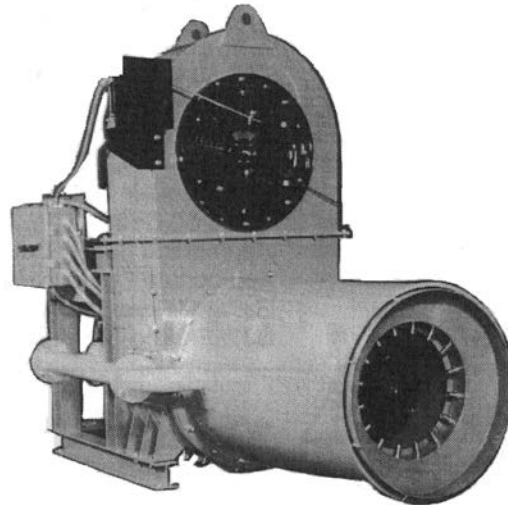




ECO-STAR™ BURNER ES-25 – ES-50



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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These instructions are intended to serve as guidelines covering the installation, operation, and maintenance of Hauck equipment. While every attempt has been made to ensure completeness, unforeseen or unspecified applications, details, and variations may preclude covering every possible contingency. **WARNING: TO PREVENT THE POSSIBILITY OF SERIOUS BODILY INJURY, DO NOT USE OR OPERATE ANY EQUIPMENT OR COMPONENT WITH ANY PARTS REMOVED OR ANY PARTS NOT APPROVED BY THE MANUFACTURER.** Should further information be required or desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, contact Hauck Mfg. Co.

SECTION 2: OPERATION

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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.

SECTION 1: INSTALLATION

A. 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.



WARNING

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

B. DIMENSIONS

Eco-Star™ burner and fuel rack dimension drawings are located in the appendix.

CY6931 – Dimensions, ES-25 through ES-50

CY5493 – Dimensions, Rack Mounted Fuel Manifold ES-25 through ES-50

C. COMPONENT IDENTIFICATION

For Eco-Star™ burner component identification, see drawings CY6932 for ES-25 through ES-50 located in the appendix.

D. 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 vailing 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 flights and keeping the flights as low as possible to the drum. Consult Hauck for details on flight design and combustion zone requirements. See drawings Y7100 in appendix, for dimensions and installation recommendations.

See Hauck Application Sheet GJ75 for additional data on applying an Eco-Star™ on a rotary dryer.

E. MOUNTING BURNER

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 appendix. The support structure must be able to support the weight of the burner (see table 1). If the fuel rack and primary Turbo Blower are to be mounted on the same structure as the burner, allow for the additional weight. Consult Hauck for recommended burner mounting options. Choose a suitable location for the fuel rack and primary TBA blower. The pipe rack should be firmly attached to the base structure or concrete pad. The rack is supplied with mounting holes in the base angle iron. See appropriate dimensional drawing in the appendix for dimensions. Consult TBA blower instruction sheet for proper mounting instructions for the primary 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 Fiberglass Turbo Blower is also supplied with lifting eyes on the blower frame. Do not use the motor lifting eye to lift the entire fiberglass blower unit.

Eco-Star™ Approximate Burner Weights

Model No.	25	50
Pounds*	1850	2750

Table 1

(*does not include TBA blower, valve trains or piping)

3. The burner can be ordered with a split-mounting flange that can be bolted onto the dryer breech plate. This allows positioning the burner at various insertion depths past the breech plate. Typical burner insertion depth is 18" to 24". Cut out a hole in the breech plate 2 inches 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" due to the amount of radiant heat in an oil flame depending on the application.

Model No.	25	50
Part No.	56546x	56547x

Table 2

**Eco-Star™ Burner Split mounting flange
(Mounting plate OD can be specified with order)**

4. To provide visual flame observation, Hauck recommends installing an observation port, part #53849, in the drum bulkhead. (Available separately)
5. Bolt the burner to the support structure.
6. Wire the main fan motor and the turbo blower motor per instructions on the motor.
7. 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 correctly rotating. As a rule of thumb, the main blower rotates counterclockwise viewing from the motor side. The fiberglass blower rotates toward the outlet connection.**

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.

F. FUEL MANIFOLD INSTALLATION.

The Eco-Star™ burner system is supplied with a modular fuel rack. The fuel rack has all modulating fuel valves mounted on it. In addition to modulating fuel valves, the rack hosts the automatic oil and LP shut-off valves. Consult PGM-9 for instructions on installation of a Hauck Prepipd Gas Manifold.

IMPORTANT

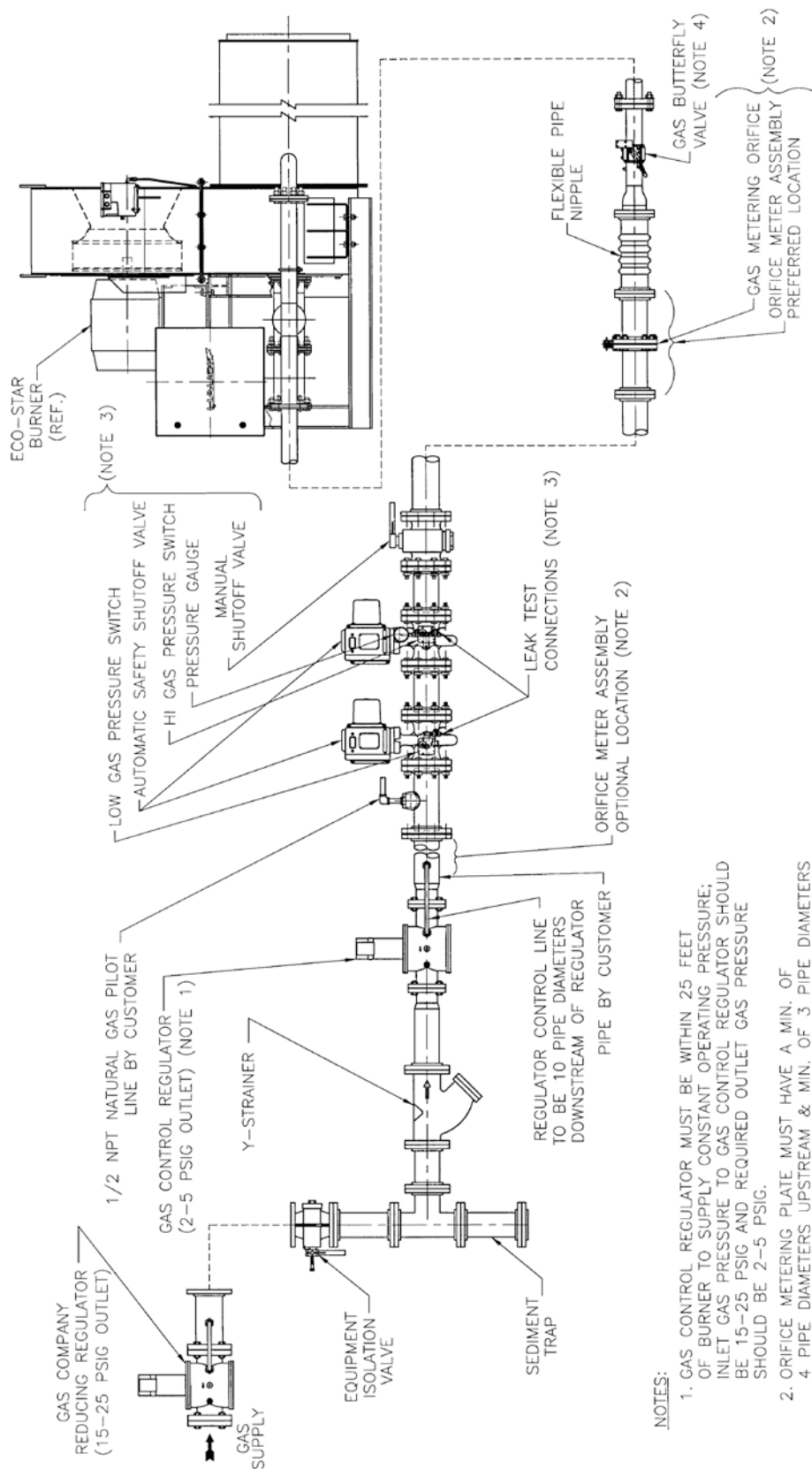
Fuel manifolds must be mounted in a horizontal position. Safety shut-off valves will not function properly mounted vertically. Liquid fuel manifolds should not be mounted above the burner centerline.

Oil and LP manifold should be mounted as close to the burner as possible. For heavy fuel applications (any fuel requiring heating for use), Hauck, in addition to an adequate heating system, recommends using insulation and heat trace to maintain proper temperatures for achieving oil viscosity of 90 SSU or less. Fuel temperature should not exceed 250°F (120°C). Oil viscosity should be checked prior to burner operation. Consult Hauck for oil applications above 250°F.

Hauck recommends the use of solid pipe to connect fuel manifolds to the burner fuel inlets. Schedule 40 iron pipe is recommended for natural gas and oil systems. LP applications **REQUIRE** the use of schedule 80 (350 psi) pipe and fittings.

All fuel manifolds and associated piping must be leak-tested. All leaks must be repaired before operating the burner.

G. NATURAL GAS FUEL PIPING SYSTEM



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. ORIFICE METERING PLATE MUST HAVE A MIN. OF 4 PIPE DIAMETERS UPSTREAM & MIN. OF 3 PIPE DIAMETERS DOWNSTREAM IN STRAIGHT, UNOBSTRUCTED LENGTH (PREFERRED LOCATION IS RECOMMENDED).
3. PART OF PREPARED GAS MANIFOLD.
4. PART OF GAS RACK MOUNTED MANIFOLD.

Y6953
(NOT TO SCALE)

Figure 1

NOTE

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

Eco-Star™ Burner Recommended Prepiped Gas Manifold

PGM Part Number	47389	47391
Eco-Star™ Model#	25	50

Table 3

1. Install a controlling gas regulator in the main gas line within 25 feet of the burner. For good control, supply 15-20 psig to this regulator. This regulator should be sized to provide the required gas flow at the inlet of the burner manifold; 2 to 5 psig is the nominal gas pressure required at the burner. Exact gas pressure must be set at the initial start-up depending on piping configuration, burner size, and maximum capacity desired.
2. A manual shutoff valve and gas strainer must be installed upstream of the gas control regulator and automatic safety shutoff valves to ensure compliance to NFPA standards. The strainer protects the regulator and shutoff valves from dirt which can cause the regulator components to malfunction and the shutoff valves to fail. It is also recommended that a manual shutoff valve be installed upstream of the gas strainer to facilitate servicing of the downstream components.
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 1)

IMPORTANT

Install a flexible fitting in the gas manifold to reduce flexing of the manifold resulting from plant vibrations.

Eco-Star™ Burner Recommended flexible pipe nipples

FPN Model Number	800598	800598
Eco-Star™ Model#	25	50

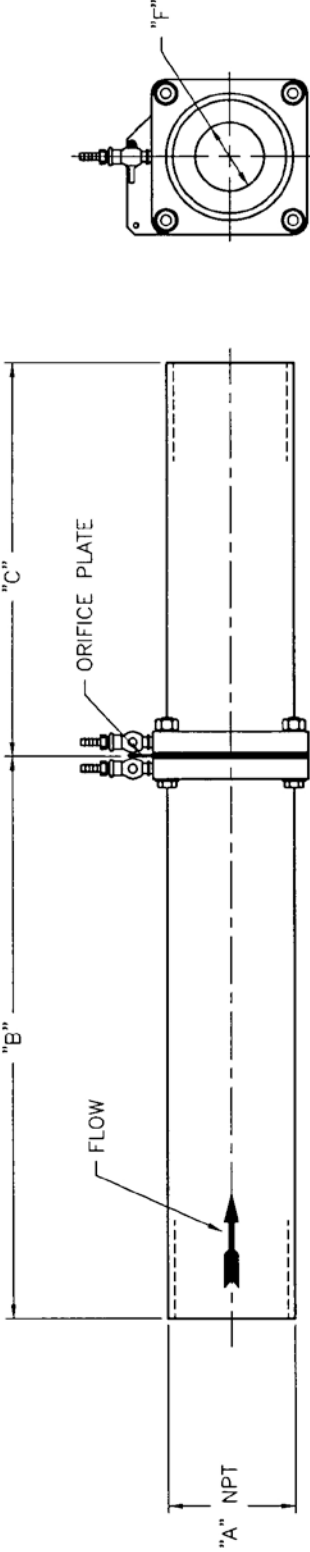
Table 4

5. The piping from the gas regulator outlet to the burner gas manifold should be sized to minimize pressure losses. See chart GL86FA, figure 3, for pipe pressure losses.
6. Install the OMG orifice section in a suitable location (refer to figure 1). The location should be such that the metering section is close to the burner as well as being accessible. See figure 2 for dimensions of the orifice section. Avoid placement of the OMG in areas that will provide turbulence or obstruction of flow, such as near elbows or valves.

Eco-Star™ Burner Natural Gas Orifice Meter Assemblies

OMG P/N	54140x001	54140x002
Eco-Star™ Model#	25	50

Table 5



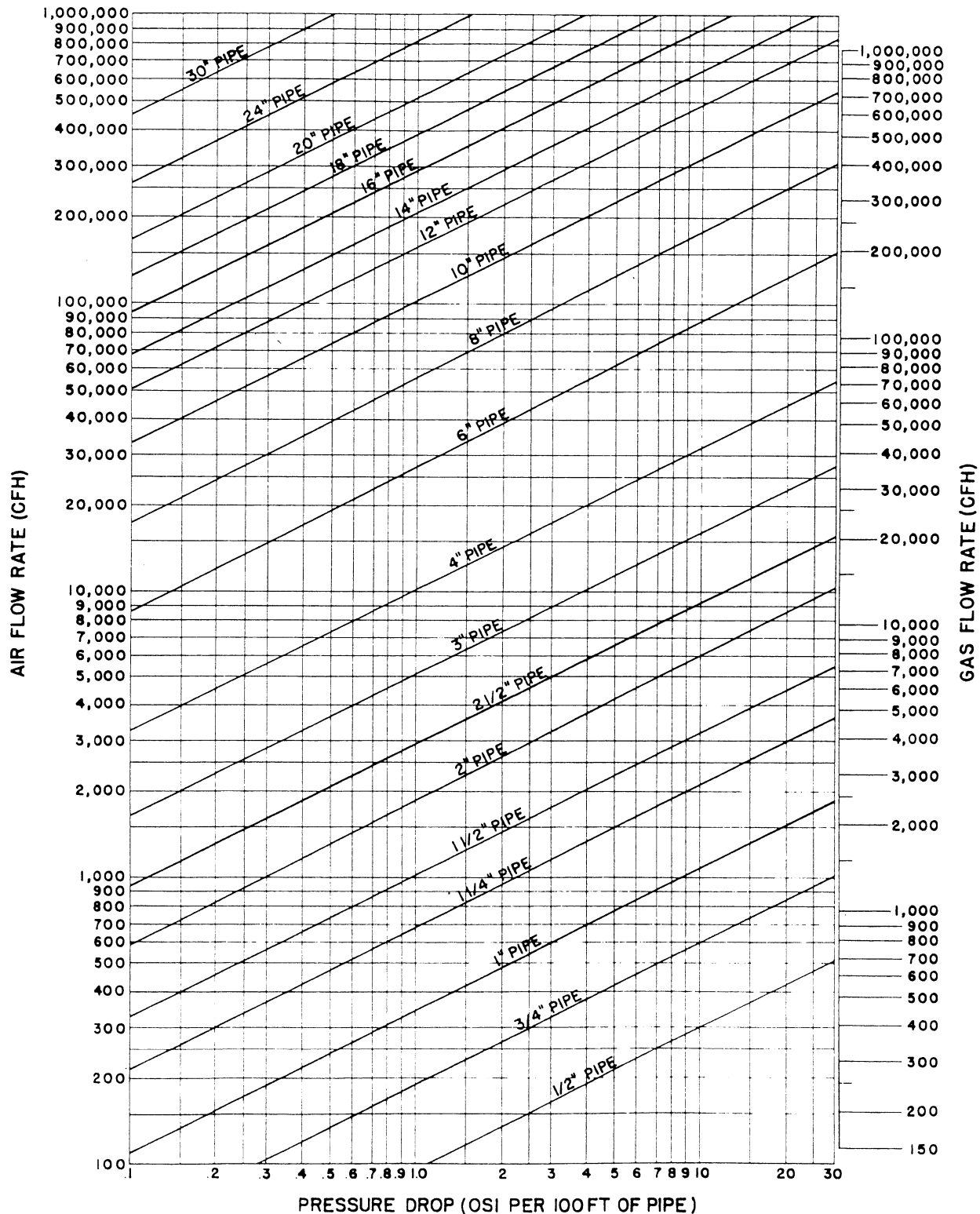
CX5364
(NOT TO SCALE)

ES-25 & ES-50

MODEL NO.	"A"	"B"	"C"	"D"	"E"	"F"
ES-25	4	20	14	--	--	3.154
ES-50						

Figure – 2 Orifice Meter Location And Dimensions

SIMPLIFIED FLOW CHART
NATURAL GAS & AIR



GL86FA
@ Near Atmospheric Conditions
Figure - 3 Simplified Gas and Air Flow Chart

H. LIGHT OIL FUEL PIPING SYSTEM

NOTE

Hauck requires the use of oil manifolds that meet NFPA guidelines. NFPA requires two shutoff valves piped in series in the burner's main oil line. A low oil pressure switch must be interlocked with the burner's shutoff valves.



