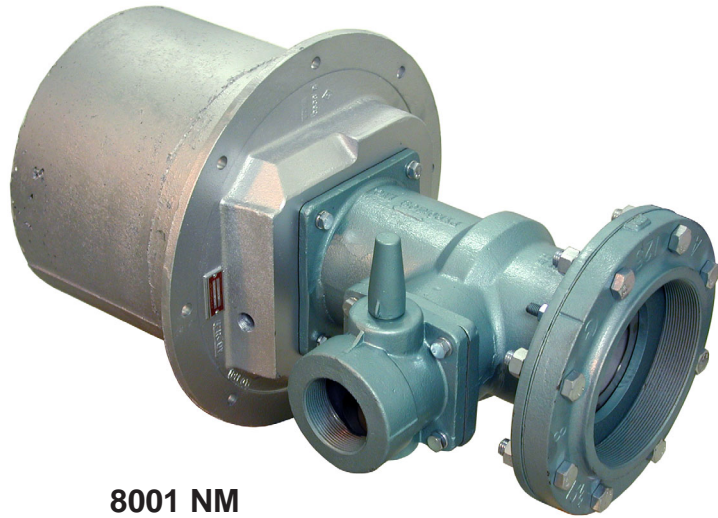


BURNERS NOZZLE MIX SINGLE TUNNEL MULTIPLE TUNNEL

MODEL: 3501 - Single Tunnel
3506 - Multiple Tunnel

Revision: 0

BULLETIN
3501 & 3506



8001 NM

FEATURES

- High heat inputs - intense combustion
- Excellent flame stability
- Wide turndown range - greater than 10:1 on single tunnel burners, higher turndown with multiple tunnels
- Flanged construction - eliminates pipe unions
- High flame velocities for better furnace circulation
- Short flame lengths - less than 1 ft. per million BTU/hr when firing into an air stream
- Designed for pressurized firing
- Precision pilot and flame detection mountings
- Unique stepped tunnel design
- Will burn at high fire with cold block - no warm up required
- Lower air pressures required
- No flashbacks
- Refractory burner blocks for operation up to 3300°F
- Rugged heavy duty construction

APPLICATIONS

- Forging Furnaces
- Air Heaters
- Annealing Furnaces
- Fume Destructors
- Melting Furnaces
- Ovens
- Dryers
- Malleabilizing Furnaces
- Incinerators
- Crematoriums
- Ladle Heating
- Curing Ovens
- Burn Out Furnaces
- Steam Generators

CAUTION: Operation of combustion equipment can be hazardous resulting in bodily injury or equipment damage. Each burner should be supervised by a combustion safeguard and only qualified personnel should install, make system adjustments and perform any required service.



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BURNERS NOZZLE MIX SINGLE TUNNEL MULTIPLE TUNNEL

BULLETIN 3501 & 3506
PAGE NO.2

DESCRIPTION

Nozzle Mix Burners are short flame high capacity units designed for extremely wide turndown ranges. Gas and air are mixed only at the point of discharge, flashback is prevented.

Exclusive stepped tunnel design creates very high turbulence and internal recirculation in the flame. The combustion tunnel shape produces pressures in the flame that are lower than the furnace pressure aiding flame retention.

Ignition of main flame is smooth and stable in all sizes. Hot refractory surfaces on the blocks are not required for ignition. All sizes may be lighted and raised immediately to high fire with excellent flame stability.

Each burner is equipped with an integral mounting flange for pressurized firing up to 10 psig furnace pressure (consult factory).

NM burners develop capacity ratings at low pressure drops. Economical low pressure air blowers are adequate.

Flanged connections are standard. Pipe unions are normally not required.

Flame lengths are very short (see capacity table). Large combustion chambers are not required. When operating in air heaters flame shield block extensions are used to prevent flame quenching.

Multiple tunnel units produce higher capacities with short flame lengths by spreading the flame over a large area. Cross ignition ports between tunnels are provided to stabilize the flames at normal firing rates and fuel-air ratios. Individual pilots are recommended for each tunnel with main flame supervision.

Each NM burner can be ordered with a micrometer type gas flow adjuster. Pressure referenced control systems are used to control heat inputs.

CAPACITY TABLE

| Model No. | Air Pipe Size | Gas Pipe Size | Maximum Capacity in 1000's BTU/hr At Various Air & Gas Pressures (at burner) ¹ | | | | | | | | | Flame Length ³ |
|-----------|---------------|---------------|---|-------|-------|-------|--------------------|-------|-------|-------|--------|---------------------------|
| | | | 1/2 oz. | 1 oz. | 2 oz. | 3 oz. | 4 oz. ² | 5 oz. | 6 oz. | 8 oz. | 10 oz. | |
| 101NM | 3/4" | 3/8" | 35 | 50 | 70 | 87 | 100 | 112 | 122 | 140 | 158 | 6" |
| 201NM | 1-1/4" | 3/4" | 71 | 100 | 141 | 173 | 200 | 224 | 245 | 283 | 316 | 8" |
| 301NM | 1-1/2" | 1" | 105 | 150 | 210 | 260 | 300 | 336 | 368 | 420 | 475 | 8" |
| 601NM | 2" | 1-1/4" | 210 | 300 | 420 | 520 | 600 | 670 | 735 | 840 | 950 | 10" |
| 1001NM | 3" | 1-1/4" | 350 | 500 | 700 | 870 | 1000 | 1120 | 1220 | 1400 | 1580 | 12" |
| 1501NM | 3" | 1-1/2" | 570 | 750 | 1000 | 1300 | 1500 | 1700 | 1850 | 2100 | 2400 | 24" |
| 2501NM | 4" | 2-1/2" | 880 | 1250 | 1770 | 2160 | 2500 | 2800 | 3060 | 3540 | 3950 | 30" |
| 4001NM | 6" | 3" | 1400 | 2000 | 2800 | 3460 | 4000 | 4480 | 4900 | 5600 | 6320 | 4' |
| 6001NM | 8" | 3" | 2100 | 3000 | 4200 | 5200 | 6000 | 6700 | 7350 | 8400 | 9500 | 6' |
| 8001NM | 8" | 3" | 2825 | 4000 | 5650 | 6930 | 8000 | 8950 | 9800 | - | - | 8' |
| 2002NM | 4" | 2 @ 1-1/4" | 700 | 1000 | 1400 | 1730 | 2000 | 2240 | 2450 | 2800 | 3160 | 12" |
| 4004NM | 6" | 4 @ 1-1/4" | 1400 | 2000 | 2800 | 3460 | 4000 | 4480 | 4900 | 5600 | 6320 | 12" |
| 6006NM | 8" | 6 @ 1-1/4" | 2100 | 3000 | 4200 | 5200 | 6000 | 6700 | 7350 | 8400 | 9500 | 12" |
| 10004NM | 10" | 4 @ 2-1/2" | 3500 | 5000 | 7000 | 8700 | 10000 | 11200 | 12200 | 14000 | 15800 | 30" |
| 12002NM | 10" | 2 @ 3" | 4250 | 6000 | 8500 | 10400 | 12000 | 13400 | 14700 | 17000 | 19000 | 6' |
| 16002NM | 10" | 2 @ 3" | 5650 | 8000 | 11300 | 13850 | 16000 | 17900 | 19600 | - | - | 8' |
| 18003NM | 12" | 3 @ 3" | 6350 | 9000 | 12700 | 15600 | 18000 | 20100 | 22000 | 25400 | 28500 | 6' |
| 24003NM | 12" | 3 @ 3" | 8500 | 12000 | 17000 | 20800 | 24000 | 26800 | 29400 | - | - | 8' |
| 32004NM | 14" | 4 @ 3" | 11300 | 16000 | 22600 | 27700 | 32000 | 35800 | 39200 | - | - | 8' |
| 48006NM | 20" | 6 @ 3" | 17000 | 24000 | 34000 | 41600 | 48000 | 53700 | 58800 | - | - | 8' |

