used on the upstream side of the flight. The dams on the upstream end of the flights allow a small amount of material to go under the flight thru the dam openings provided. Each set of flights will have a dam upstream of it.

Flame Shape For Eco-StarII™ or MegaStar™ Burners (Dimensions in Feet)

| Size | Spin Setting (degrees) | Oil Compressed Air Atomization | | Oil Low Pressure Atomization | | Gas | | Liquid Propane | | Nominal Firing Rate @ 25% XSA (MMBtu/hr) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Length | Diameter | Length | Diameter | Length | Diameter | Length | Diameter | |
| ES 25 | 0 | NA | NA | 14 | 2.75 | 13 | 2.5 | 12 | 3 | 35 |
| | 45° | NA | NA | 8 | 3.5 | 8 | 4 | 8 | 3 | 34 |
| | 60° | NA | NA | 8 | 4 | 7.5 | 4.5 | 8 | 3.5 | 33 |
| ES 50 | 0 | NA | NA | 14 | 3 | 15 | 3 | 12 | 3 | 62 |
| | 45° | NA | NA | 10 | 4 | 12 | 4 | 9 | 3.75 | 63 |
| | 60° | NA | NA | 7 | 5.5 | 7 | 6 | 7 | 6 | 60 |
| ESII 75B | 0 | 11 | 4 | 14.5 | 5 | 15 | 5 | 13 | 4.5 | 75 |
| | 30° | 8 | 7 | 13 | 5 | 13.5 | 6.5 | 14 | 5 | 75 |
| | 45° | 6 | 7 | 10 | 7.5 | 8.5 | 8 | 12 | 7 | 75 |
| ESII 100B | 0 | 15 | 4 | 18 | 5.5 | 15 | 5 | 19.5 | 5 | 100 |
| | 30° | 11 | 5.5 | 12 | 7 | 9 | 5 | 17 | 5 | 100 |
| | 45° | 8 | 7 | 7 | 9 | 9 | 8 | 7 | 10 | 100 |
| ESII 125B | 0 | 12 | 4 | 9 | 4.5 | 15 | 6 | 15 | 5 | 125 |
| | 30° | 10 | 5 | 8 | 4.75 | 11 | 8 | 12.5 | 6 | 125 |
| | 45° | 6 | 6.5 | 6 | 8 | 8 | 8 | 10 | 6 | 125 |
| ESII 150B | 0 | 9 | 6 | 11 | 7 | 16 | 6 | 15.5 | 6.5 | 150 |
| | 30° | 8 | 7 | 9.5 | 7 | 11 | 6 | 14.5 | 6.5 | 150 |
| | 45° | 5 | 9 | 5 | 10 | 10 | 7.5 | 9.5 | 8 | 150 |
| ESII 175B | 0 | 16 | 6.5 | 15 | 6.5 | 19 | 7 | 13 | 6 | 175 |
| | 30° | 10 | 6.5 | 11 | 7 | 15 | 8 | 14 | 5 | 175 |
| | 45° | 9 | 7 | 10 | 7.5 | 14 | 9.5 | 13 | 7.5 | 175 |
| ESII 200B | 0 | 18 | 6.5 | 17 | 6 | 20 | 7 | 15 | 5 | 200 |
| | 30° | 12 | 7 | 14 | 8 | 14 | 9 | 14 | 6 | 200 |
| | 45° | 10 | 8 | 10 | 8.5 | 14 | 10 | 14 | 7.5 | 200 |