WARNING

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

RECOMMENDED FLEXIBLE HOSE SIZE

ES 25-50
½" Hauck PN 11078

Table 6

MINIMUM PIPING SIZES FOR HAUCK OIL SUPPLY PUMPING UNITS

	Discharge Piping, Light Oil Up to 100SSU			Return Piping, Light Oil UP to 100SSU			Return Piping Heavy Oil		
	Up to 25'	25' - 49'	50' - 100'	Up to 25'	25' - 49'	50' - 100'	Up to 25'	25' - 49'	50' - 100'
Eco Star Burner									
25	¾"	¾"	¾"	¾"	¾"	1"	1"	1 ¼"	1 ¼"
50	1"	1"	1 ¼"	1"	1 ¼"	1 ¼"	1 ¼"	1 ½"	2"

Table 7

Light and Heavy Oil Fuel Pressures

Eco-Star™ Burner	Nominal Oil Pressure
ES-25	65 psi
ES-50	60 psi

Table 8

1. For recommended piping sizes see table 7. Before attaching fuel lines, purge the piping to remove scale and dirt that could clog and damage oil equipment.
2. Adjust the pressure relief valve until the required oil pressure is achieved. See table 8 for approximate settings. Final oil pressure will have to be adjusted to attain desired burner output.
3. The low oil pressure switch is factory set at 15 psig. This setting may have to be adjusted higher or lower depending on the lowest oil pressure operating point.
4. Check piping for oil leaks and repair as necessary. Do not operate the burner until all fuel leaks are repaired.

5. A manual low fire bypass oil control valve is set to maintain the low fire oil flow at the burner. See the individual burner performance sheets for start-up setting. To clean this valve, note the pointer position, then turn the handle to the clean position. Return the handle to the desired set position.

NOTE: This should not be done while the burner lit.

6. The burner oil flow control (metering) valve is usually set to travel from Position 0 to Position 9. High fire oil flow can be set with fuel pressure, or restroking the oil valve. See the individual burner performance sheets for fuel flow data.

NOTE

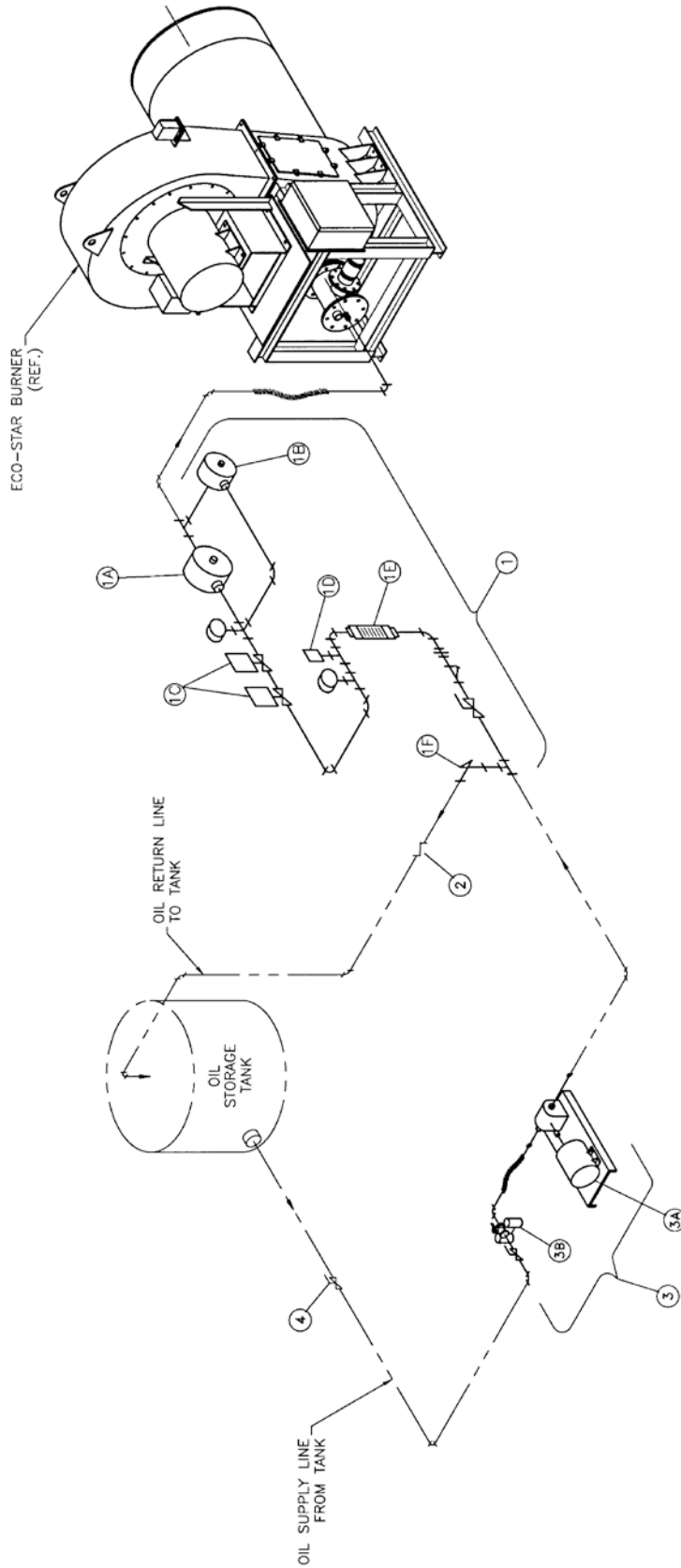
These settings are for initial set-up only. Final settings will have to be readjusted for required operation.

7. Oil flow rates can be checked with the in-line oil flow meter on the burner fuel rack.

NOTE: The flow meter glass can be rotated to view the scale.

Typical Light Oil Piping Schematic

ITEM NO.	DESCRIPTION
1	OIL MANIFOLD
1A	OIL METERING VALVE
1B	LOW FIRE OIL VALVE
1C	OIL SAFETY SHUTOFF VALVE
1D	LOW/HIGH OIL PRESSURE SWITCH
1E	FLOW METER
1F	PRESSURE CONTROL VALVE
2	CHECK VALVE
3	OIL SUPPLY PUMPING UNIT
3A	ROTARY PUMP AND MOTOR
3B	DUAL OIL BASKET STRAINER
4	OIL SHUTOFF VALVE



X6951
(NOT TO SCALE)

- NOTES:
1. OIL MANIFOLD IS PART OF RACK MOUNTED MANIFOLD.
 2. OIL TO BE SUPPLIED TO INLET OF OIL MANIFOLD AT 40-70 PSI.
 3. OIL SUPPLY PUMPING UNIT SHOULD BE SELECTED WITH CAPACITY OF 1 1/2 TIMES BURNER RATING.

Figure 4

I. HEAVY OIL 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.

Heated fuel oil and piping can burn you! 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 fuel.

NOTE

Hauck requires the use of oil manifolds that meet NFPA standards. NFPA requires two shutoff valves piped in series in the burner's main oil line. A low oil pressure switch must be interlocked with the burner's shutoff valves. When preheated oil is used, a low oil temperature limit switch must be interlocked with the burner's shutoff valves. Hauck's oil manifolds are designed to meet NFPA standards. Hauck recommends the use of a "Heavy Oil Kit" whenever heavy oil is used. The components of the heavy oil kit are identified in figure 5. **Heavy oil must be heated for proper atomization to occur.**

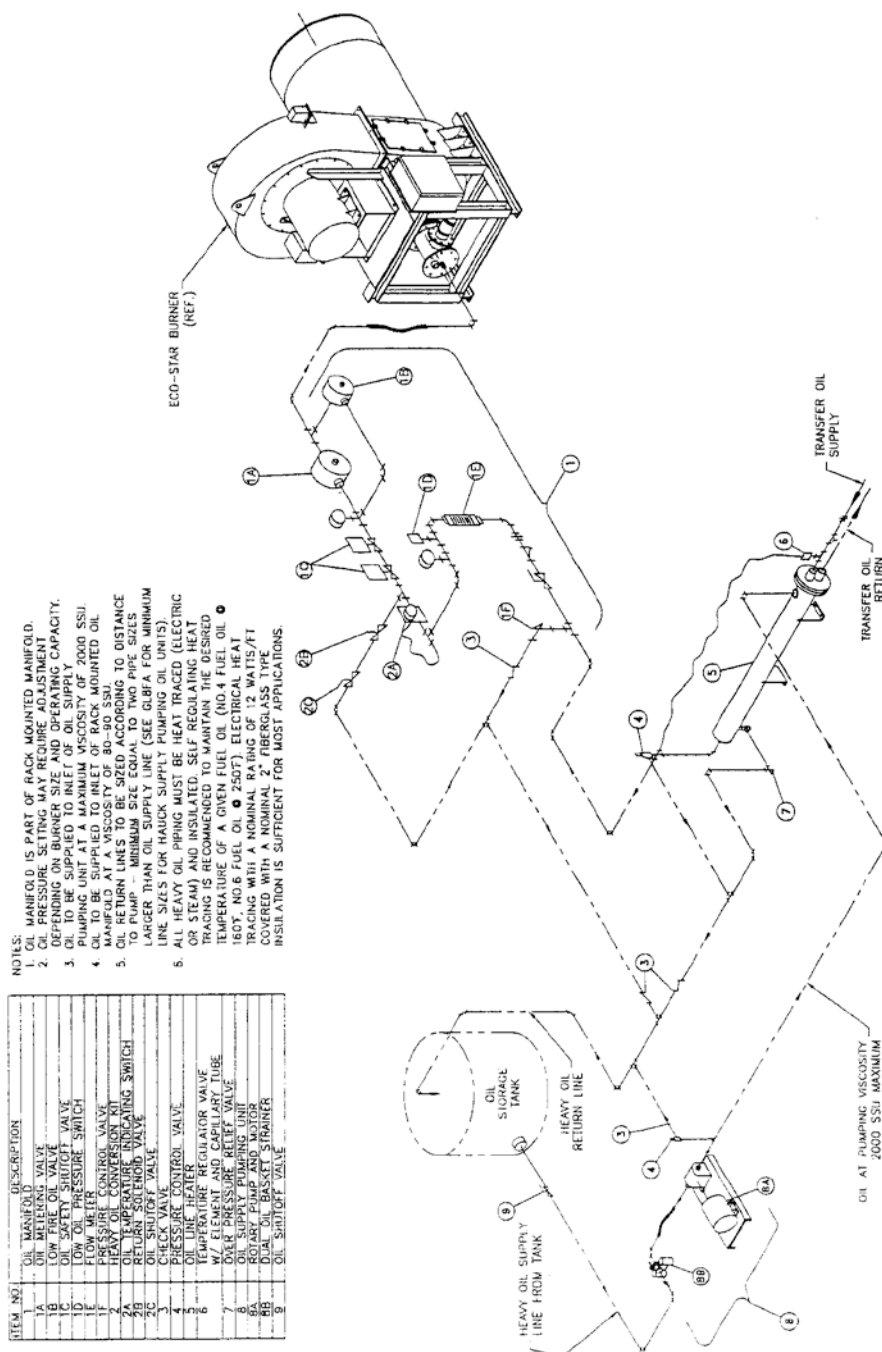
HAUCK RECOMMENDS THAT ALL PIPING BE INSULATED WITH A FIBERGLASS TYPE STEAM-PIPE COVERING. HEAT TRACE MAY BE NECESSARY FOR LONG PIPING RUNS. SELF REGULATING TRACING FOR #6 OIL SET AT 250°F OR #4 OIL SET AT 150°F ARE TYPICAL STARTING POINTS

1. For heavy oil recommended pipe sizes see table 7 in Section H. Purge the lines before attaching them to the fuel manifold oil inlet. Refer to CY5493 for inlet/outlet locations.
2. Proper fuel viscosity is required for satisfactory atomization and combustion of heavy oil. The viscosity of the oil must be 80 to 90 SSU. Use the Hauck Viscometer kit (Part# 36931) to determine proper oil temperature to achieve this viscosity. Refer to the instructions that were 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 oil heater temperature regulator and the indicating low oil temperature switch (located on the burner oil manifold) to the temperature determined in item 2 above.
4. Adjust the pressure 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.
5. The burner oil flow control (metering) valve is usually set to travel from Position 0 to Position 9. High fire oil flow can be set with fuel pressure, or by re-stroking the oil valve. See the individual burner performance sheets.

NOTE
These settings are for initial set-up only. Final settings will have to be readjusted for required operation.

6. There is a manual low fire bypass oil control valve that is set to maintain the low fire oil flow at the burner. See the individual burner performance sheets for initial settings.
7. The low oil pressure switch is factory set at 15 psig. This setting may have to be adjusted higher or lower depending on the lowest oil pressure operating point.

Typical Heavy Oil Piping Schematic



X6950
(NOT TO SCALE)

Figure 5

J. LIQUID PETROLEUM (LP) GAS PIPING SYSTEM

LP gas or Butane is supplied to the Eco-Star™ burner in a liquid form and is vaporized as the fuel exits the burner nozzles.

RECOMMENDED FLEXIBLE HOSE SIZE TO CONNECT TO BURNER

ES-25/50
½" Hauck PN 45754

Table 9



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 slowly. LP or Butane in its liquid state can cause freezing and severe injury.

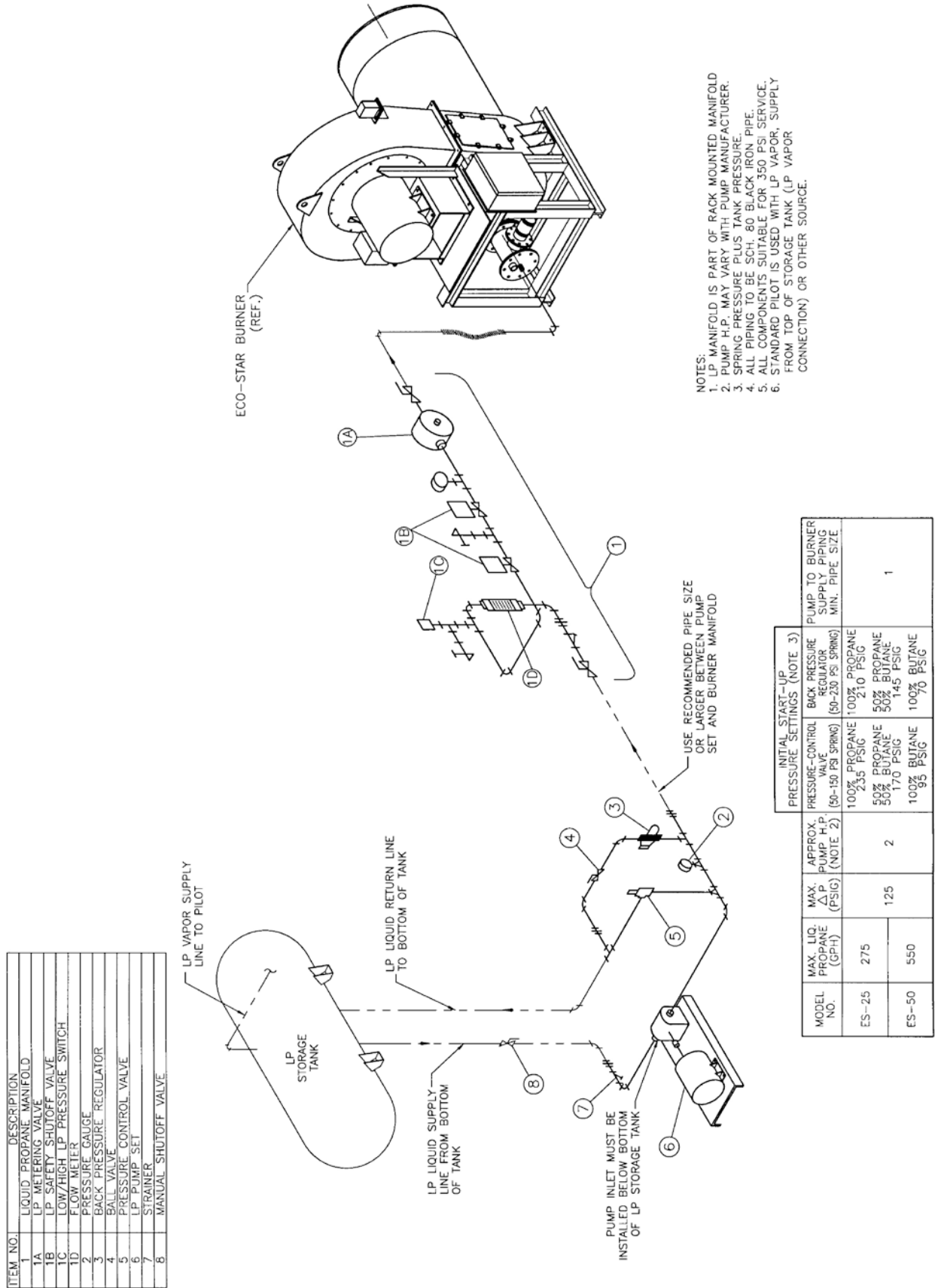
Hauck does not recommend installation of a line-reducing regulator in the LP supply line. If the regulator diaphragm ruptured, total system pressure would be applied to the burner and could result in damage to equipment, including the baghouse, and result in serious injury to personnel.