BURNERS NOZZLE MIX SINGLE TUNNEL MULTIPLE TUNNEL

BULLETIN 3501 & 3506
PAGE NO.3

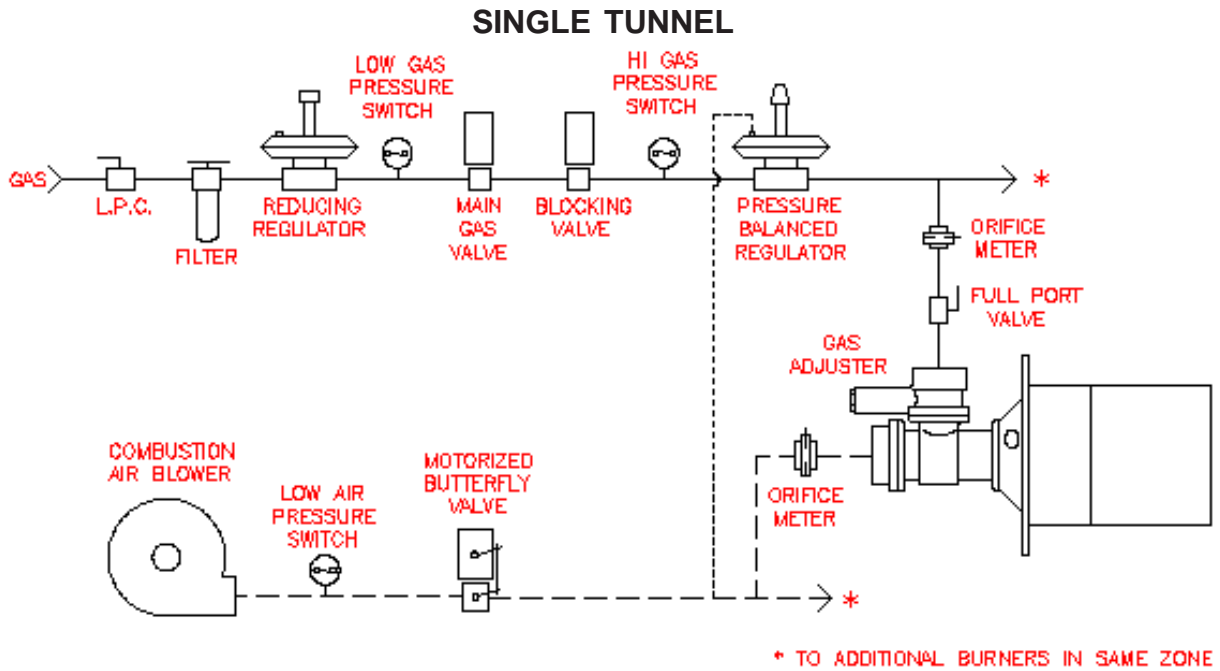


Fig. 1

OPERATION

Normal piping for a single tunnel burner system is shown in Fig. 1. This system will operate in combustion chambers with negative, neutral, or positive pressures up to 2" W. C.

Modulation of the main air valve changes the inlet air pressure to the air orifice in the mixer and the air flow. The air impulse pressure to the top of the Pressure Balanced Regulator will modulate gas outlet pressure equal to the air pressure. The flows of gas and air are metered by the pressure drops across the air and gas orifice.