## Capacity Correction Table

## Eco-StarII™ or MegaStar™ Burners At Altitude

| Altitude Above Sea Level (ft) | Air Specific Gravity | Atomizing Blower | | Capacity @ 60HZ (MMBtu/hr) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pressure At Altitude (osi) | Pressure Required At Sea Level (osi) | ES 25 | ES 50 | ESII 75B | ESII 100B | ESII 125B | ESII 150B | ESII 175B | ESII 200B |
| 0 | 1 | 36.0 | 32 | 34 | 63 | 77 | 102 | 128 | 153 | 179 | 204 |
| 500 | .98 | 35.4 | 33 | 33 | 62 | 75 | 100 | 125 | 150 | 175 | 200 |
| 1000 | .97 | 34.9 | 34 | 33 | 61 | 74 | 99 | 124 | 148 | 173 | 198 |
| 1500 | .96 | 34.4 | 35 | 33 | 60 | 73 | 98 | 122 | 147 | 171 | 196 |
| 2000 | .94 | 33.9 | 35 | 32 | 59 | 72 | 96 | 120 | 144 | 168 | 192 |
| 2500 | .93 | 33.4 | 37 | 32 | 58 | 71 | 95 | 119 | 142 | 166 | 190 |
| 3000 | .91 | 32.9 | 38 | 31 | 58 | 70 | 93 | 116 | 139 | 163 | 186 |
| 3500 | .90 | 32.4 | 39 | 31 | 57 | 69 | 92 | 115 | 138 | 161 | 184 |
| 4000 | .89 | 32.0 | 40 | 30 | 56 | 68 | 91 | 114 | 136 | 159 | 182 |
| 4500 | .87 | 31.5 | 42 | 30 | 55 | 67 | 89 | 111 | 133 | 155 | 178 |
| 5000 | .86 | 31.0 | 43 | 29 | 54 | 66 | 88 | 110 | 132 | 154 | 176 |
| 5500 | .85 | 30.5 | 44 | 29 | 53 | 65 | 87 | 108 | 130 | 152 | 173 |
| 6000 | .84 | 30.1 | 46 | 28 | 53 | 64 | 86 | 107 | 129 | 150 | 171 |
| 6500 | .82 | 29.6 | 47 | 28 | 52 | 63 | 84 | 105 | 126 | 146 | 167 |
| 7000 | .81 | 29.2 | 48 | 28 | 51 | 62 | 83 | 103 | 124 | 145 | 165 |
| 7500 | .80 | 28.7 | 50 | 27 | 50 | 61 | 82 | 102 | 122 | 143 | 163 |
| 8000 | .79 | 28.3 | 52 | 27 | 50 | 60 | 81 | 101 | 121 | 141 | 161 |
| 8500 | .77 | 27.8 | 53 | 26 | 49 | 59 | 79 | 98 | 118 | 138 | 157 |
| 9000 | .76 | 27.4 | 55 | 26 | 48 | 58 | 78 | 97 | 116 | 136 | 155 |
| 9500 | .75 | 27 | 57 | 25 | 47 | 57 | 77 | 96 | 115 | 134 | 153 |
| 10000 | .74 | 26.6 | 59 | 25 | 46 | 57 | 76 | 94 | 113 | 132 | 151 |
| 10500 | .73 | 26.2 | 60 | 25 | 46 | 56 | 74 | 93 | 112 | 130 | 149 |
| 11000 | .72 | 25.7 | 63 | 24 | 45 | 55 | 73 | 92 | 110 | 129 | 147 |
| 11500 | .70 | 25.3 | 64 | 24 | 44 | 54 | 71 | 89 | 107 | 125 | 143 |
| 12000 | .69 | 24.9 | 67 | 24 | 44 | 53 | 70 | 88 | 106 | 123 | 141 |
| 12500 | .68 | 24.5 | 70 | 23 | 43 | 52 | 69 | 87 | 104 | 121 | 139 |
| 13000 | .67 | 24.1 | 71 | 23 | 42 | 51 | 68 | 85 | 103 | 120 | 137 |
| 13500 | .66 | 23.8 | 73 | 22 | 42 | 51 | 67 | 84 | 101 | 118 | 135 |
| 14000 | .65 | 23.4 | 76 | 22 | 41 | 50 | 66 | 83 | 99 | 116 | 133 |
| 14500 | .64 | 23.0 | 78 | 22 | 40 | 49 | 65 | 82 | 98 | 114 | 131 |
| 15000 | .63 | 22.6 | 80 | 21 | 40 | 48 | 64 | 80 | 96 | 113 | 129 |

1. Altitude limitation for 36 osi blower is 2500 ft for heavy oil and 4500 ft for light fuel oil. Above these altitudes, use blower altitude kit or compressed air atomization; consult Hauck. For ES25 and ES50, the blower altitude kit is the only available option for high altitude installations.

2. Atomizing blower pressure required at sea level can be used to select appropriate blower pressure required at sea level in order to achieve the equivalent sea level capacity at a given altitude.