NOTE

Hauck requires the use of fuel manifolds that meet NFPA standards. NFPA requires two fuel shutoff valves wired in series and a shutoff cock downstream of the second (blocking) shutoff valve and a low LP pressure switch that is interlocked with the burner's shutoff valves.

1. 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 9 for recommended flex connection.
2. Purge the piping before attaching the fuel lines.
3. Use schedule 80 black iron pipe, valves and fittings rated for 350 psig service for all liquid propane lines.
4. Consult the LP pump instructions for proper pump installation and setup.

LP Piping Schematic



- NOTES:
1. LP MANIFOLD IS PART OF RACK MOUNTED MANIFOLD PUMP H.P. MAY VARY WITH PUMP MANUFACTURER.
 2. SPRING PRESSURE PLUS TANK PRESSURE.
 4. ALL PIPING TO BE SCH. 80 BLACK IRON PIPE.
 5. ALL COMPONENTS SUITABLE FOR 350 PSI SERVICE.
 6. STANDARD PILOT IS USED WITH LP VAPOR, SUPPLY FROM TOP OF STORAGE TANK (LP VAPOR CONNECTION) OR OTHER SOURCE.

X6952
(NOT TO SCALE)

Figure 6

CAUTION

Hauck strongly recommends that a Flo-Control valve **and** a backpressure regulator be installed in all LP systems and piped as shown in CX6952. All components must be rated for 350 psi for LP use.

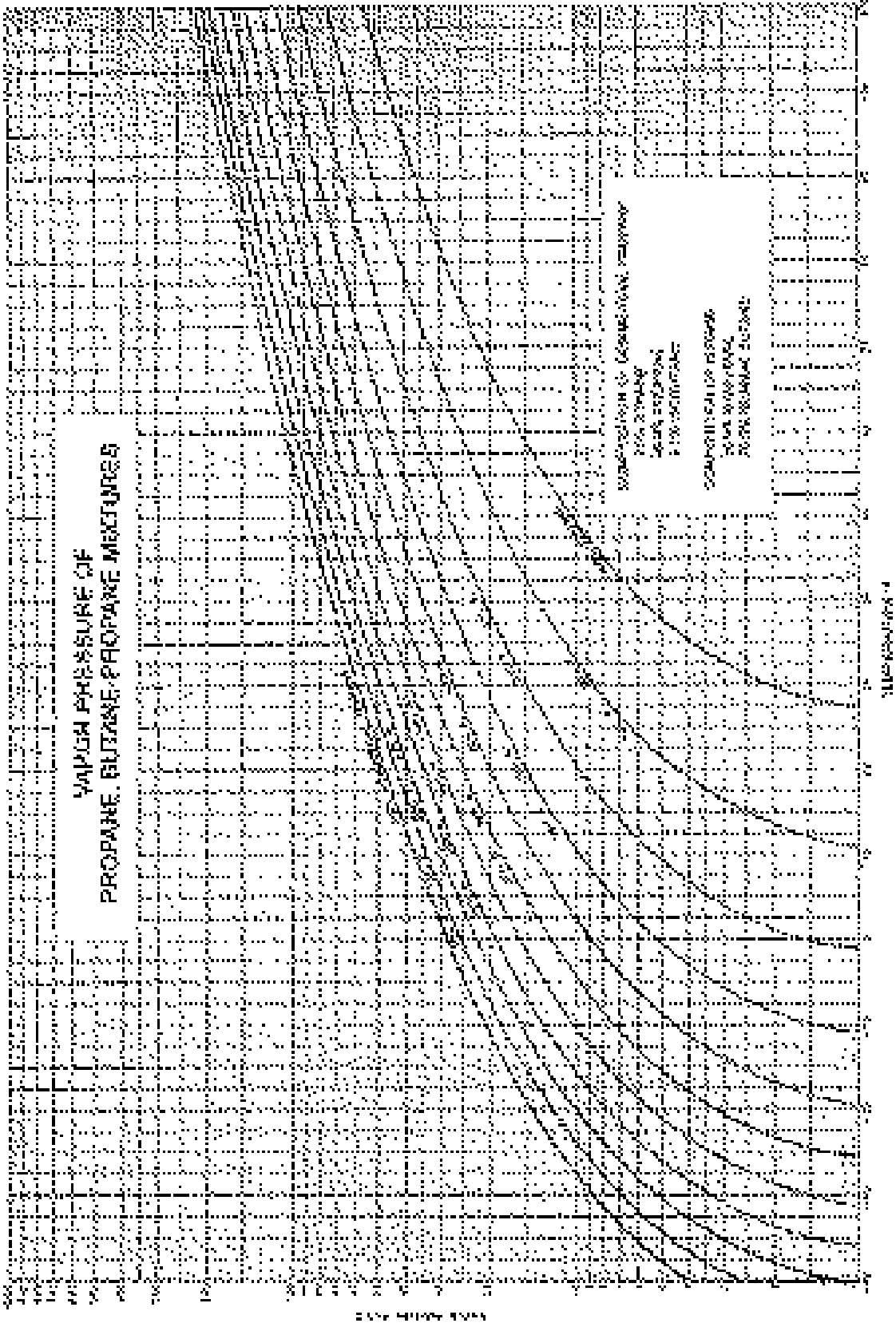
NOTE

The system in drawing CX6952 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.

5. After completing piping, check for leaks using accepted standards and practices. **Do not operate the system until all leaks are repaired.**
6. Adjustment of LP supply pressure:
 - a. Close the ball valve downstream of the back pressure regulator to temporarily take the regulator out of the system.
 - b. Adjust the pump bypass valve for an initial setting of 100 psig above the maximum expected tank pressure. **Constantly monitor the pump motor amp draw. Always stay within the pump amp rating.**
 - c. To adjust the back pressure regulator, open the ball valve downstream of the back pressure regulator and adjust the regulator to an initial setting of 50 psig above the maximum expected tank pressure.
 - d. The low pressure switch setting should be approximately 15 psig below the back pressure regulator setting.
 - e. Check with your LP supplier for the exact maximum expected tank pressure for your fuel.

NOTE

These settings are for initial set-up only. Final settings will have to be readjusted for temperature and required operation.



LP Pressure Temperature curve
Figure 7

7. The burner LP flow control (metering) valve is set based on flow required from low to high fire. See attached individual burner performance sheets for initial settings. Ice downstream of the flow control valve at low fire indicates that the pressure drop through the valve is too high. If icing occurs, increase the low fire setting on the metering valve slightly until ice disappears. If the low fire setting is too high for the process requirements, then the propane nozzle orifice size may need to be reduced. If reduction is required, consult Hauck for proper sizing. High fire fuel flow can be set by adjusting fuel pressure, or by re-stroking the modulating fuel valve. See the individual burner performance sheets for specific fuel pressures, flows and valve settings.
8. 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 mix, be sure to specify the fuel when ordering and consult with Hauck engineering for specific nozzle hole sizes.
9. The Eco-Star™ utilizes a multi-port LP nozzle assembly positioned around the primary air tube. Atomizing air 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.

**Recommended LP Fuel Pressures
(Burner Supply Pressures)**

Tank Temp. Maximum °F	100% Propane	50/50	Butane
70	175	125	75
80	190	140	80
90	215	160	85
100	230	172	95

Table 10

K. BURNER PILOT CONNECTION

The Eco-Star™ incorporates a forced air pilot system. The pilot and ultraviolet flame supervisory detectors, UV scanners, are factory mounted and wired. The flame detectors need no adjustment or aiming and are ready for use as supplied. The pilot air is provided from the backplate of the atomizing air connection.

1. Before connecting to the pilot assembly fuel line, the fuel line should be purged to remove any dirt. Pipe the pilot gas supply line to the inlet of the pilot shutoff valve, check for leaks. Size the pilot gas supply line to avoid excessive pressure drops. See table 11 for recommended pipe size.

Recommended Pilot Line Sizes

Length of Pilot Fuel Line	Pipe Size
0 — 25'	1/2"
25 — 100'	3/4"

Table 11

2. Constant gas pressure up to 5 psig must be available at the inlet of the Hauck gas pilot manifold. Note: The gas pressure must not exceed 20 psi.

- The spark wire gap is factory set at 1/8". This gap can be changed by carefully removing the pilot internals. Bend the spark wire to adjust, reinsert, and check the gap. The thickness of a nickel can be used as a gauge for adjusting the spark gap.

Eco-Star™ Pilot System

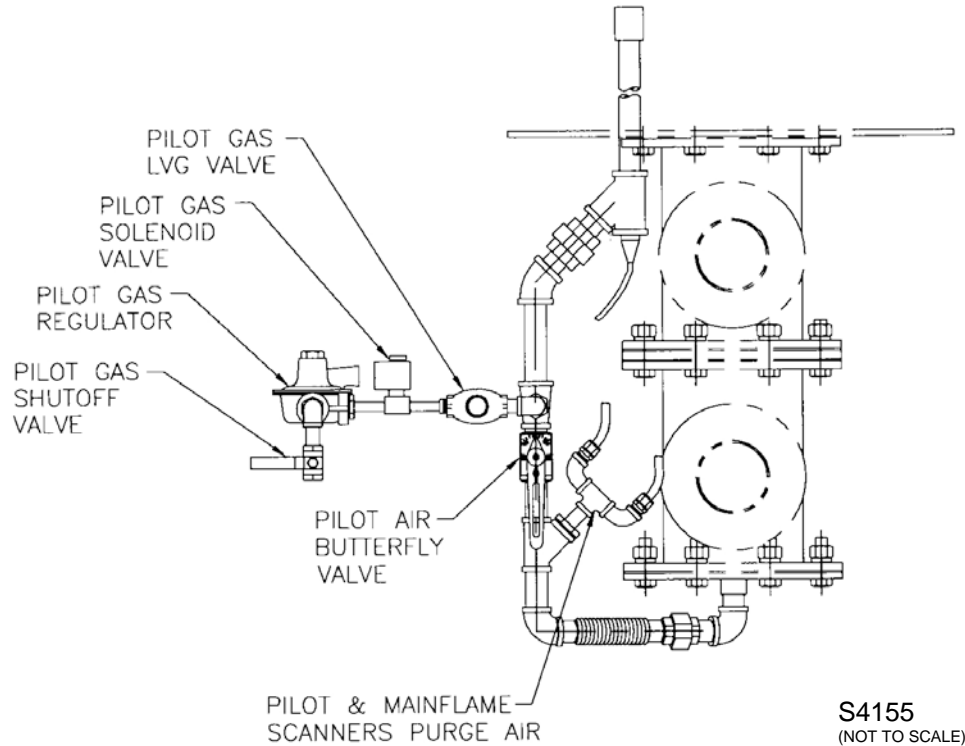


Figure 8

L. PRIMARY AIR

Primary air is used for improved mixing at low fire on gas and LP, and for atomizing oil fuel. Hauck supplies a TBA Turbo Blower for primary air supply. The primary air blower is supplied with an outlet flange to meet 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.

SECTION 2: OPERATION



WARNING

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

M. GENERAL INFORMATION

The Eco-Star™ Burner is designed for maximum economy and ecological benefit. Economical benefits include higher combustion efficiency, multi-fuel capability, and ease of installation and start-up. The Ecological benefits are lower noise levels and lower pollutant emissions. In conjunction with the main air attenuator, the Eco-Star™ is one of the quietest burners available. The Eco-Star™ Burner is a sealed-in Combustion System that provides all necessary combustion air, ensuring that sufficient air plus 20% excess air is available for efficient operation at rated capacity. Flame length and width is adjustable to fit many different dryer configurations.

Fuel/Air ratio is maintained throughout the burner's operating range with electronically linked air and fuel valves.

The Eco-Star™ will burn all commercial grades of fuel oil, natural gas, and liquid propane. The burner provides a nominal 7:1 turndown from the maximum firing rate.

NOTE

The Eco-Star™ is supplied with Honeywell type C7027A ultraviolet flame detectors. If an alternate flame detector is required, consult Hauck.

N. BURNER CAPACITIES

Burner Model	SCFH Burner Air	Integral Burner Blower (Hp)	Primary Air Blower Model	SCFH Primary Air	Primary Air Blower (HP)	Nominal Btu Rating
ES-25	410,000	20	TBA-36-10	20,000	10	25
ES-50	720,000	30	TBA-36-10	20,000	10	50

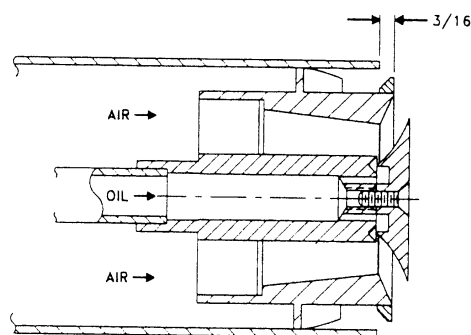
Table 12

1. Burner capacity is based on 60Hz power and SCFH (Standard Cubic Feet per Hour) 70°F air at sea level. Correction factors must be applied for altitude or temperature variations. Consult Hauck for assistance, if required. An altitude correction table is available in Hauck Application Sheet GJ75.
2. Viscosity of oil delivered at the burner must be 80 to 90 SSU.
3. The dryer exhaust fan must be large enough to provide a slight negative pressure (suction in the range of 0.25 — 1" wc) at the burner breech plate to exhaust the products of combustion.

4. Eco-Star™ 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 20" wc will be required for this measurement. Air flow at a given body pressure can be obtained from the burner data tables or fan curves located in the appendix.
5. All burners are supplied with fuel flow measuring devices. Liquid fuel racks are supplied with an inline flow meter. Burners equipped with a gas orifice meter 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 0-20 inches of water column. Readings can be related to gas flow using chart Q754 in the appendix.
6. Atomizing air for the Eco-Star™ is provided by a 36 osi Hauck high efficiency Turbo Blower. This high-pressure air is used to atomize liquid fuels and improve mixing speed with all fuels. The Turbo Blower also supplies pilot air.

O. FUEL OIL ATOMIZER

The position of the fuel oil atomizer affects its ability to atomize the oil. The atomizer should be positioned as shown below.



ES-25 & ES-50

Figure 9 – Eco-Star™ Atomizer Position

To change the oil atomizer 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. Notice the present orientation of the oil nozzle in the burner. Determine if the oil atomizing nozzle must be moved in or out to maintain the proper distance. (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 Oil Atomizing 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".

7. Once the proper positioning of the atomizer is completed:
 - a. Tighten the jam nut.
 - b. Attach the Oil Atomizer Assembly to the oil manifold, using the union provided.
 - c. Open the manual oil valve. Check for leaks using accepted practices.

P. PROPANE NOZZLE

With the propane nozzle properly installed, the propane nozzle assembly should not interfere with the main flame detector, pilot flame detector or pilot nozzle. Consult Hauck for propane nozzle installation and maintenance instructions.

Q. BURNER PILOT SYSTEM

The Eco-Star™ incorporates a forced air pilot system. The pilot and ultraviolet flame detectors (UV scanners) are factory mounted and wired. The flame scanners need no adjustment or aiming and are ready for use as supplied. The pilot air is provided from the backplate of the atomizing air connection.

NOTE

See Section 1, Part K; Burner Pilot Connection, for illustration of pilot assembly and configuration.