MULTIPLE TUNNEL

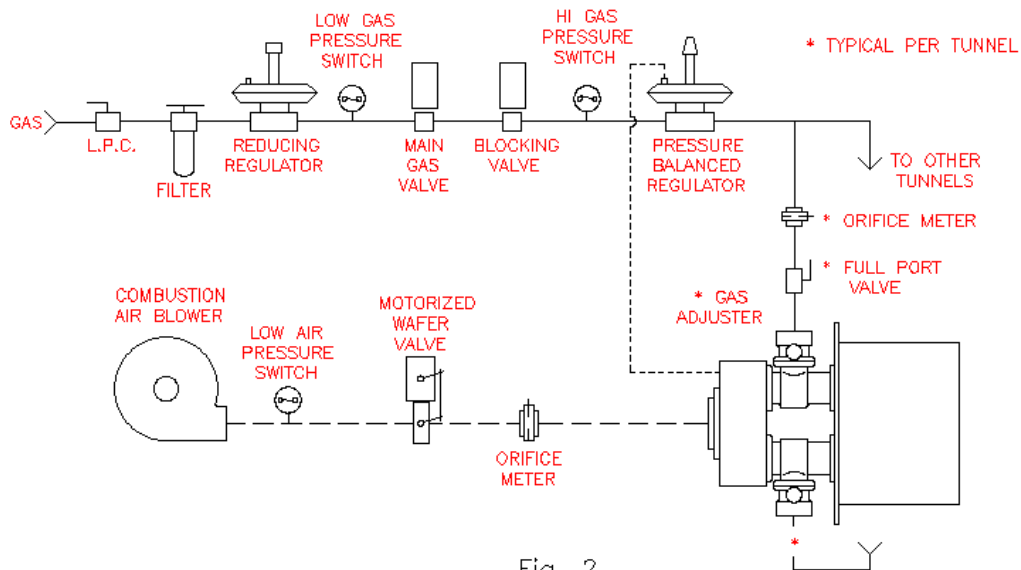


Fig. 2

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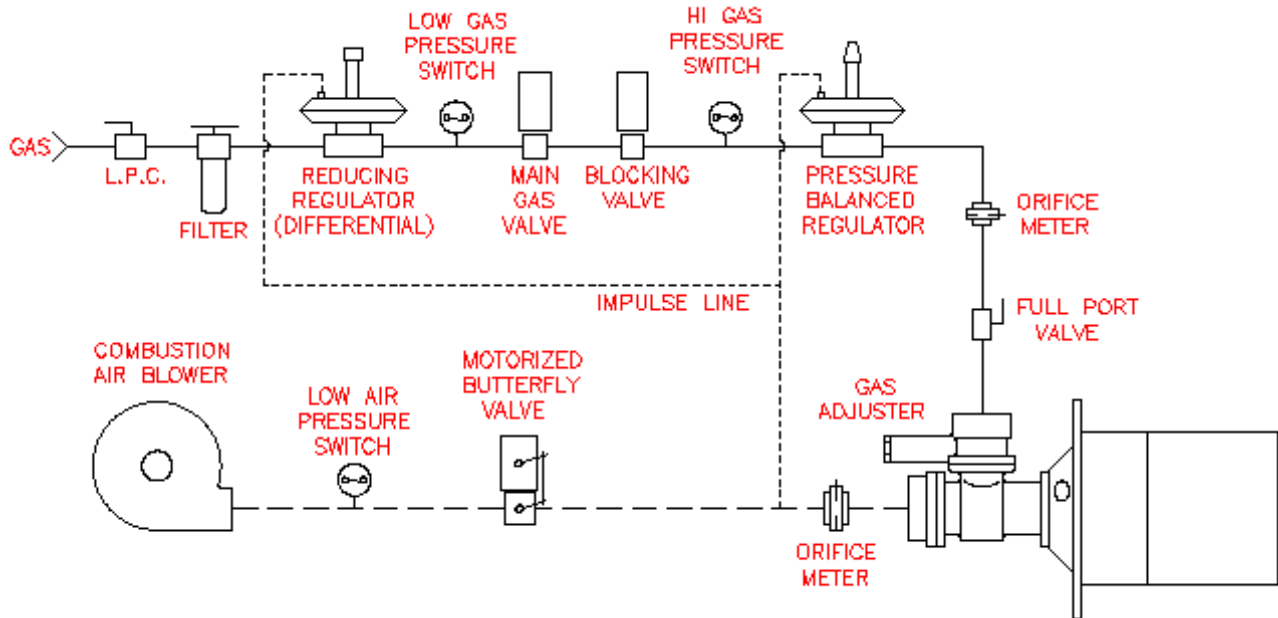
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BURNERS NOZZLE MIX SINGLE TUNNEL MULTIPLE TUNNEL

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BACK PRESSURE FIRING



With equal pressure drops across both orifices, the gas and air flows will maintain the same proportional relationship. The adjustable gas orifice is set at high fire for proper flame and locked. Once set, the fuel to air ratio will remain constant at all firing rates.

Inlet gas pressures to the Pressure Balanced Regulator must be higher than the blower maximum air pressure for proper operation.

When inlet gas pressure is less than blower air pressure a bleed type loader (5108 # 2TDL Loader) must be used. Gas outlet pressure will then be always proportional to the air pressure, and fuel to air ratios will be constant.

Flanged Orifice Plate meters are recommended at convenient points in the air and gas supply lines to the burners to measure flows. See pressure drop vs. flow calibration curves on Bulletin 5720.

One Pressure Balanced Regulator may supply any number of burners provided they are on the same control zone.

Heat input is controlled by the main air valve. Automatic modulation of input is easily obtained by using electric or pneumatic motors. See Bulletin 1301, 1302.

Multiple tunnel Nozzle Mix Burners operate the same as single tunnel units (see Fig. 2). Gas cocks are installed in supply lines to each mixer.

On initial start-up each tunnel is adjusted for proper fire individually. In operation all may be operated to fire as a single unit or tunnels may be phased off for wider turndown ratios.

Positive pressure combustion chamber firing with nozzle mixing burner systems (see Fig. 3) use a similar control system. Pressures must be increased to hold initial pressure drops on air and gas supplies at desired levels. Inlet gas pressures must be 1 psig to 10 psig higher than air pressure. Inlet air pressure must be above the furnace pressure. The air pressures shown in the capacity table on page 2 are the pressure drops required across the burners.

The Differential Regulator spring is normally set for 8 oz. outlet pressure without top loading. The added air impulse pressure causes the Differential Regulator to deliver gas outlet pressures always 1/2 psig above firing air pressure. The Pressure Balanced Regulator has a constant pressure drop permitting higher pressure operation.

BURNERS NOZZLE MIX SINGLE TUNNEL MULTIPLE TUNNEL

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PAGE NO.5

BACK PRESSURE FIRING WITH AIR REGULATION

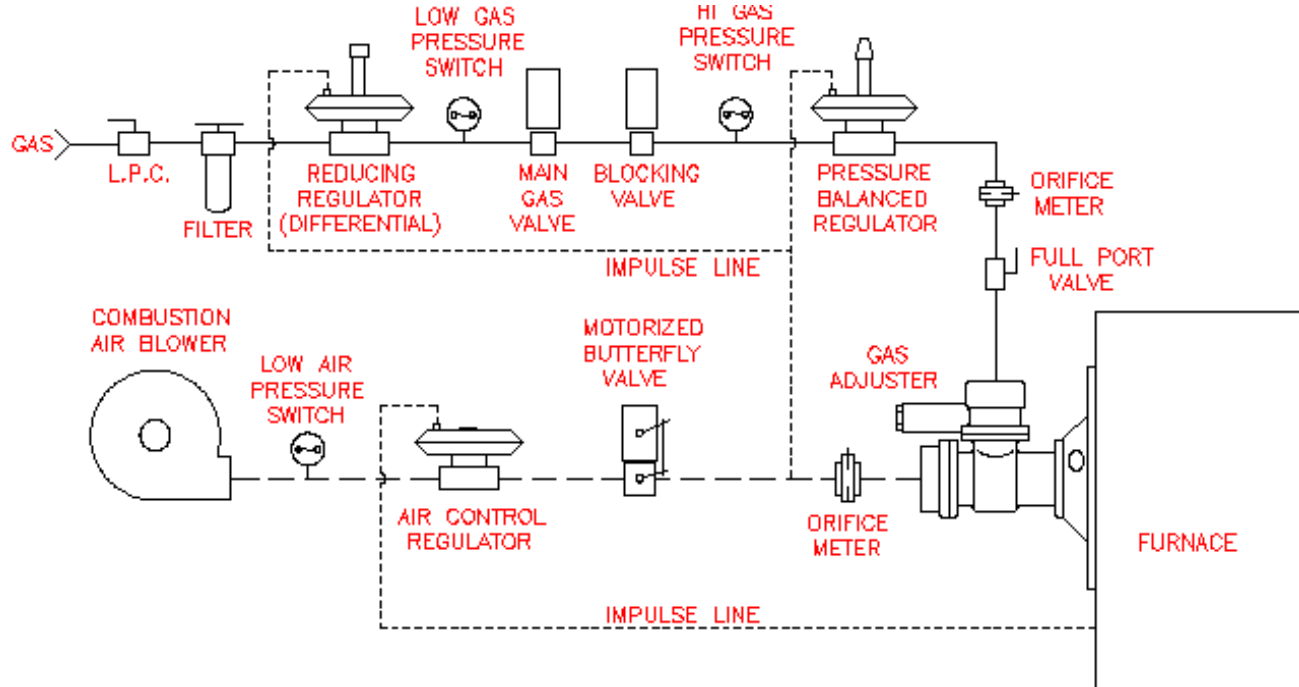


Fig. 4

Air control valves should be arranged to prevent maximum air pressure drop across burners from exceeding 12 psi.

Ignition of pilots and main burners under furnace pressures up to 10 psig is smooth and stable. Pilots should have a Differential and Pressure Balanced Regulator in the gas supply line similar to the main combustion system.

With varying furnace pressure conditions an air control regulator is set for desired high fire air pressure drop across the burner (see Fig. 4).