1. Before connecting to the pilot assembly, the fuel line should be purged to remove any dirt. Pipe the pilot gas supply line to the inlet of the pilot shutoff valve, check for leaks. Size the pilot gas supply line to avoid excessive pressure drops. For pilot gas supply lines up to 25 feet, use 1/2" pipe.
2. Constant gas pressure up to 5 psig must be available at the inlet of the Hauck gas pilot manifold. Note: The gas pressure must not exceed 20 psi.
3. The spark wire gap is factory set at 1/8". This gap can be changed by carefully removing the pilot internals. Bend the spark wire to adjust, reinsert, and check the gap. The thickness of a nickel can be used as a gauge for adjusting the spark gap.
4. Complete the initial pilot adjustment as follows:
 - a. Make sure the spark igniter is connected to the ignition transformer.
 - b. Place the pilot air butterfly valve at 1/2 open (position 5).
 - c. Remove the aluminum hex cover on the Hauck Adjustable Gas Limiting Valve (LVG) and rotate the adjustment screw 3 to 5 turns from the FULLY CLOSED position. This initial recommended setting may be changed during the final adjustment of the pilot. Clockwise adjustment will close the valve orifice.
 - d. Remove the protective cover of the pilot gas regulator and rotate the adjustment screw until the scale on the regulator indicates that it is one-half open. This is only a preliminary setting and may also be changed to provide optimum pilot performance.
 - e. Once a good spark is established at the pilot nozzle, adjust the gas LVG (and if necessary the air valve) until a good strong pilot is obtained.

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.

R. OPERATION

1. The Eco-Star™ uses one control motor for the fuel valves, and another for the combustion air blower inlet damper.
2. The combustion air inlet damper valve must open for purging the system before lightoff, the safety limits must be satisfied, and the purge proof 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 passages (including the baghouse and flue stack). **For most applications, the air damper will travel from position 0 at low fire to the fully open position at high fire.**
3. Set the low gas pressure switch to an initial setting of ½ psig.
4. Set the high gas pressure switch to an initial setting of 5 psig.
5. The fuel valve linkage must be adjusted for proper flow control. See individual burner performance sheets for air and fuel flows.
6. Before light off, the combustion air inlet damper valve must be at the low fire position. (The contacts in the combustion air switch must be set to close at 2" wc.) The low fire fuel limit switches, located on the fuel rack, 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.**

S. ADJUSTMENTS



WARNING

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

1. In order to drive the control motors and set linkage and travel, consult burner control panel instructions.
2. The spin vane adjustment affects the flame shape and combustion intensity. Spin set at 30° will produce a long narrow flame; a spin setting of 60° will produce a short wide flame. For most situations, the spin should be in the mid to low range (40°-50° on indicator). For a very short flame, in a large diameter combustion zone, the spin can be set on maximum (60° on indicator). Caution is advised as overheating of the combustion flights or drum could occur when using maximum spin. A longer flame can be obtained by adjusting the spin to 30°. Check the flue gas to make sure the flame is not so long that it is going into the vailing zone of the dryer (this can result in incomplete combustion, high CO and high Hydrocarbon readings in the flue gas).
3. During the adjustment process take flue gas measurements to verify that complete combustion is taking place (see Application Sheet GJ73 for general information on conducting flue gas analysis).
4. Make sure all linkage adjustment rod setscrews are tightened sufficiently to prevent slipping.

T. MAINTENANCE

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

1. Check and lubricate all points of valve linkage. Mark linkage so any slippage will be seen.
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 in dusty conditions) remove and clean the burner oil tube and nozzle assembly by the following procedure. **Refer to Section O for nozzle settings.**

- 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 oil, remove the nozzle and soak it in a good solvent to loosen the oil deposits. Scrape the nozzle body and holes (if necessary), using wooden tools only, being careful not to damage machined parts. A plastic bristle brush can be used.
 - e. Reassemble the nozzle, reattach nozzle to primary air tube; then attach the burner backplate to burner body.
 - f. Check to make sure the atomizing oil nozzle is at the proper position inside the burner.
3. Periodically check all safety equipment, such as pressure switches and solenoids, to make sure they are not clogged with dirt, or in any way inoperative.
 4. Ultraviolet (UV) flame detectors should be inspected periodically to keep them clean of dirt and dust.
 5. A yearly check of impeller and fan balance is recommended.

NOTE

The main blower impeller should be balanced whenever the wheel or motor are removed or replaced. Refer to drawing CW6245.

6. Eco-Star™ fan impellers are equipped with wear resistant impeller blades. However, effort should be made to minimize dust flow into the fan impeller. Excessive dust may cause premature wearing of impeller blades and burner parts in addition to unbalance 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 10 for installation instructions.

IMPORTANT

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

- 8. Periodically check air/fuel ratio to ensure that the burner is operating at peak efficiency. Flue gas analysis can be performed with the Hauck FGA flue gas analyzer.

MODEL NO.	"A"
ES-25	1/8
ES-50	9/64

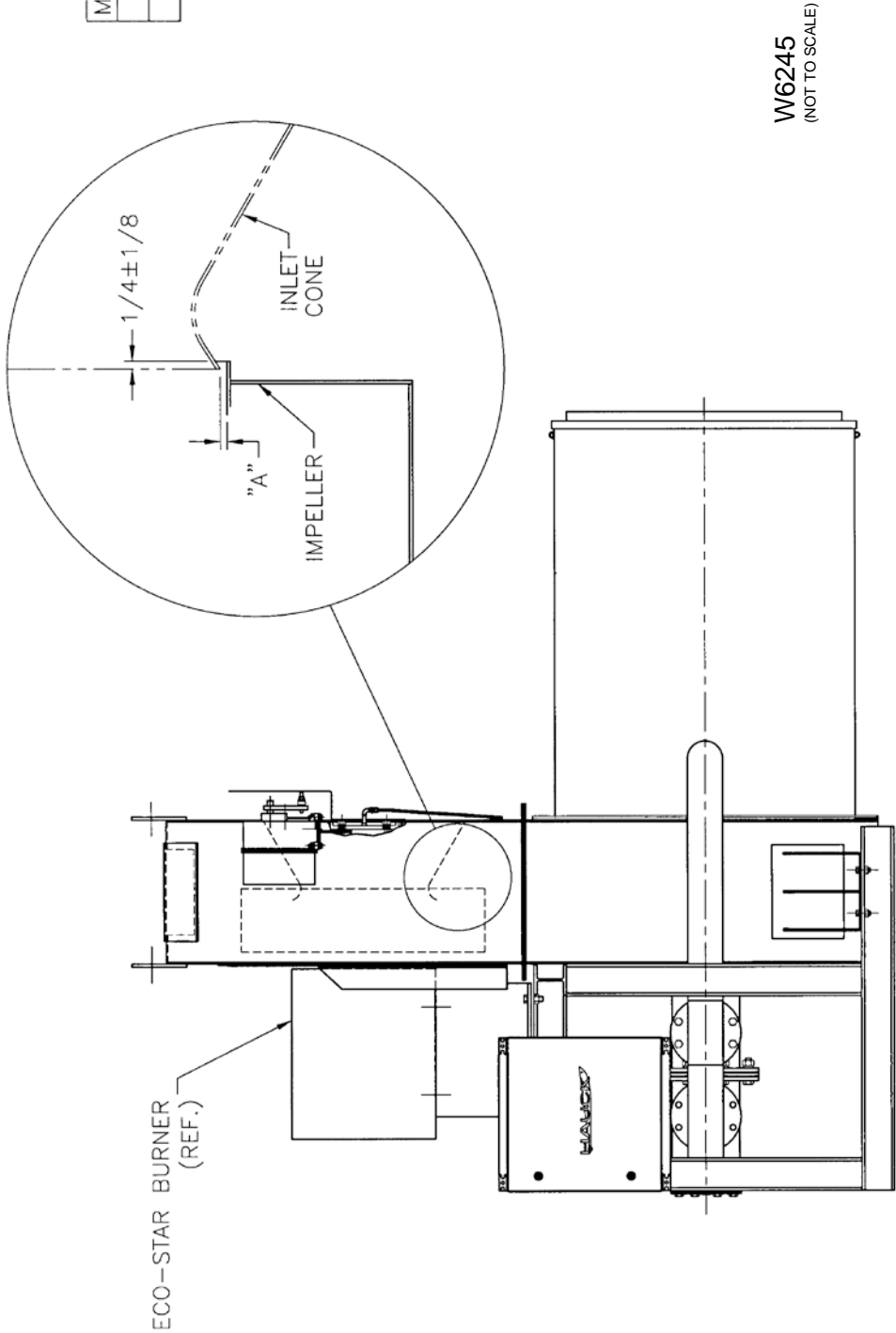


Figure 10
Proper impeller position on motor shaft.

U. RECOMMENDED SPARE PARTS

Item	Qty.	Part No.	Description
1	1	41814	Converter, Barber Colman #659B (SEE NOTE BELOW. THIS PART IS USED ON BURNERS BUILT BEFORE 6/98)
2	1	16847	Motor, Barber Colman #EA57 (fuel motor)
3	1	20627	Motor, Barber Colman #EA71 (air motor) (SEE NOTE BELOW)
4	2	20579	UV Detector C7027A-1049
5	1	84447822	Air Pressure Switch, Combustion Air & Purge Air 1.-20" w.c.
6	1	84447832	Air Pressure Switch, Primary Air 12-60" w.c.

Table 13

For convenience, the above spare parts are available from Hauck as the "EcoStar™ Spare Parts Kit", part # 71485.

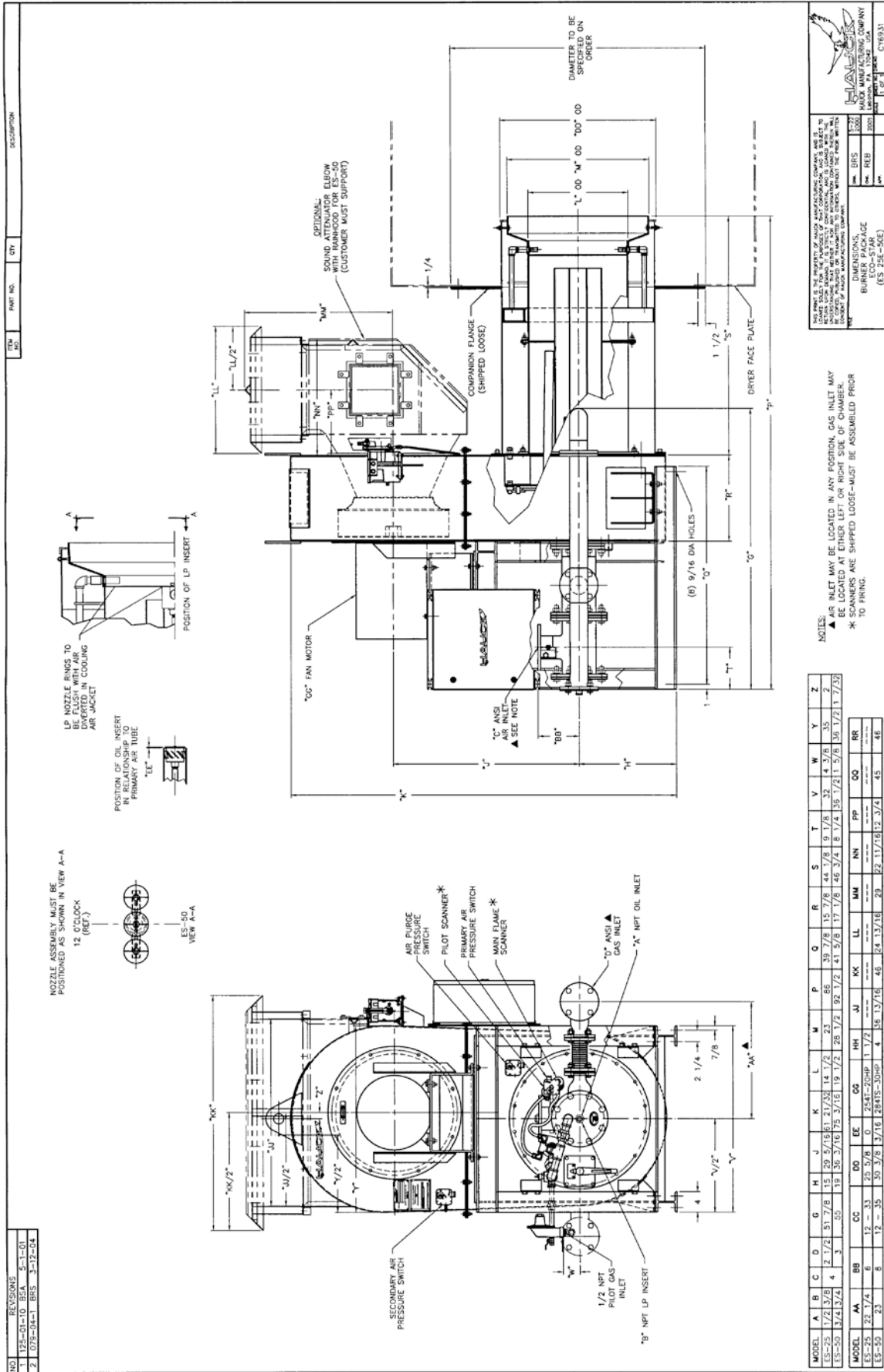
NOTE

The Barber Colman #659B Converter is not required for systems that use the Hauck BCS 5000 OR BCS 3000H control systems.

The Hauck BCS 3000H Control System uses a signal conditioner for motor positioning. Part Number 61838.

For early model burners (Built before 1993), consult factory for control motor model & part number)

APPENDIX:



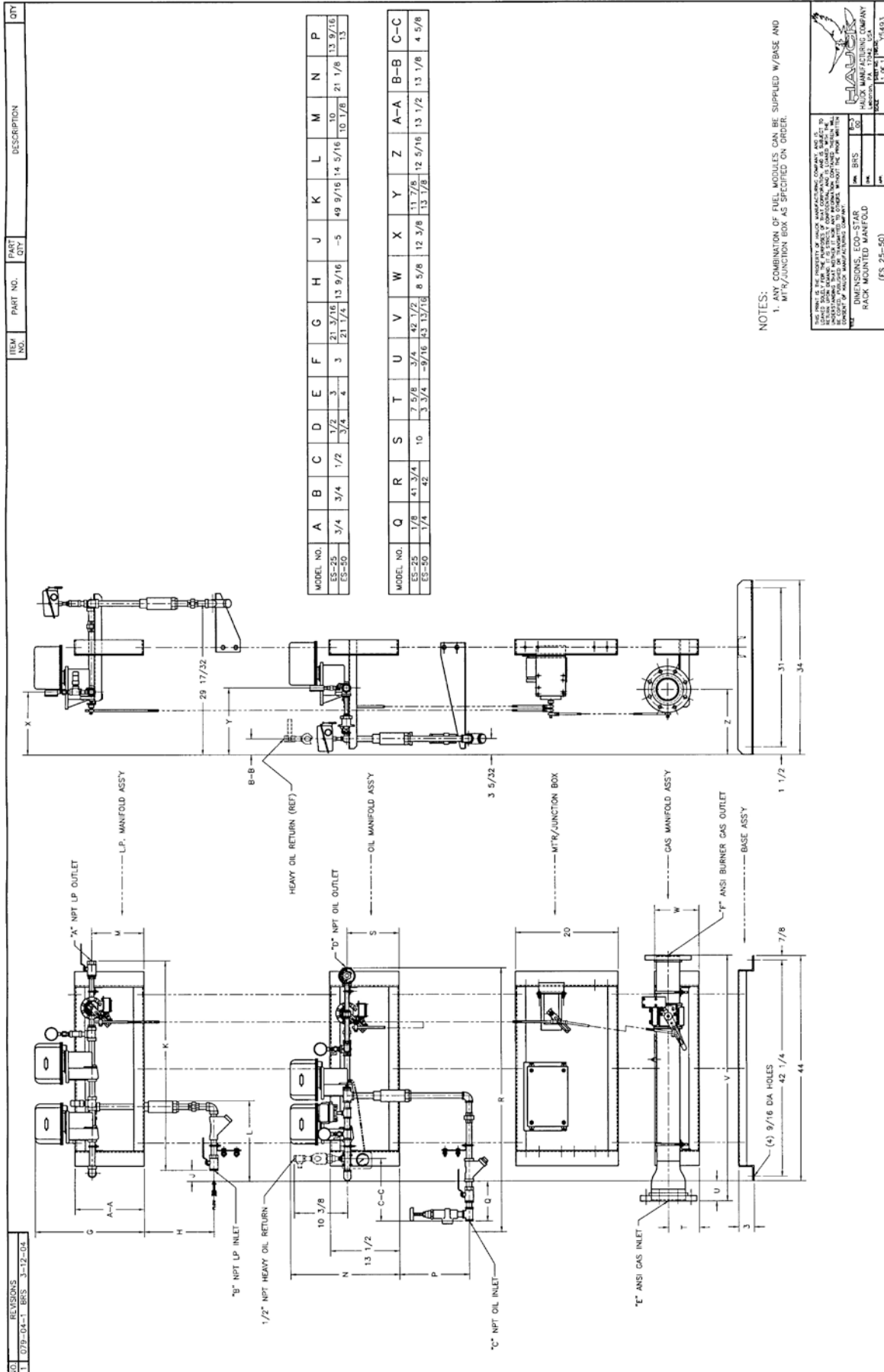
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DATE: 03/12/04
 DRAWN BY: BNS
 CHECKED BY: BNS
 APPROVED BY: BNS

DIMENSIONS: DIMENSIONS IN INCHES
 BURNER PACKAGE
 ECO-STAR
 (ES 25-50)

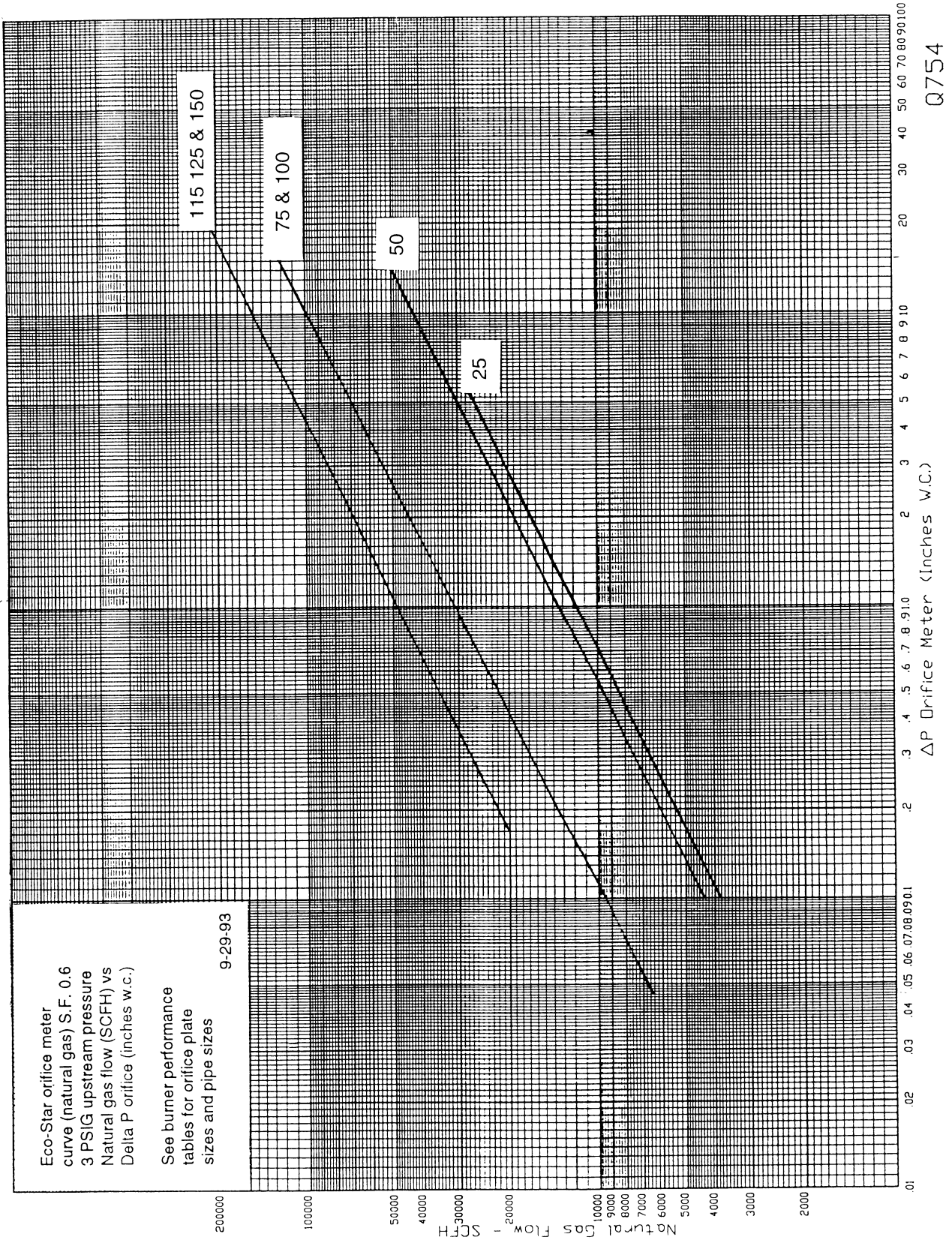
HADCO MANUFACTURING COMPANY
 1000 W. 10TH ST. SUITE 100
 DENVER, CO 80202
 TEL: 303.733.1111
 FAX: 303.733.1112
 C-06931

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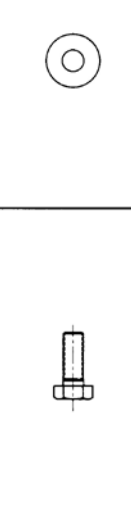
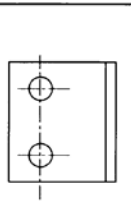
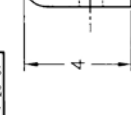


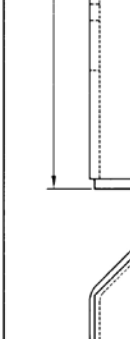
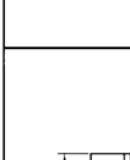
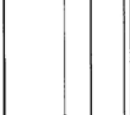
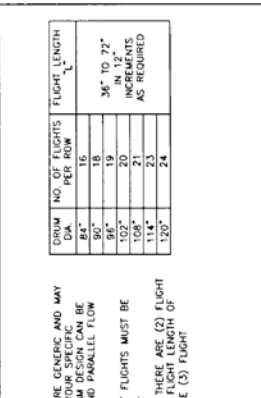
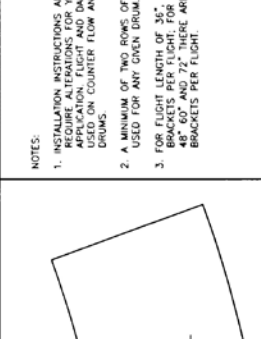
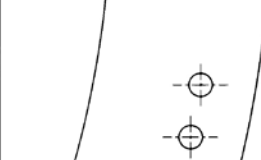

APPENDIX:

Eco-Star Orifice Meters



Q754

APPENDIX:

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1	23-01-1	BSA	6-25-01																										
2	04-02-1	BSA	1-2-03																										
3	04-05-1	BGS	1-2-03																										
4	121-07-1	BSA	4-26-07																										

NOTES:

- INSTALLATION INSTRUCTIONS ARE GENERIC AND MAY VARY FROM APPLICATION TO APPLICATION. FLIGHT AND DAM DESIGN CAN BE USED ON COUNTER FLOW AND PARALLEL FLOW DRUMS.
- A MINIMUM OF TWO ROWS OF FLIGHTS MUST BE USED FOR ANY GIVEN DRUM.
- FOR FLIGHT LENGTH OF 36", THERE ARE (2) FLIGHT BRACKETS PER FLIGHT; FOR FLIGHT LENGTH OF 36" TO 72" THERE ARE (3) FLIGHT BRACKETS PER FLIGHT.

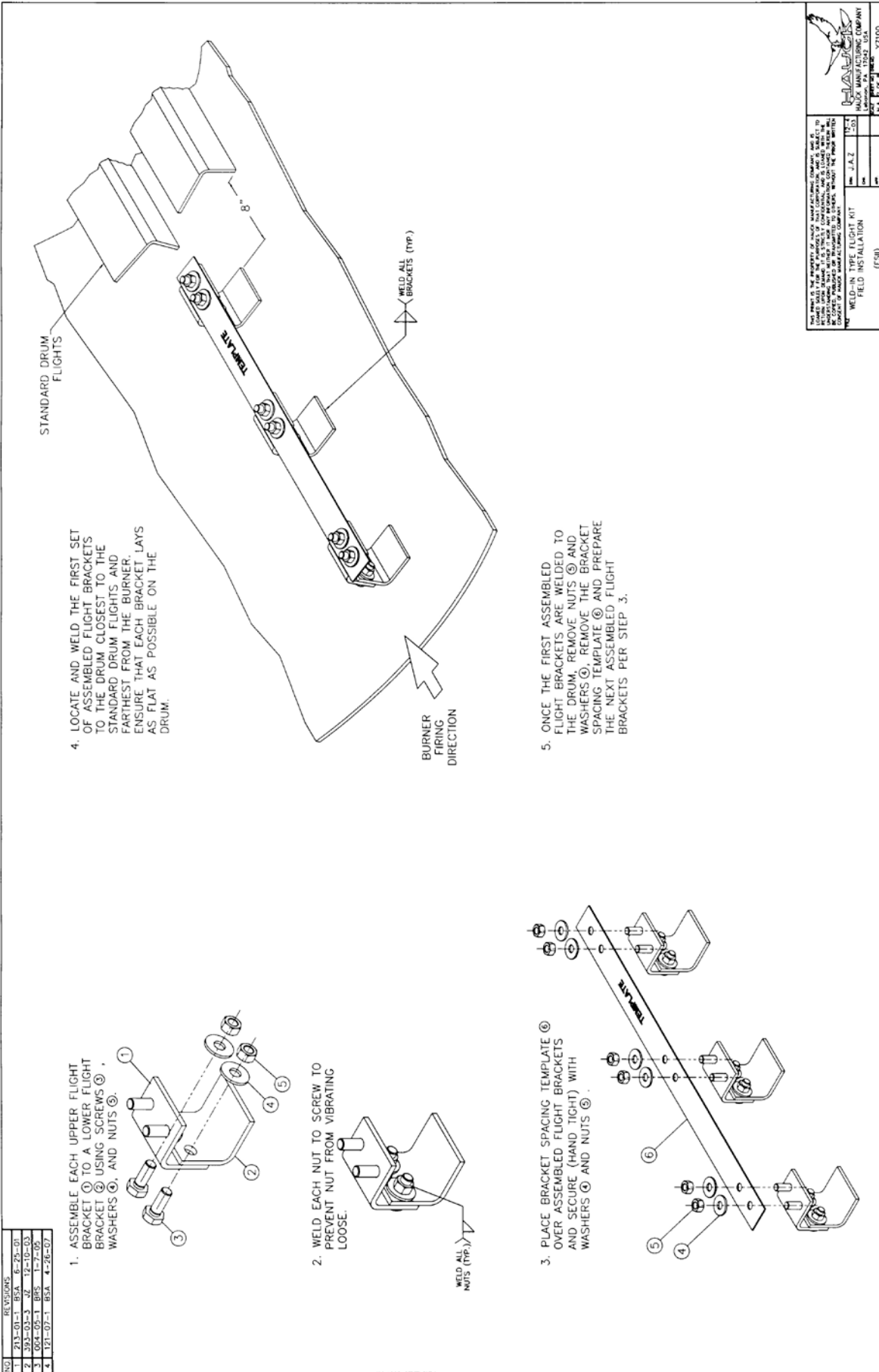
DRUM NO. OF FLIGHTS PER ROW	FLIGHT LENGTH L
16	36" TO 72"
18	AS REQUIRED
19	AS REQUIRED
20	AS REQUIRED
21	AS REQUIRED
23	AS REQUIRED
24	AS REQUIRED

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FIELD INSTALLATION (ESI)

DATE: 12/22/07
BY: J.A.Z.
CHECKED BY: J.A.Z.
HANCO MANUFACTURING COMPANY
HANCO, IN 47502, U.S.A.

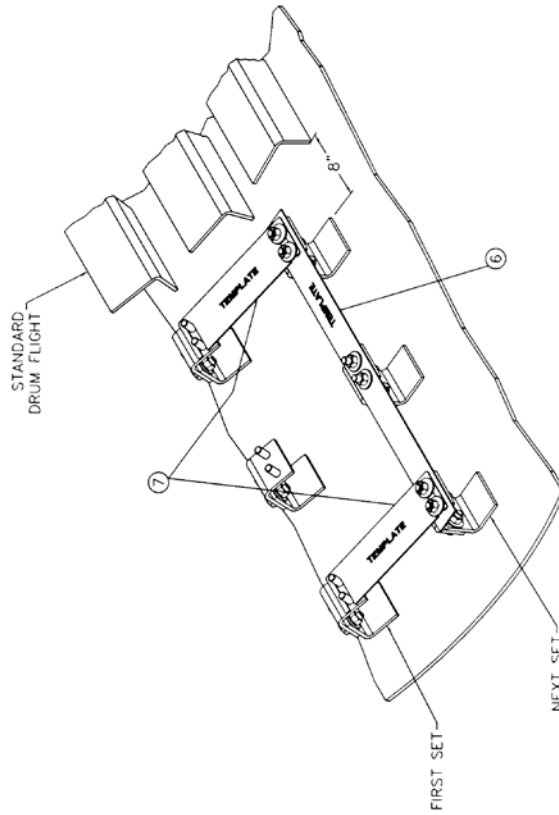
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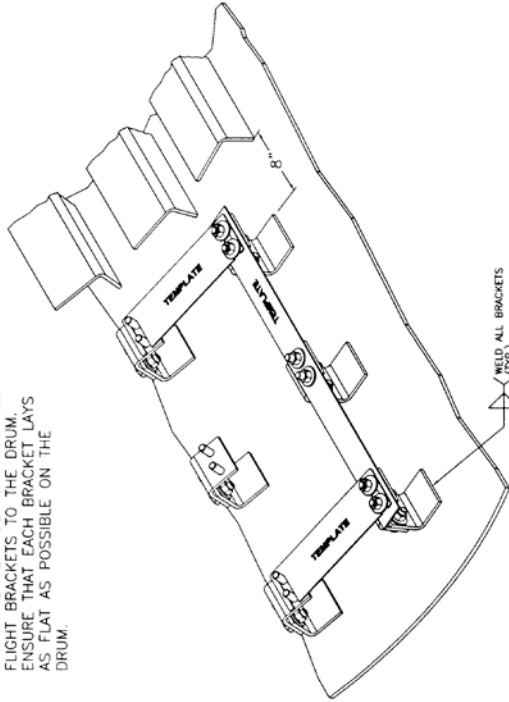
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2	313-03-3 JZ 12-10-03	
3	304-03-1 BKS 1-7-05	
4	121-07-1 BSA 4-26-07	

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.

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REVISED BY: J.A.Z. 12-23
DATE: 12-23-03

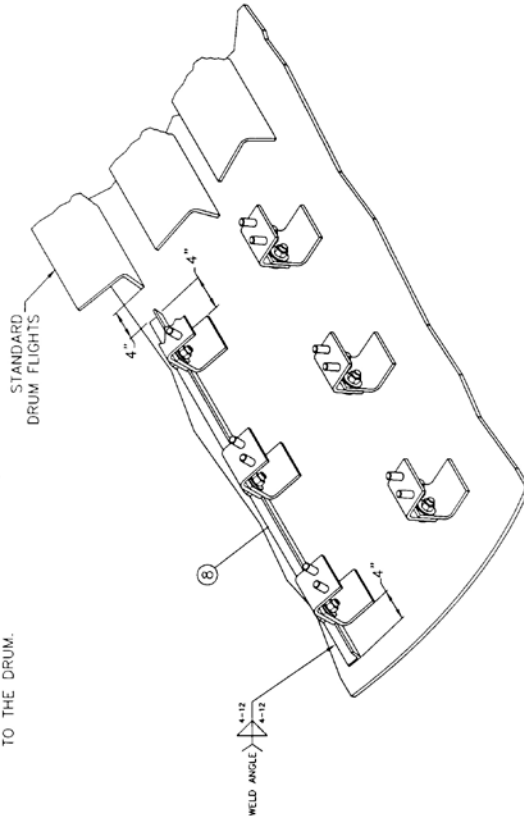
WELDON TYPE FLIGHT KIT
FIELD INSTALLATION (ES9)

HADCO MANUFACTURING COMPANY
10000 W. 10TH AVE.
DENVER, CO 80202 USA
P.O. BOX 25
K7100

APPENDIX:

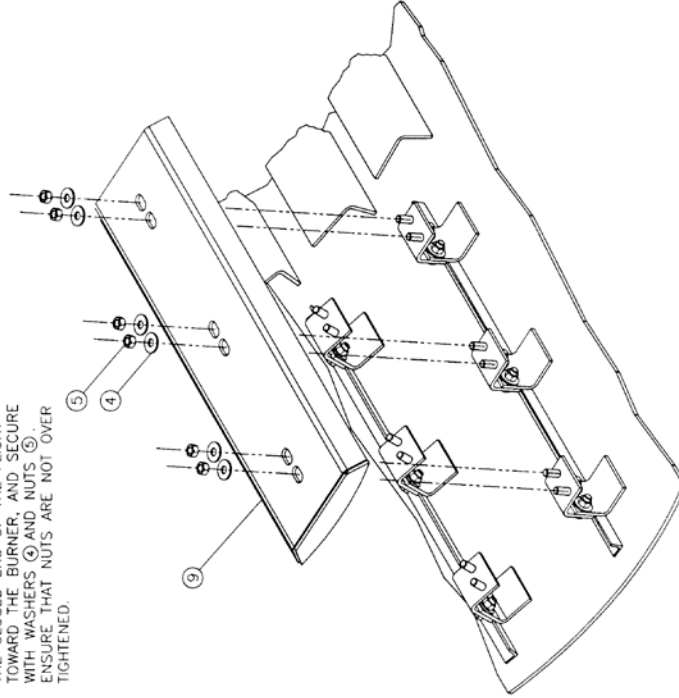
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2	018-01-01 01B 12-10-03
3	004-05-01 BRG 1-7-05
4	121-07-01 BSA 4-26-07

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.