The furnace pressure impulse loading to the air regulator will provide a constant air pressure drop across the system. Closing the air control valve modulates the burner input. Inlet air and gas pressures to the system must be 1 psig to 10 psig higher than the maximum furnace pressures.

Operation of the system with pressure impulsed Pressure Balanced Regulators is the same as with the standard system in Fig. 1 except for the increased furnace pressures.

ORDERING INFORMATION

Select the number and sizes of Nozzle Mix Burners based on total heat input and heat patterns required.

Specify quantity and model numbers of burners.

Add a subscript to number to indicate type of burner block holder and refractory required.

- 1 With Std. Refractory less Jacket 3000°F.
- 2 With Hi-Temp. Refractory Less Jacket 3300°F.
- C With Alloy Jacket & Std. Refractory 3000°F.
- D With Alloy Jacket & Hi-Temp. Refractory 3300°F.
- E With Short Alloy Jacket & Std. Refractory 3000°F.
- F With Short Alloy Jacket & Hi-Temp. Refractory 3300°F.

Con't on Pg. 6

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BURNERS NOZZLE MIX SINGLE TUNNEL MULTIPLE TUNNEL

BULLETIN 3501 & 3506
PAGE NO. 6

4. Specify pilots or direct spark elect. (DSE)

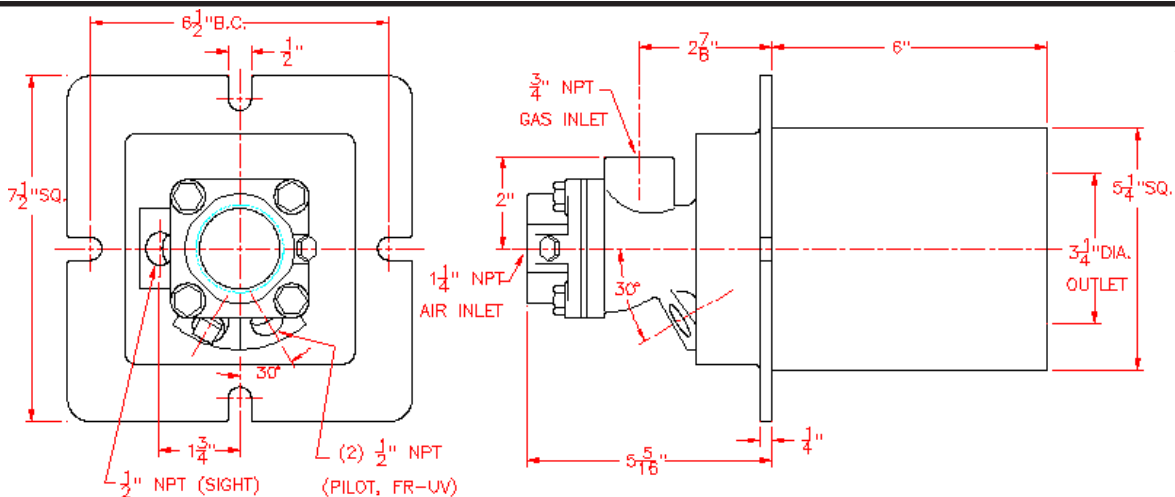
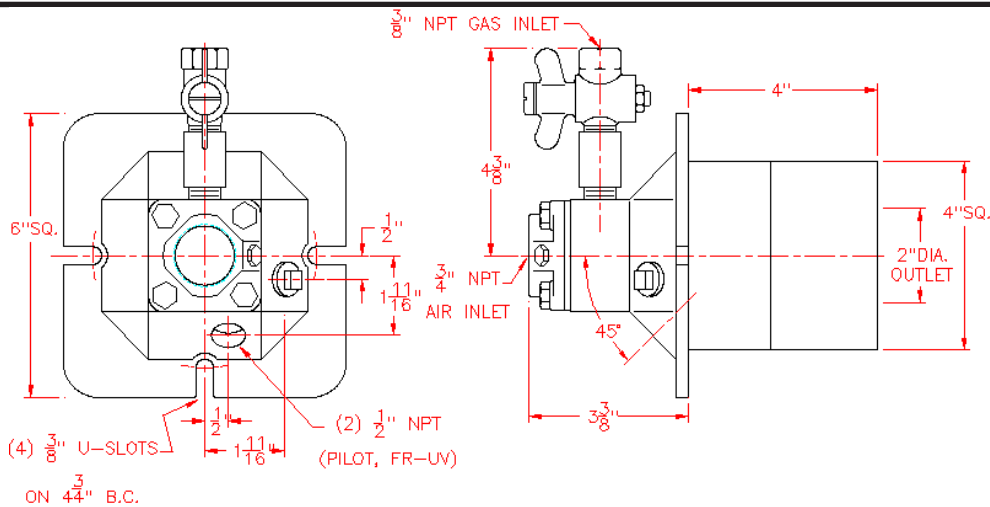
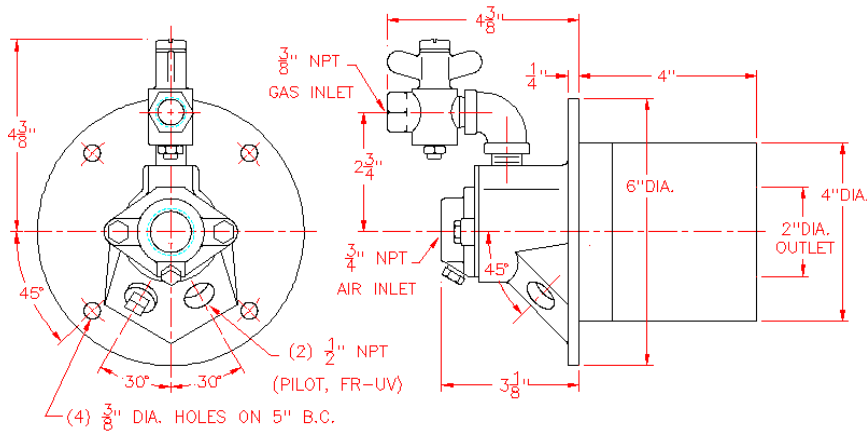
PILOTS

#41PBST for 101NM, 201NM
#62 or 64PBST for 301NM, 601NM, 1001NM, and 1501NM.
#84 or 86PBST for all others.

DIRECT SPARK ELECT.

DSE-10 for 101NM & 201NM
DSE-1 for 301NM through 2501NM
DSE-11 for 4001NM through 8001NM

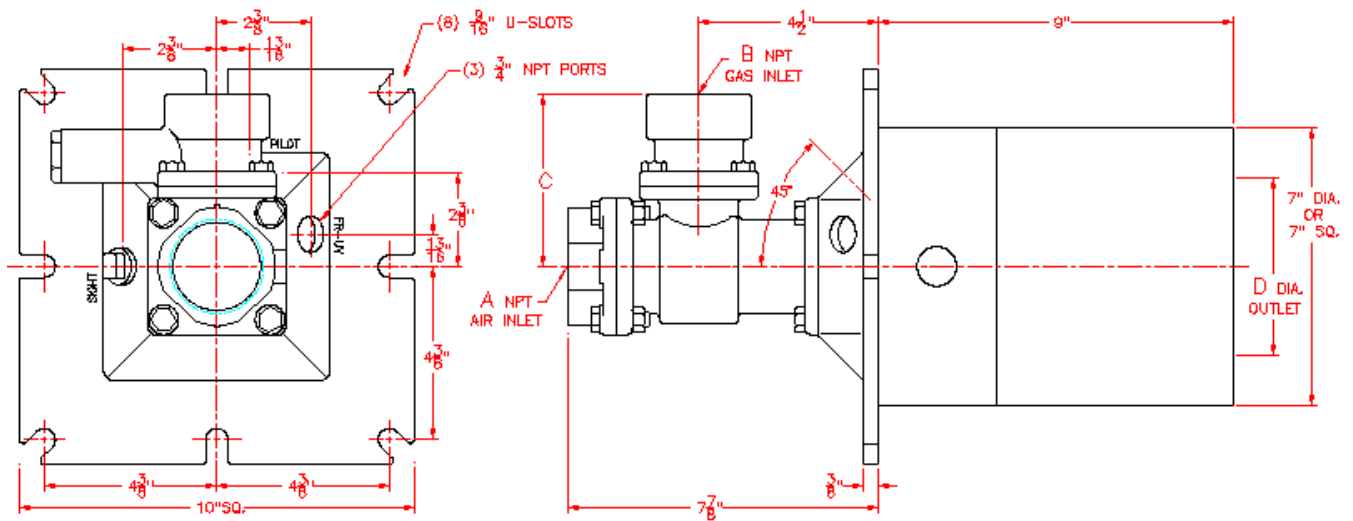
5. Specify accessory equipment such as blowers, gas and air regulators, manual reset safety shut off valves, orifice flow meters, gas cocks, air valves, controllers, etc.



BURNERS NOZZLE MIX SINGLE TUNNEL MULTIPLE TUNNEL

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PAGE NO. 7

| Model No. | A Air Inlet | B Gas Inlet | C | D |
|--------------------------|----------------|----------------|-------|-------|
| 301NM-F-R 301NM-F-S | 1-1/2 | 1 | 2-3/4 | 4-1/4 |
| 301NM-GA-R 301NM-GA-S | 1-1/2 | 1 | 3-3/4 | 4-1/4 |
| 601NM-F-R 601NM-F-S | 2 | 1-1/4 | 3-1/4 | 4-1/2 |
| 601NM-GA-R 601NM-GA-S | 2 | 1-1/4 | 4-1/4 | 4-1/2 |



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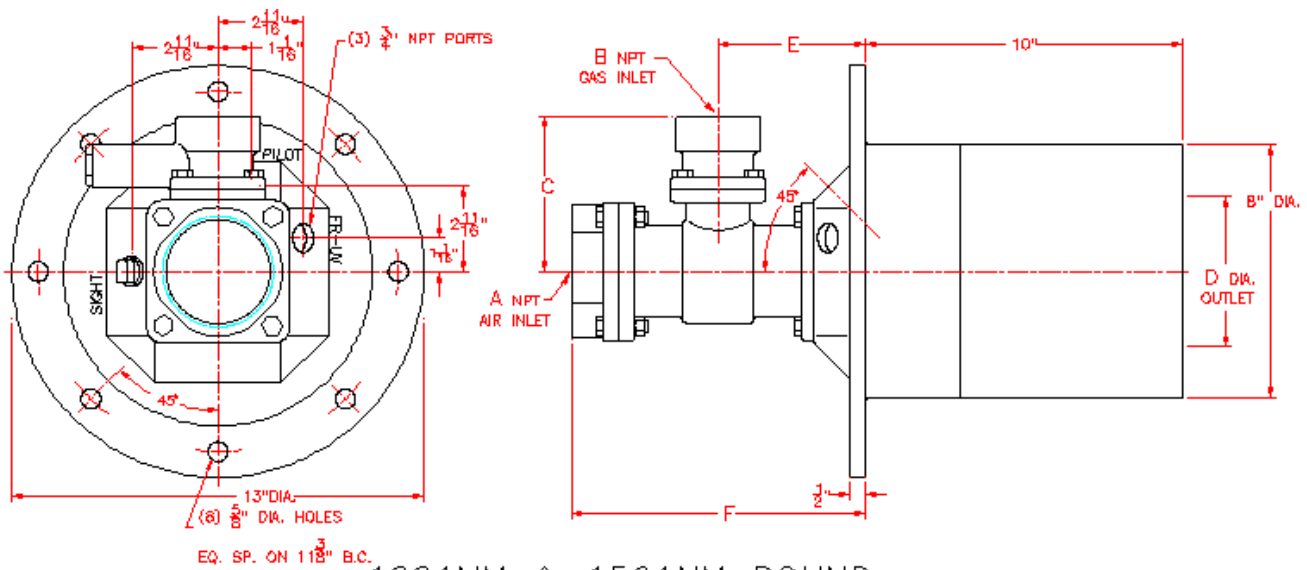
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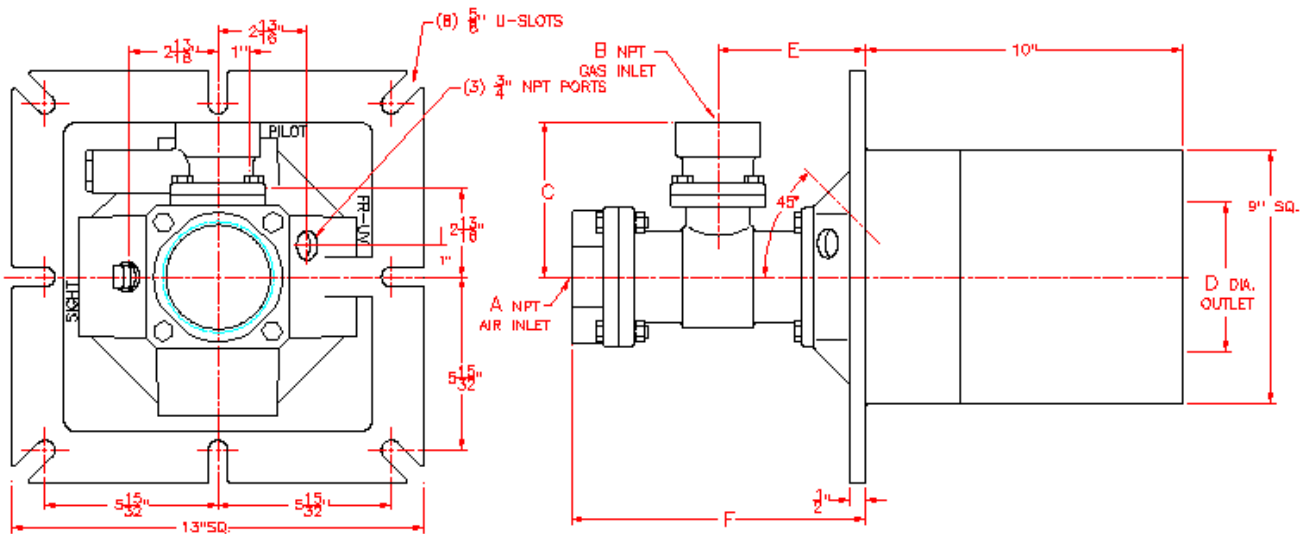
BURNERS NOZZLE MIX SINGLE TUNNEL MULTIPLE TUNNEL