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.

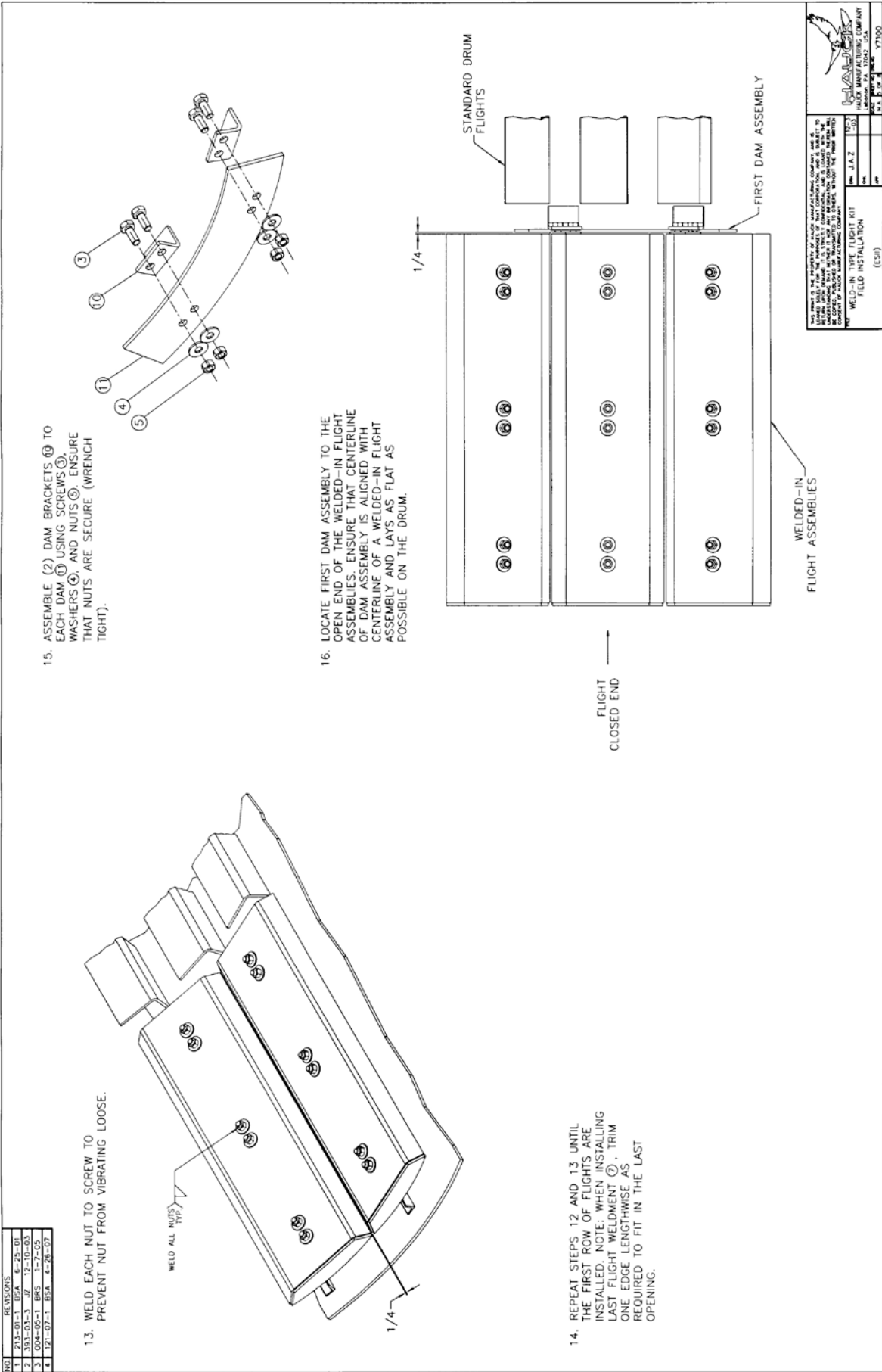


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WELD-IN TYPE FLIGHT KIT
FIELD INSTALLATION
(ES9)

DATE: 01/12/07
DRAWN BY: J.A.Z.
CHECKED BY: [Signature]
DATE: 01/12/07
HANCO MANUFACTURING COMPANY
1100 W. 10TH ST. WYOMING, NE
PO BOX 1000
WYOMING, WY 82001-1000
TEL: 307.438.1710

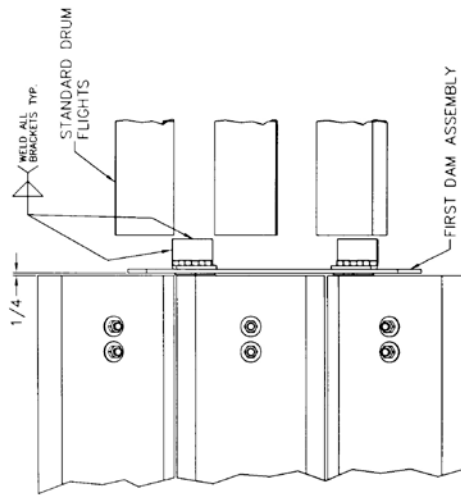
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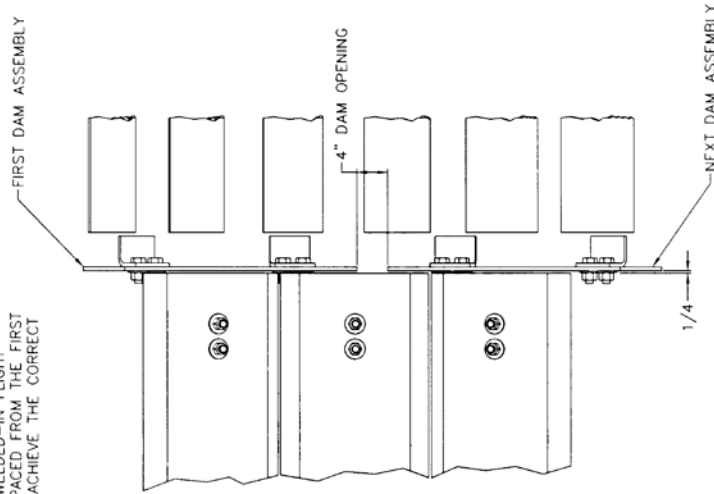
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2	393-03-3 02 12-10-03
3	004-05-1 BRFS 1-7-05
4	171-07-1 05A 4-26-07

17. WELD THE DAM BRACKET OF THE DAM ASSEMBLY TO THE DRUM.



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.



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.

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WELD-IN TYPE FLIGHT KIT
FIELD INSTALLATION
(ES9)

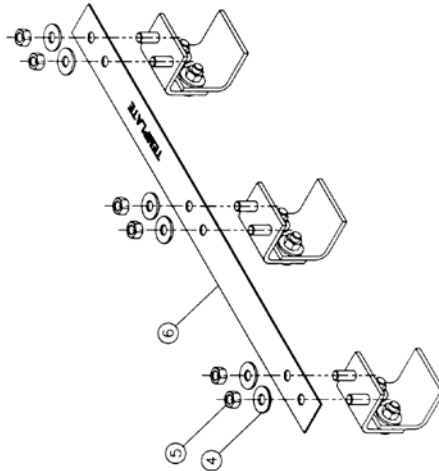
DATE: 04/26/07
BY: J.A.Z.
CHECKED: J.S.S.
DESIGNED: J.S.S.
DRAWN: J.S.S.

HANCOX MANUFACTURING COMPANY
1000 W. 10TH STREET
MILWAUKEE, WI 53233
U.S.A. P. O. # 77100

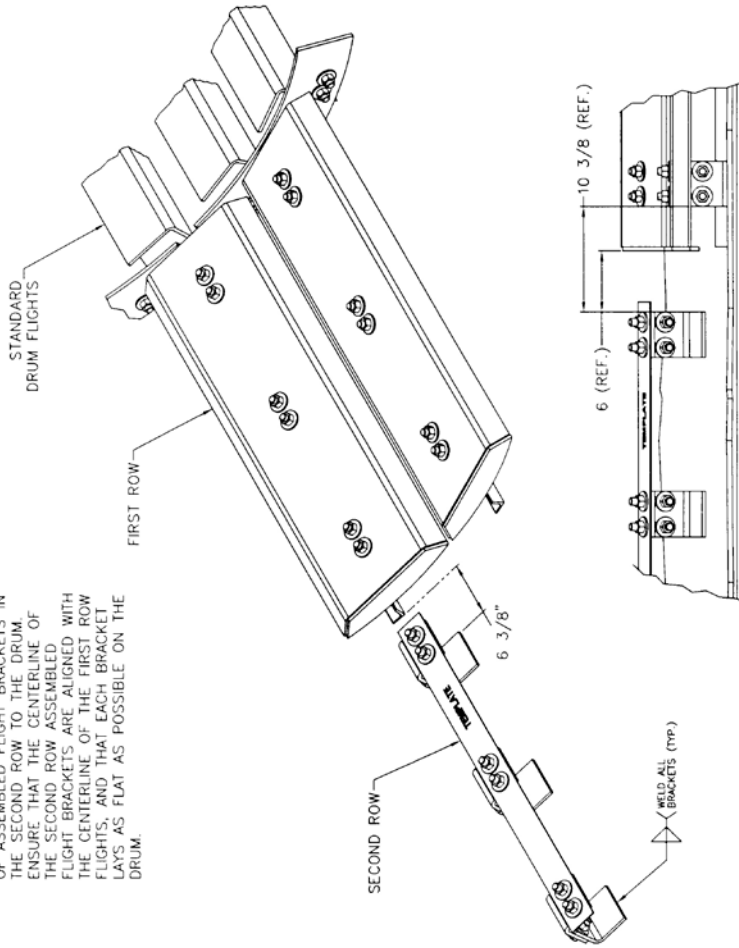
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2	393-03-3 JZ	12-10-03
3	094-05-1 BRS	1-7-05
4	121-07-1 BSA	4-26-07

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 (4) AND NUTS (5).



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.

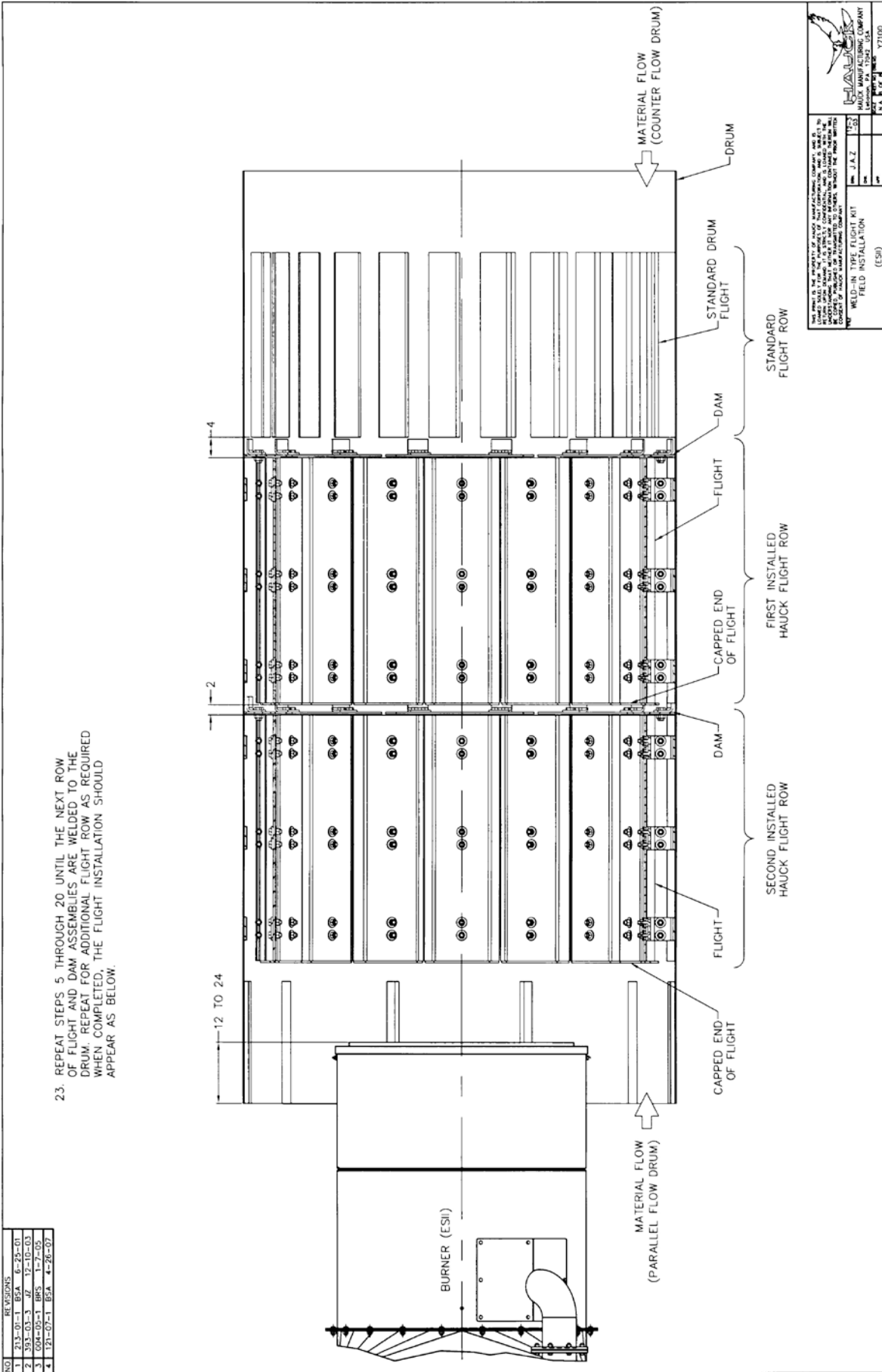


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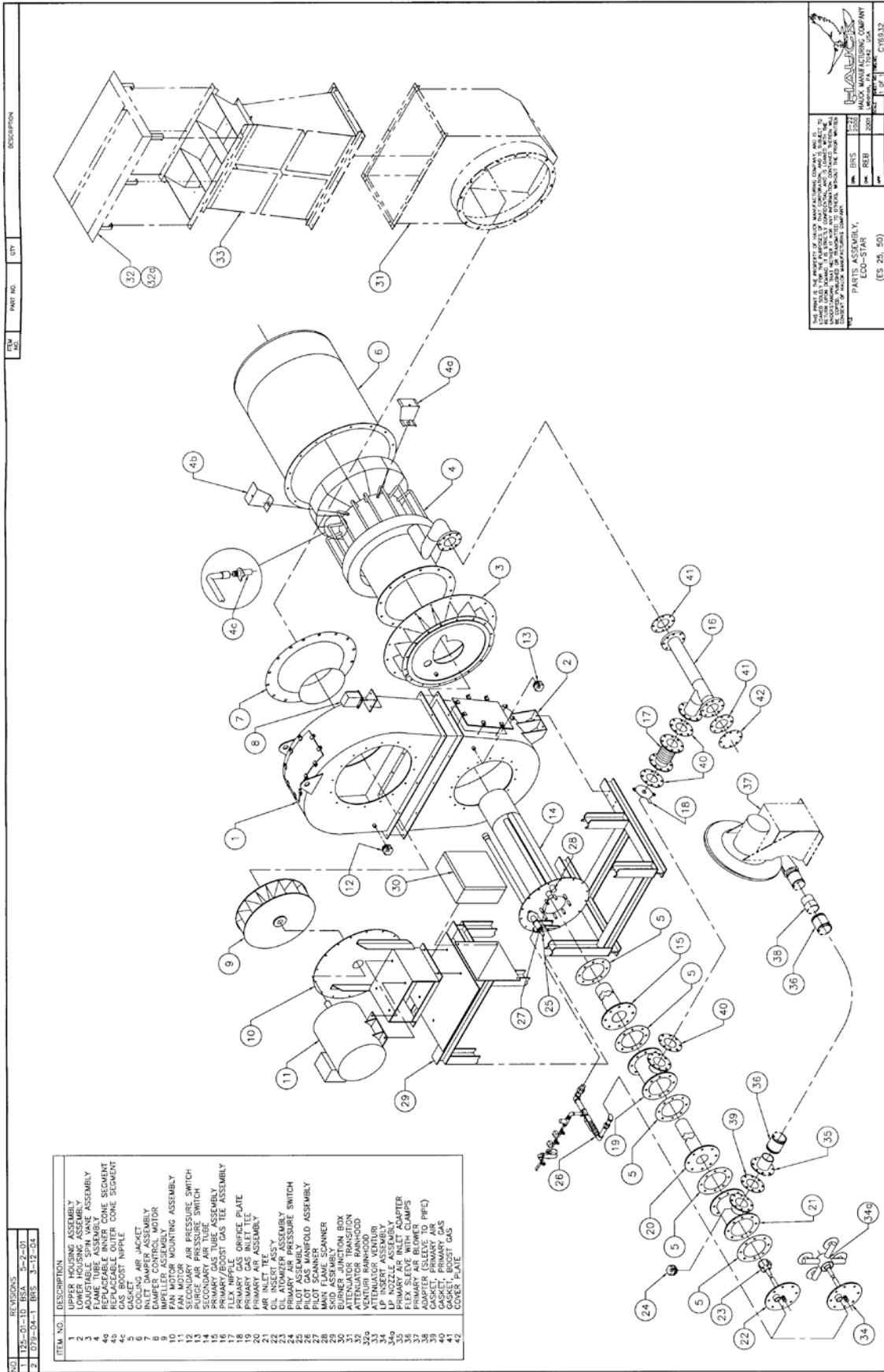
WELD-IN TYPE FLIGHT KIT
FIELD INSTALLATION (ES9)