BULLETIN 3501 & 3506
PAGE NO. 8

| Model No. | A Air Inlet | B Gas Inlet | C | D | E | F |
|----------------------------|----------------|----------------|-------|-------|-------|--------|
| 1001NM-F-R 1001NM-F-S | 3 | 1-1/4 | 3-3/4 | 4-3/4 | 4-5/8 | 9-1/4 |
| 1001NM-GA-R 1001NM-GA-S | 3 | 1-1/4 | 4-7/8 | 4-3/4 | 4-5/8 | 9-1/4 |
| 1501NM-F-R 1501NM-F-S | 3 | 2 | 3-3/4 | 5 | 5-1/2 | 10-1/8 |
| 1501NM-GA-R 1501NM-GA-S | 3 | 1-1/2 | 5-1/4 | 5 | 5-1/2 | 10-1/8 |



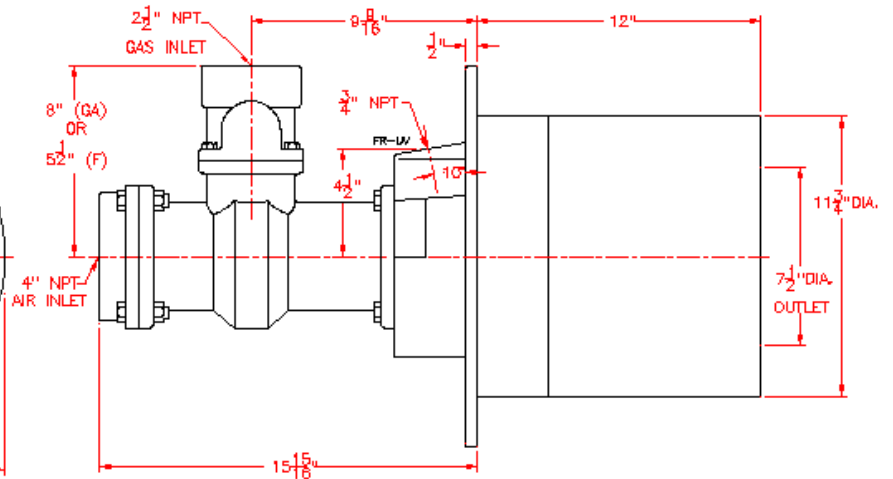
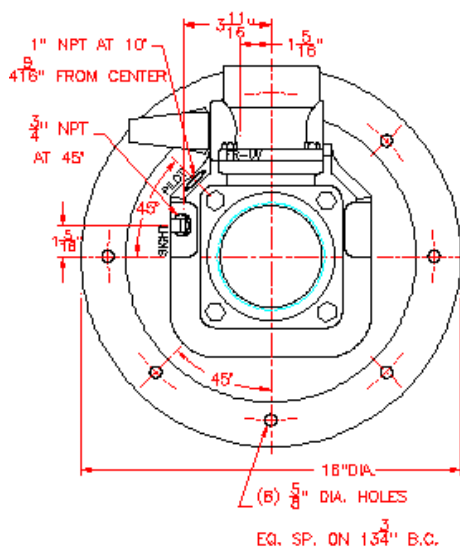
1001NM & 1501NM ROUND



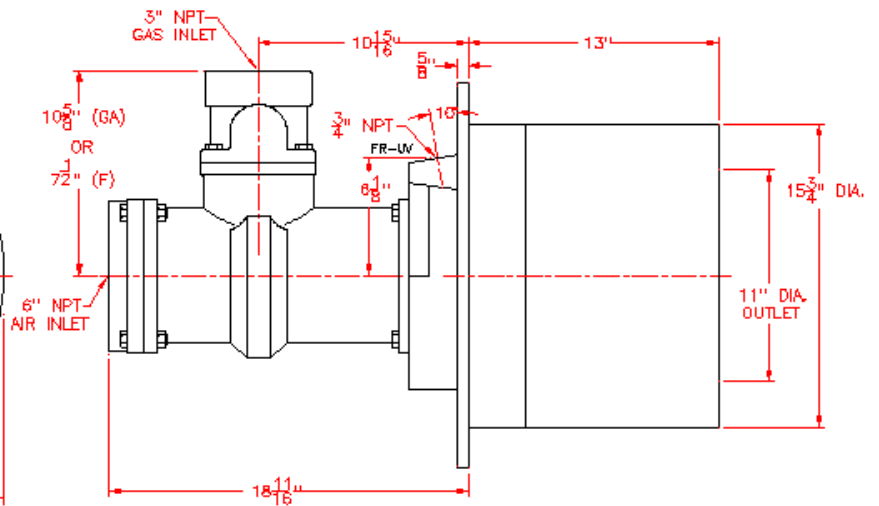
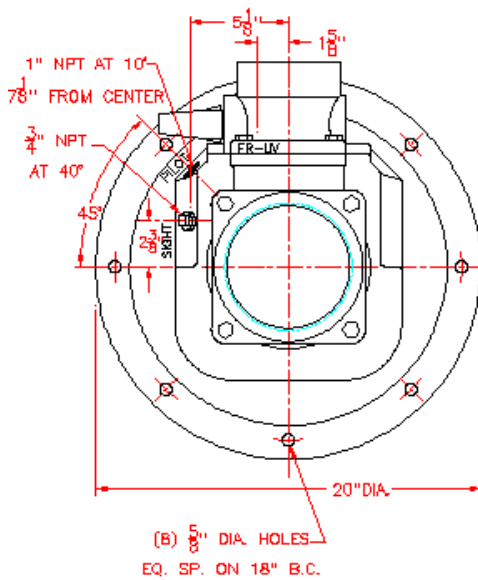
1001NM & 1501NM SQUARE

BURNERS NOZZLE MIX SINGLE TUNNEL MULTIPLE TUNNEL

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PAGE NO.9



2501 NM



4001 NM

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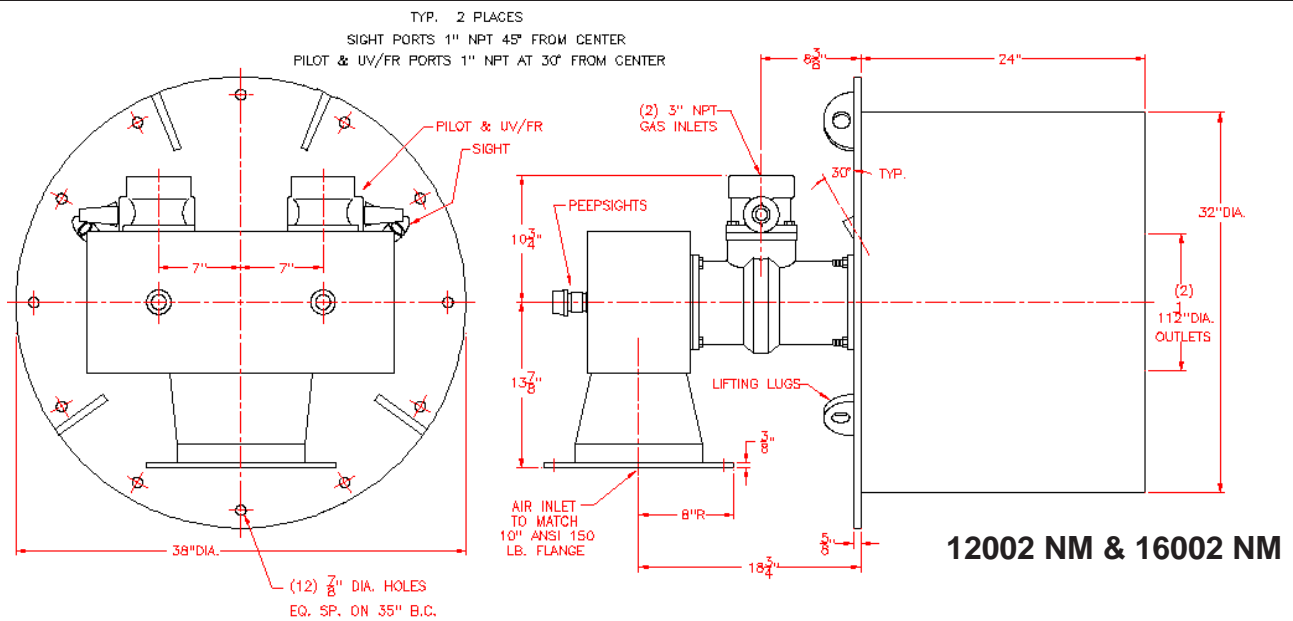
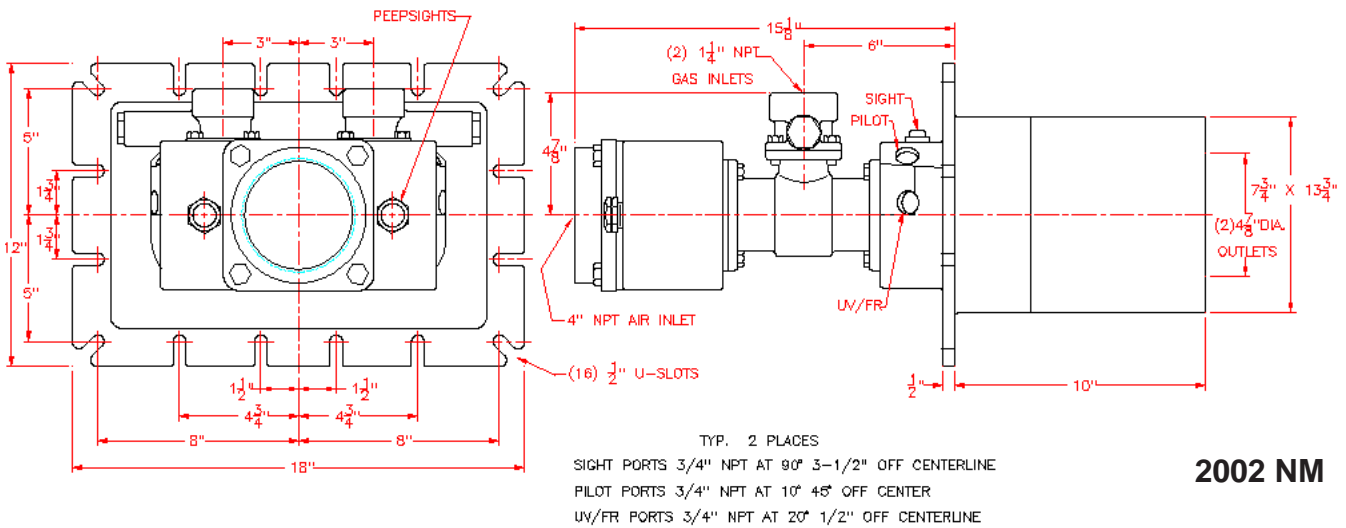
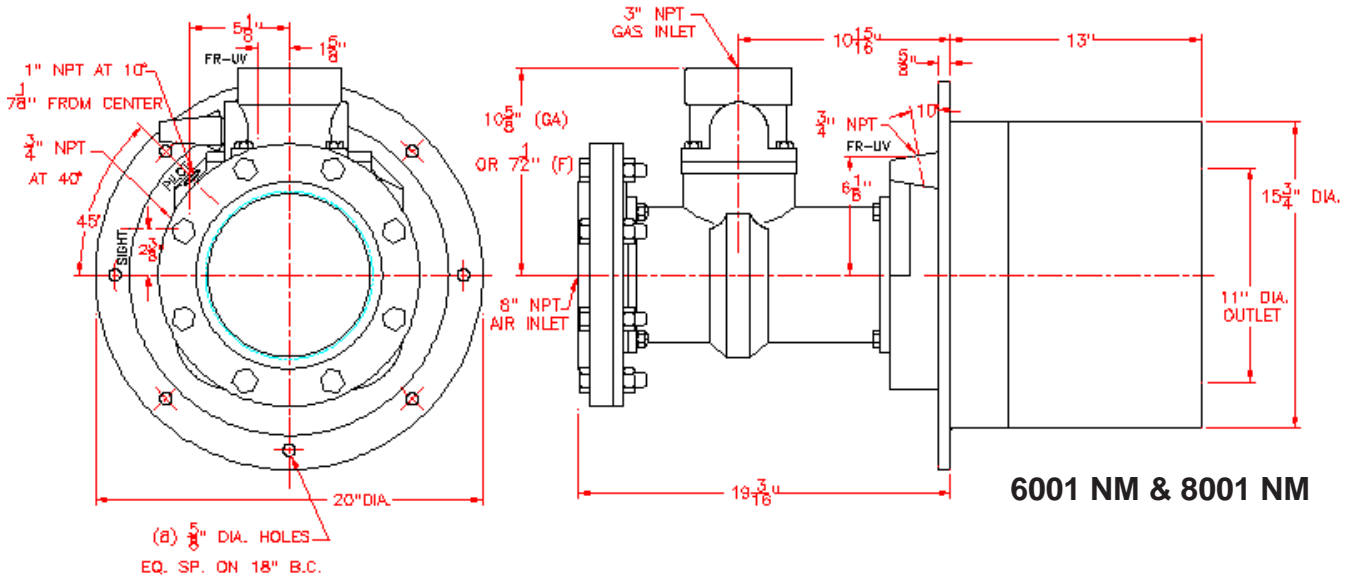