DATE: 12/10/03
DRAWN BY: J.A.Z.
CHECKED BY: J.A.Z.
APPROVED BY: J.A.Z.
HANCO MANUFACTURING COMPANY
17100

APPENDIX:




APPENDIX:



REV.	REV. NO.	REV. DATE	REV. BY	REV. DESCRIPTION
1	01	10	BBA	5-2-01
2	02	04	BBS	3-12-04

ITEM NO.	DESCRIPTION
1	UPPER HOUSING ASSEMBLY
2	ADJUSTABLE SPIN WAVE ASSEMBLY
3	FLAME TUBE ASSEMBLY
4	REPLACEABLE OUTER CONE SEGMENT
4a	GAS BOOST NIPPLE
4b	COOLING AIR JACKET
4c	INLET DAMPER ASSEMBLY
5	FAN MOTOR MOUNTING ASSEMBLY
6	IMPELLER ASSEMBLY
7	PURGE AIR PRESSURE SWITCH
8	SECONDARY AIR PRESSURE SWITCH
9	FLAME TUBE ASSEMBLY
10	PRIMARY GAS TEE ASSEMBLY
11	PRIMARY GAS ORIFICE PLATE
12	PRIMARY GAS INLET TEE
13	AIR INLET TEE ASSEMBLY
14	OIL INSERT ASSY
15	PILOT ASSEMBLY
16	PILOT ASSEMBLY
17	MAN FLAME SCANNER
18	BURNER JUNCTION BOX
19	ATTENUATOR TRANSITION
20	VENTURI BURNER HOOD
21	LP NOZZLE ASSEMBLY
22	ATTENUATOR VENTURI
23	ATTENUATOR VENTURI
24	PRIMARY AIR INLET ADAPTER
25	ADAPTER (SLEEVE TO PIPE)
26	GASKET, PRIMARY GAS
27	GASKET, BOOST GAS
28	COVER PLATE
29	
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REV.	REV. NO.	REV. DATE	REV. BY	REV. DESCRIPTION
1	01	10	BBA	5-2-01
2	02	04	BBS	3-12-04

PARTS ASSEMBLY
 ECO-STAR
 (ES 25, 50)



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 O₂, 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: O₂ - 4%

CO - 2000 PPM

Combustibles - 2%

Problem: 4% O₂ - is too low

CO - is too high

Combustibles are too high

Solution: **Gradually** reduce fuel flow or increase air flow while watching O₂, CO, and combustibles. Typically the following will occur – O₂ 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.

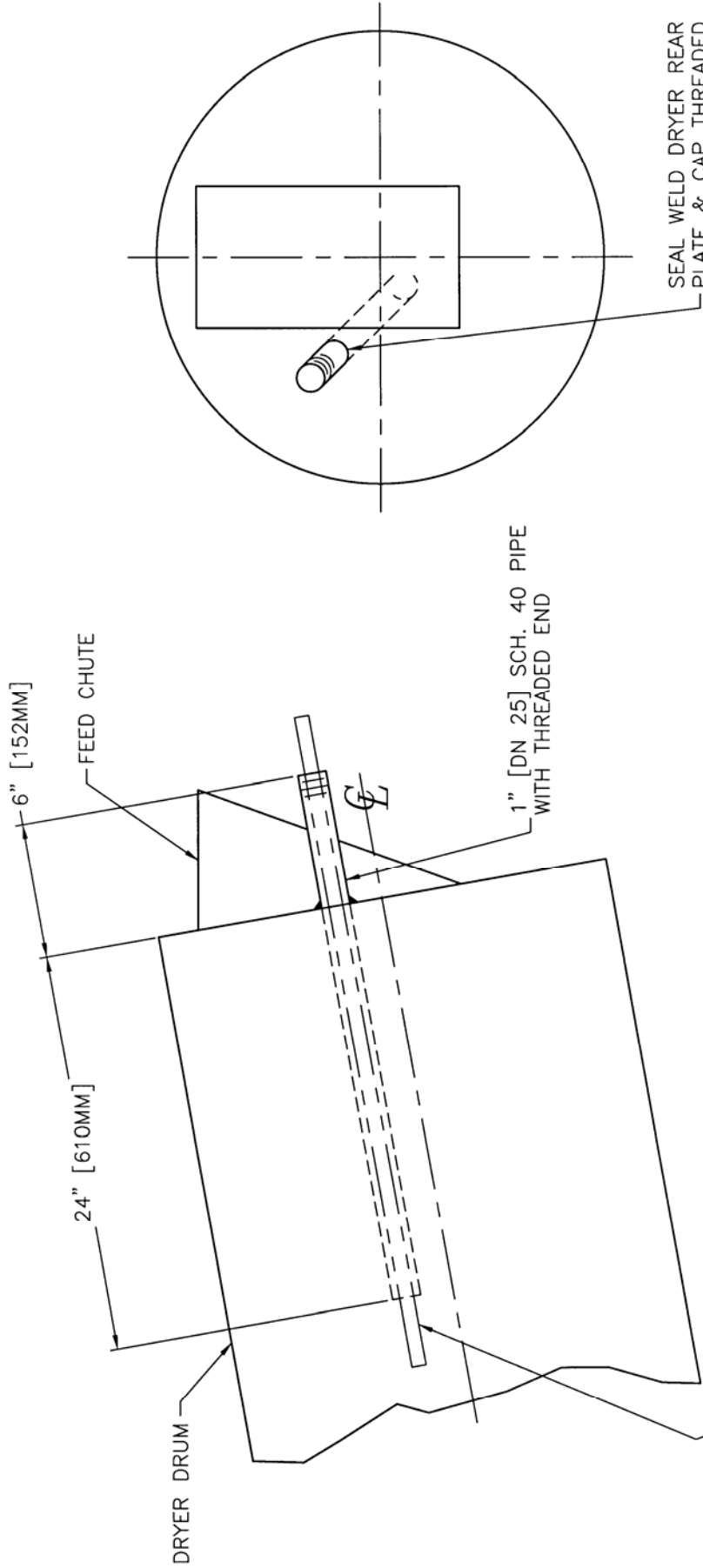
NOTE: Typically some CO and combustibles will always be present.

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 too 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



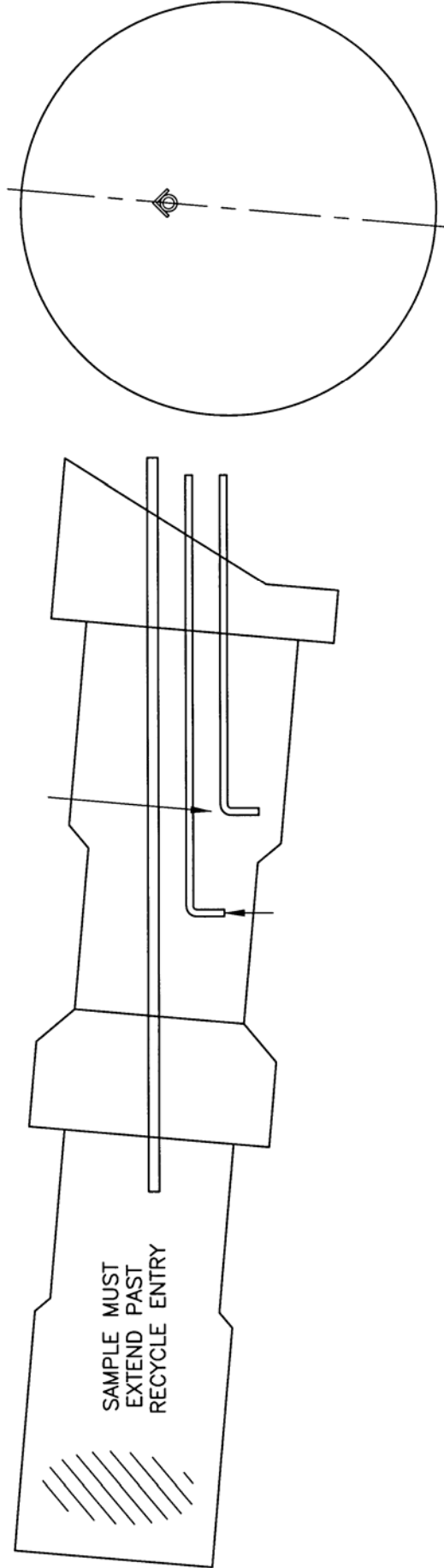
A MEASURING PROBE IS NORMALLY INSERTED 8 - 12 FT [2.4 - 3.6M] INTO THE CENTER PORTION OF THE DRYER. LOCATE PIPE APPROXIMATELY 6" [152MM] ABOVE DRYER CENTER LINE TO ALLOW FOR PROBE SAG

W7406
(NOT TO SCALE)

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

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-STAR™/ECO-STARII™ BURNERS WITHOUT COMBUSTION CHAMBERS ON ROTARY AGGREGATE DRYERS

The dryer combustion zone must be sized to allow full development of the Eco-Star™/Eco-StarII™ 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-Star™/Eco-StarII™ 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 impingement 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-Star™/Eco-StarII™ on a rotary dryer; for detailed installation instructions of Hauck weld-in type flights, see Y7100.

On most drums using the recommended combustion lighting, 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-Star™/Eco-StarII™ efficiently operates with a slight amount of excess air and produces a 3000°F flame, the recommended combustion lighting 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/ft³ ·hr)

$$100,000,000 \text{ Btu/hr} \div 250,000 \text{ Btu/ft}^3 \cdot \text{hr} = 400 \text{ ft}^3 \text{ of combustion space required.}$$

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:

$$96" - (2 \times 6") = 84" \text{ effective combustion zone ID.}$$

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

$$(\text{Effective Combustion Zone ID} \div 2)^2 \times 0.02181$$

In The Example:

$$(84" \div 2)^2 \times 0.02181 = 38.5 \text{ ft}^3 \text{ combustion volume / ft drum length.}$$

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).

$$400 \text{ ft}^3 \div 38.5 \text{ ft}^3 / \text{ft drum length} = 10.4\text{ft combustion lighting required.}$$

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-Star™/Eco-StarII™ is capable of high flame intensities. Flame intensity is defined as Btu/hr ·ft³ 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/ft³ on natural gas and 175,000 to 250,000 Btu/ft³ on oil firing. Propane fired burners require 150,000 to 200,000 Btu/ft³. 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 lighting to complete the combustion lighting 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/ft³ 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% O₂. 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-Star™/Eco-StarII™). 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-Star™/ Eco-StarII™ 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-Star™/Eco-StarII™ 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-Star™/Eco-StarII™ 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-Star™/Eco-StarII™ 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.

EcoStar 25 CAPACITY & PERFORMANCE

ZERO SPIN #2 OIL FIRING										
Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Oil Flow GPM	Oil Microvalve Position	Oil Microvalve Inlet Pressure (PSI)	Excess Air Limit Min GPM / %	Flame Length / Diameter In feet	
13.50	Full Open	447,200	37.2	24.50	4.50	10	90	.5 GPM / 1000%	7 / 3	
7.30		333,000	22.7	16.60	2.75	6	90	.5 GPM / 750%	4 / 3	
3.30		204,048	15.7	14.60	1.90	3	92	.5 GPM / 324%	2 / 2.5	
0.10	Closed	39,777	4.1	13.10	0.50	0	92	.5 GPM / 44%	1.5 / 2	

1/2 SPIN #2 OIL FIRING										
Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Oil Flow GPM	Oil Microvalve Position	Oil Microvalve Inlet Pressure (PSI)	Excess Air Limit Min GPM / %	Flame Length / Diameter In feet	
14.00	Full Open	457,800	37.2	24.40	4.50	10	90	.5 GPM / 1054%	4 / 4	
7.30		307,380	22.7	16.70	2.75	6	94	.5 GPM / 690%	2.5 / 3	
3.30		183,120	15.7	13.80	1.90	3	92	.5 GPM / 390%	2 / 2.5	
0.10	Closed	39,777	4.1	13.10	0.50	0	92	.5 GPM / 44%	1.5 / 2	

FULL SPIN #2 OIL FIRING										
Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Oil Flow GPM	Oil Microvalve Position	Oil Microvalve Inlet Pressure (PSI)	Excess Air Limit Min GPM / %	Flame Length / Diameter In feet	
14.40	Full Open	438,180	37.2	24.00	4.50	10	90	.5 GPM / 1006%	3.5 / 4	
7.30		248,520	22.7	15.80	2.75	6	94	.5 GPM / 548%	2.5 / 3.5	
3.30		187,044	15.7	14.10	1.90	3	92	.5 GPM / 400%	2.2 / 4	
0.10	Closed	39,777	4.1	13.10	0.50	0	92	.5 GPM / 44%	1.5 / 2	

Notes:

Main microvalve BL-1/2-20

Bypass valve S-3-11C Set at 6

Excess air GPM limit is the minimum fuel flow at the given burner body air pressure.

Firing rate is at 25% excess air.

Fuel oil is rated at 138,000 Btu/Gallon

EcoStar 25 CAPACITY & PERFORMANCE

ZERO SPIN NATURAL GAS FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Gas Flow SCFH	OMG dP 3.004" Dia "wc	Gas BVA Position / Inlet Pressure (PSI)	Excess Air Limit Min OMG dP "wc % excess air	Flame Length / Diameter In feet
12.50	Full Open	444,720	37.1	24.50	35,577	10.41	9 / 3.6	0.4 / 557	8.5 / 2
7.30		333,000	28.2	16.60	27,153	6.06	5 / 3.6	0.3 / 485	6 / 1.65
3.30		204,048	17.9	14.30	17,211	2.40	3.5 / 4	0.2 / 354	4 / 1.6
0.10	Closed	39,777	7	13.10	6,730	0.37	1 / 4	0.05 / 142	3 / 1.25

1/2 SPIN NATURAL GAS FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Gas Flow SCFH	OMG dP 3.004" Dia "wc	Gas BVA Position / Inlet Pressure (PSI)	Excess Air Limit Min OMG dP "wc % excess air	Flame Length / Diameter In feet
12.80	Full Open	457,800	38.2	24.40	36,730	11.20	9 / 3.6	0.4 / 585	7 / 2.2
7.30		307,380	26.1	16.70	25,153	5.20	5 / 3.6	0.3 / 442	6 / 2
3.30		183,120	16.2	13.80	15,615	2.00	3.5 / 4	0.2 / 312	5 / 2
0.10	Closed	39,777	7	13.10	6,730	0.37	1 / 4	0.05 / 142	2.5 / 1.25

FULL SPIN NATURAL GAS FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Gas Flow SCFH	OMG dP 3.004" Dia "wc	Gas BVA Position / Inlet Pressure (PSI)	Excess Air Limit Min OMG dP "wc % excess air	Flame Length / Diameter In feet
13.10	Full Open	438,180	36.6	24.00	35,192	10.30	9 / 3.6	0.4 / 557	5 / 3.2
7.30		248,520	21.4	15.80	20,653	3.52	5 / 3.6	0.3 / 345	5 / 3
3.30		187,044	16.5	14.10	15,923	2.30	3.5 / 4	0.2 / 320	4 / 2
0.10	Closed	39,777	7	13.10	6,730	0.37	1 / 4	0.05 / 142	2.5 / 1.25

Gas control valve 2" BVA

OMG diameter 3.004" with 4" metering pipe

Excess air dP"wc limit is the minimum fuel flow at the given burner body air pressure.

Firing rate is at 25% excess air.

Natural gas firing at 1040 Btu/Cubic Foot

EcoStar 25 CAPACITY & PERFORMANCE

ZERO SPIN LIQUID PROPANE FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Propane Flow GPM	Propane Microvalve Position	Propane Microvalve Inlet Pressure (PSI)	Excess Air Limit Min GPM / %	Flame Length / Diameter In feet
12.50	Full Open	444,720	36.9	24.50	6.8	10	200 .5 GPM / 1682%	9 / 2.5	
7.30		333,000	21.2	16.70	3.9	5.5	200 .5 GPM / 1254%	5.5 / 2.25	
3.30		204,048	12	14.30	2.2	4.25	200 .5 GPM / 759%	4 / 2	
0.10	Closed	39,777	2.7	13.10	0.5	1	200 .5 GPM / 129%	3 / 2	

1/2 SPIN LIQUID PROPANE FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Propane Flow GPM	Propane Microvalve Position	Propane Microvalve Inlet Pressure (PSI)	Excess Air Limit Min GPM / %	Flame Length / Diameter In feet
12.80	Full Open	457,800	36.9	24.40	6.8	10	200 .5 GPM / 1732%	8 / 2.75	
7.30		307,380	21.2	16.70	3.9	5.5	200 .5 GPM / 1255%	5.5 / 2.5	
3.30		183,120	12	13.80	2.2	4.25	200 .5 GPM / 679%	3.5 / 2.25	
0.10	Closed	39,777	2.7	13.10	0.5	1	200 .5 GPM / 129%	2.75 / 3	

FULL SPIN LIQUID PROPANE FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Propane Flow GPM	Propane Microvalve Position	Propane Microvalve Inlet Pressure (PSI)	Excess Air Limit Min GPM / %	Flame Length / Diameter In feet
13.10	Full Open	438,180	36.9	24.00	6.8	10	200 .5 GPM / 1657%	7.5 / 3.25	
7.30		248,520	21.2	15.80	3.9	5.5	200 .5 GPM / 929%	6.3 / 3.0	
3.30		187,044	12	14.10	2.2	4.25	200 .5 GPM / 694%	4 / 2.8	
0.10	Closed	39,777	2.7	13.10	0.5	1	200 .5 GPM / 129%	2.75 / 3	

Microvalve HB-1-2-18W

Excess air GPM limit is the minimum fuel flow at the given burner body air pressure.
 Firing rate is at 25% excess air.
 Liquid Propane is rated at 91,000 Btu/Gallon

EcoStar 50 CAPACITY & PERFORMANCE

ZERO SPIN #2 OIL FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Oil Flow GPM	Oil Microvalve Position	Oil Microvalve Inlet Pressure (PSI)	Excess Air Limit Min GPM / %	Flame Length / Diameter In feet
10.00	Full Open	753,000	62	39.00	7.5	9	60	.75 GPM / 1110%	14 / 3
4.00		500,000	42	28.00	5.0	4	61	.75 GPM / 710%	14 / 3
2.00		290,000	25	22.00	3.0	2.25	62	.75 GPM / 370%	12 / 2.5
0.00	Closed	107,000	10	21.00	1.2	0	63	.75 GPM / 70%	2 / 2

1/2 SPIN #2 OIL FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Oil Flow GPM	Oil Microvalve Position	Oil Microvalve Inlet Pressure (PSI)	Excess Air Limit Min GPM / %	Flame Length / Diameter In feet
10.00	Full Open	766,000	63	39.00	7.6	9	60	.75 GPM / 1130%	10 / 4
4.00		500,000	42	28.00	5.0	4	61	.75 GPM / 710%	10 / 3.75
2.00		290,000	25	22.00	3.0	2.25	62	.75 GPM / 370%	8 / 3
0.10	Closed	80,000	8	21.00	1.0	0	63	.75 GPM / 30%	2 / 2

FULL SPIN #2 OIL FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Oil Flow GPM	Oil Microvalve Position	Oil Microvalve Inlet Pressure (PSI)	Excess Air Limit Min GPM / %	Flame Length / Diameter In feet
11.60	Full Open	730,000	60	39.00	7.2	9	60	.75 GPM / 1080%	7 / 5.5
6.00		500,000	42	28.00	5.0	4	61	.75 GPM / 710%	8 / 4
3.00		290,000	25	22.00	3.0	2.25	62	.75 GPM / 370%	8 / 3
0.10	Closed	80,000	8	21.00	1.0	0	63	.75 GPM / 30%	2 / 2

Main microvalve F-1/2-20

Bypass valve S-3-16103 Set at 2.7

Bypass flow 0.8 GPM

Excess air GPM limit is the minimum fuel flow at the given burner body air pressure.

Firing rate is at 25% excess air.

Fuel oil is rated at 138,000 Btu/Gallon

EcoStar 50 CAPACITY & PERFORMANCE

ZERO SPIN NATURAL GAS FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Gas Flow SCFH	OMG dP 3.144" Dia. "wc	Gas BVA Position / Inlet Pressure (PSI)	Excess Air Limit Min OMG dP "wc % excess air	Flame Length / Diameter In feet
10.00	Full Open	753,000	62	39.00	61,840	21.00	9 / 4.5	0.5 / 710	15 / 3
4.00		500,000	42	28.00	41,600	9.50	5 / 5	0.5 / 440	12 / 3
2.00		290,000	25	22.00	24,800	3.40	3 / 6	0.5 / 220	11 / 3
0.00	Closed	107,000	10	21.00	10,160	0.60	2 / 7	0.15 / 140	5 / 3

1/2 SPIN NATURAL GAS FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Gas Flow SCFH	OMG dP 3.144" Dia. "wc	Gas BVA Position / Inlet Pressure (PSI)	Excess Air Limit Min OMG dP "wc % excess air	Flame Length / Diameter In feet
10.00	Full Open	766,000	63	39.00	62,880	21.70	10 / 4.5	0.5 / 720	12 / 4
4.00		500,000	42	28.00	41,600	9.50	5 / 5.5	0.5 / 440	11 / 3.5
2.00		290,000	25	22.00	24,800	3.40	3 / 6	0.5 / 220	12 / 3
0.10	Closed	80,000	8	21.00	8,000	0.40	2 / 7	0.15 / 90	4 / 3

FULL SPIN NATURAL GAS FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Gas Flow SCFH	OMG dP 3.144" Dia. "wc	Gas BVA Position / Inlet Pressure (PSI)	Excess Air Limit Min OMG dP "wc % excess air	Flame Length / Diameter In feet
11.60	Full Open	730,000	60	39.00	60,000	19.80	10 / 4.5	0.4 / 780	7 / 6
6.00		500,000	42	28.00	41,600	9.50	5 / 5.5	0.4 / 510	7 / 5
3.00		290,000	25	22.00	24,800	3.40	3 / 6	0.4 / 260	7 / 4
0.10	Closed	80,000	8	21.00	8,000	0.40	2 / 7	0.15 / 90	4 / 2.5

Gas control valve 3" BVA

OMG diameter 3.154" with 4" metering pipe

Excess air dP"wc limit is the minimum fuel flow at the given burner body air pressure.

Firing rate is at 25% excess air.

Natural gas firing at 1040 Btu/Cubic Foot

EcoStar 50 CAPACITY & PERFORMANCE

ZERO SPIN LIQUID PROPANE FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Propane Flow GPM	Propane Microvalve Position	Propane Microvalve Inlet Pressure (PSI)	Excess Air Limit Min GPM / %	Flame Length / Diameter In feet
10.00	Full Open	753,000	62	39.00	11.3	5.5	205	3 GPM / 370%	12 / 3
4.00		500,000	42	28.00	7.6	3.75	210	2.5 GPM / 280%	14 / 3
2.00		290,000	25	22.00	4.5	2.25	210	2.5 GPM / 130%	14 / 2.5
0.00	Closed	107,000	10	21.00	1.9	1	220	1 GPM / 130%	5 / 2

1/2 SPIN LIQUID PROPANE FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Propane Flow GPM	Propane Microvalve Position	Propane Microvalve Inlet Pressure (PSI)	Excess Air Limit Min GPM / %	Flame Length / Diameter In feet
10.00	Full Open	766,000	63	39.00	11.5	6	205	3 GPM / 380%	9 / 3.75
4.00		500,000	42	28.00	7.6	3.75	210	2.5 GPM / 280%	9 / 3.5
2.00		290,000	25	22.00	4.5	2.25	210	2.5 GPM / 130%	7 / 3
0.10	Closed	80,000	8	21.00	1.5	1	220	1 GPM / 80%	4 / 2

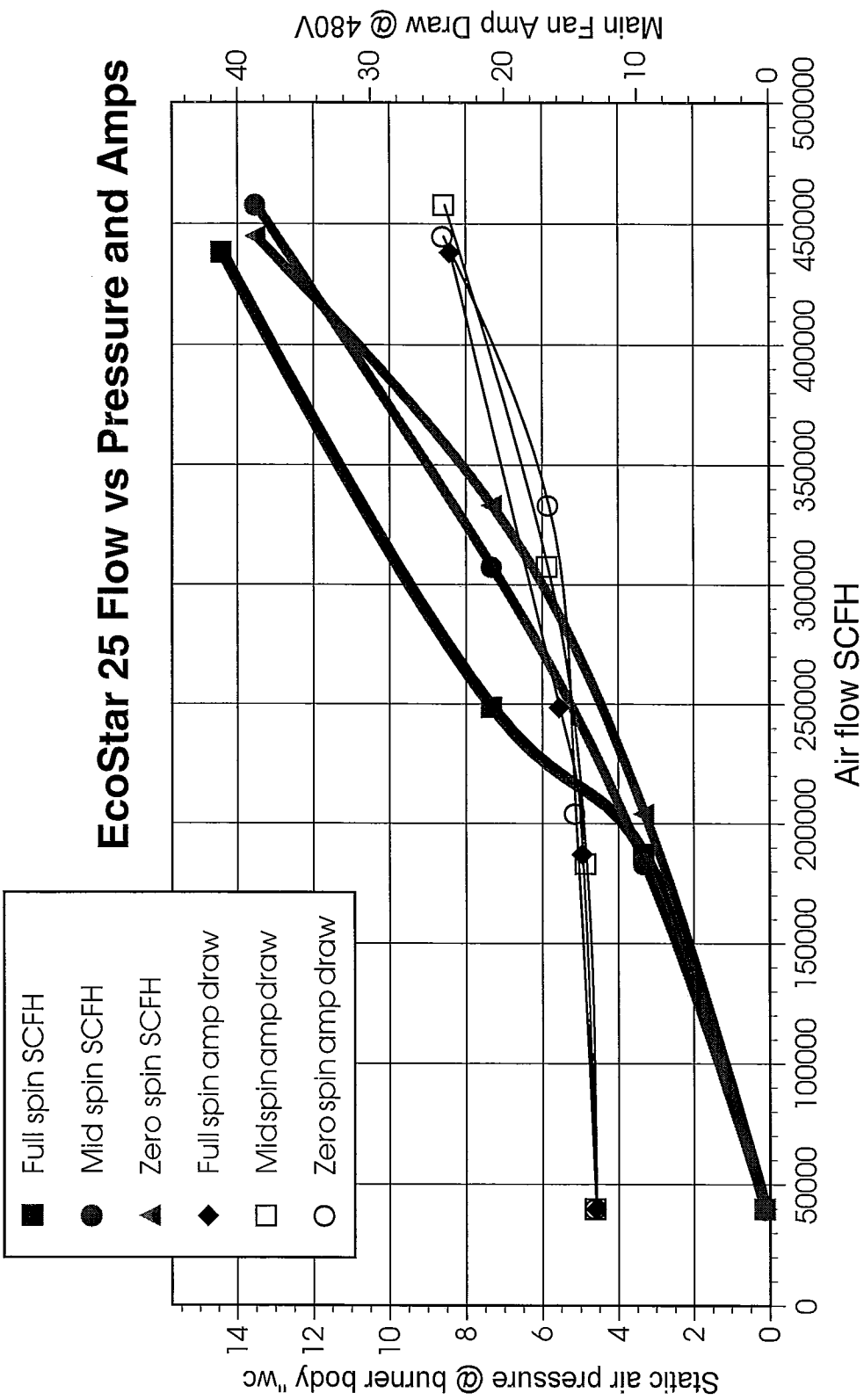
FULL SPIN LIQUID PROPANE FIRING

Burner Body Air Pressure "wc	Main Air Inlet Damper Position	Main Air Flow SCFH	Firing Rate Million Btu/Hr	Main Air Fan Motor Amp Draw 460/3/60	Propane Flow GPM	Propane Microvalve Position	Propane Microvalve Inlet Pressure (PSI)	Excess Air Limit Min GPM / %	Flame Length / Diameter In feet
11.60	Full Open	730,000	60	39.00	11.0	6	205	3 GPM / 360%	6 / 6
6.00		500,000	42	28.00	7.6	3.75	210	2.5 GPM / 280%	7 / 6
3.00		290,000	25	22.00	4.5	2.25	210	2.5 GPM / 130%	6 / 4
0.10	Closed	80,000	8	21.00	1.5	1	220	1 GPM / 80%	4 / 2

Microvalve H-1/2-20

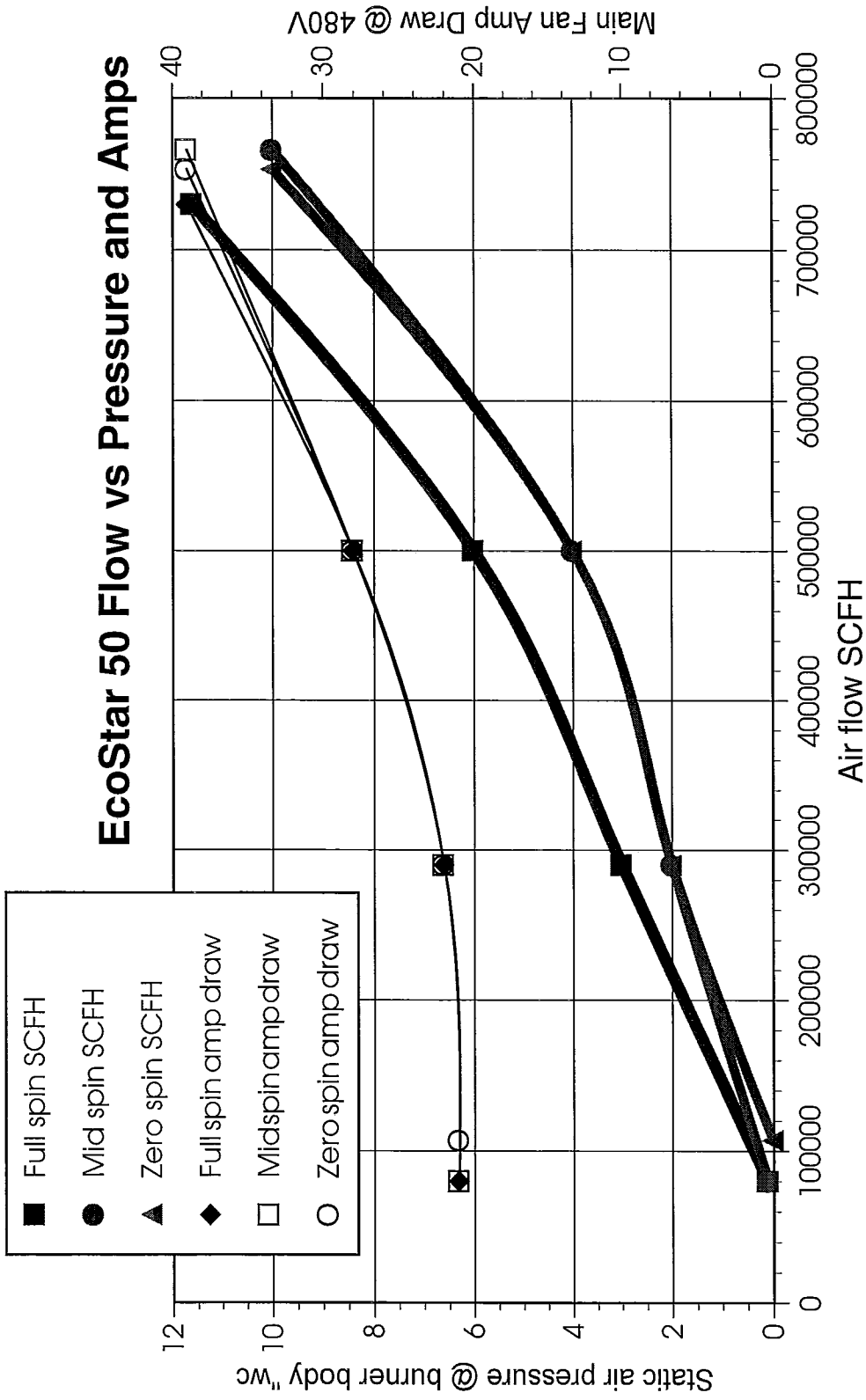
Excess air GPM limit is the minimum fuel flow at the given burner body air pressure.
 Firing rate is at 25% excess air.
 Liquid Propane is rated at 91,000 Btu/Gallon

EcoStar 25 Flow vs Pressure and Amps



Note: This is a typical fan curve with the burner firing. Amp/Flow curve, thin line, read to right scale. Pressure/Flow curve, thick line, read to left scale.

EcoStar 50 Flow vs Pressure and Amps



Note: This is a typical fan curve with the burner firing. Amp/Flow curve, thin line, read to right scale. Pressure/Flow curve, thick line, read to left scale.