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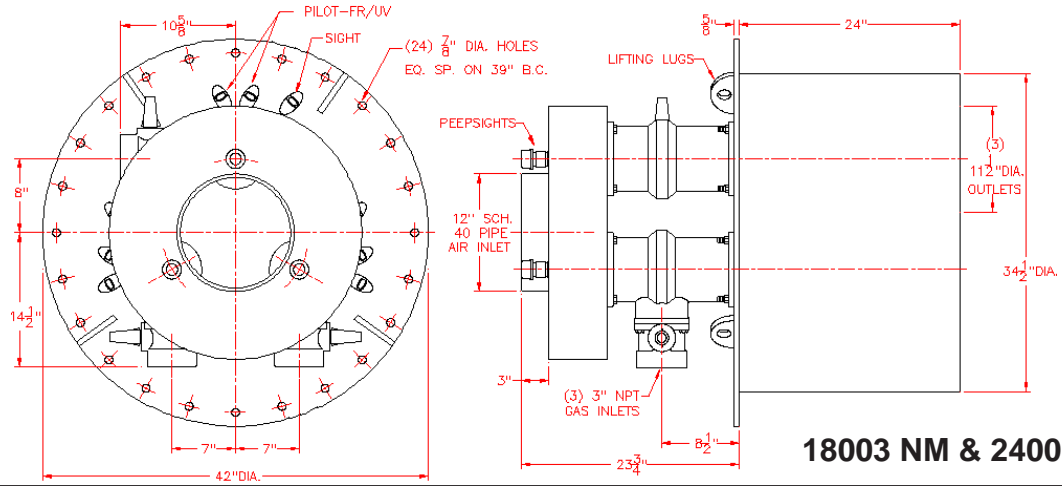
BULLETIN 3501 & 3506
PAGE NO. 10



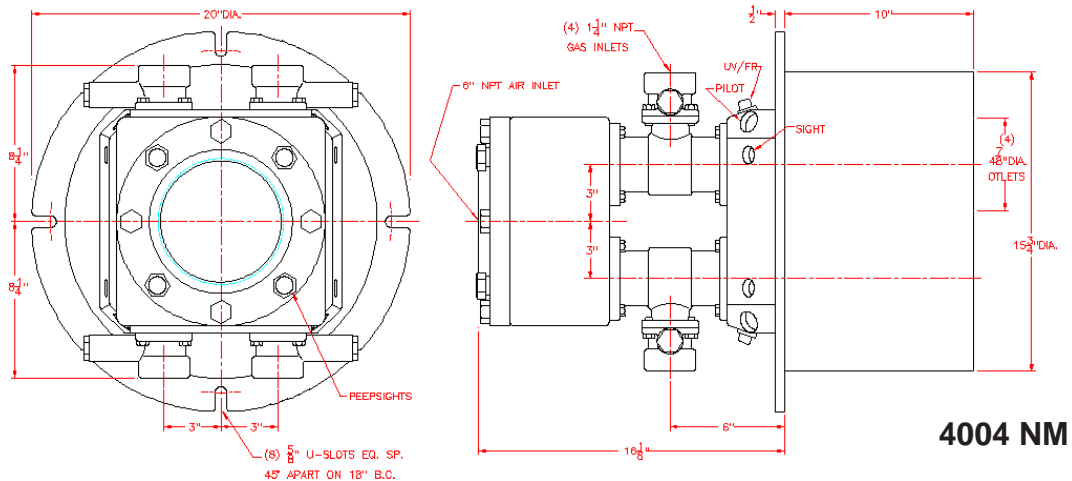
BURNERS NOZZLE MIX SINGLE TUNNEL MULTIPLE TUNNEL

BULLETIN 3501 & 3506
PAGE NO. 11

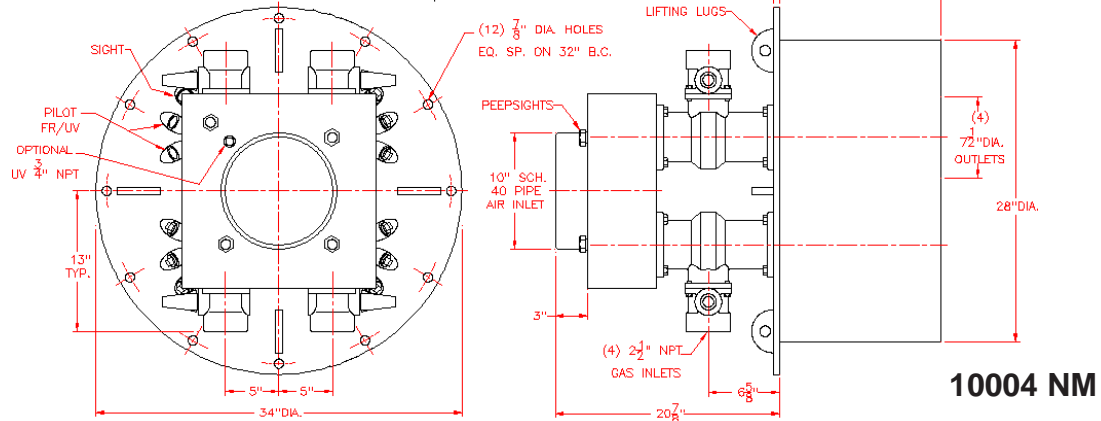
TYP. 3 PLACES
SIGHT PORTS 1" NPT AT 30°
PILOT & UV/FR PORTS 1" NPT AT 30°



TYP. 4 PLACES
SIGHT PORTS 3/4" NPT AT 10°, 3-1/2" OFF CENTERLINE
PILOT PORTS 1" NPT AT 10°, 45° OFF CENTER
UV/FR PORTS 3/4" NPT AT 20°, 3-1/2" OFF CENTERLINE



TYP. 4 PLACES
SIGHT PORTS 1" NPT AT 45°
PILOT & UV/FR PORTS 1" NPT AT 30°



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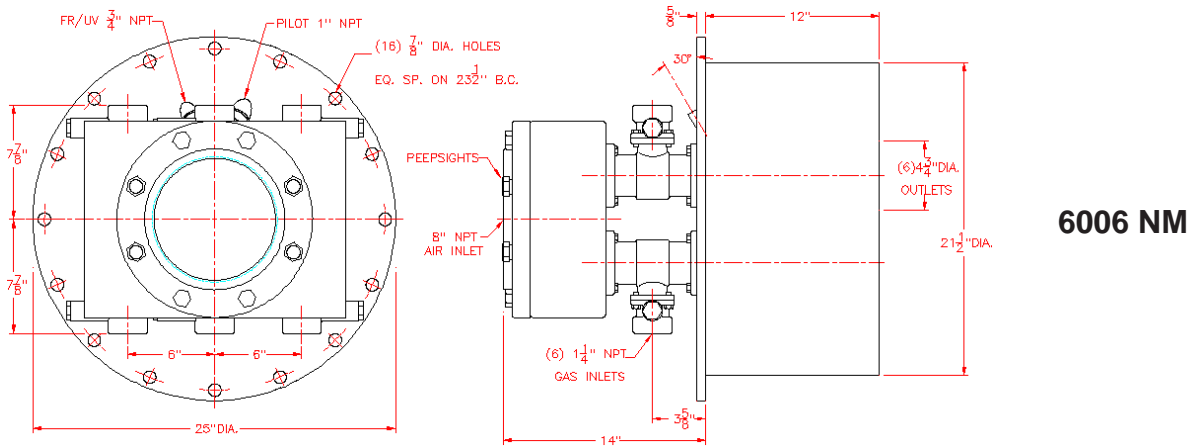
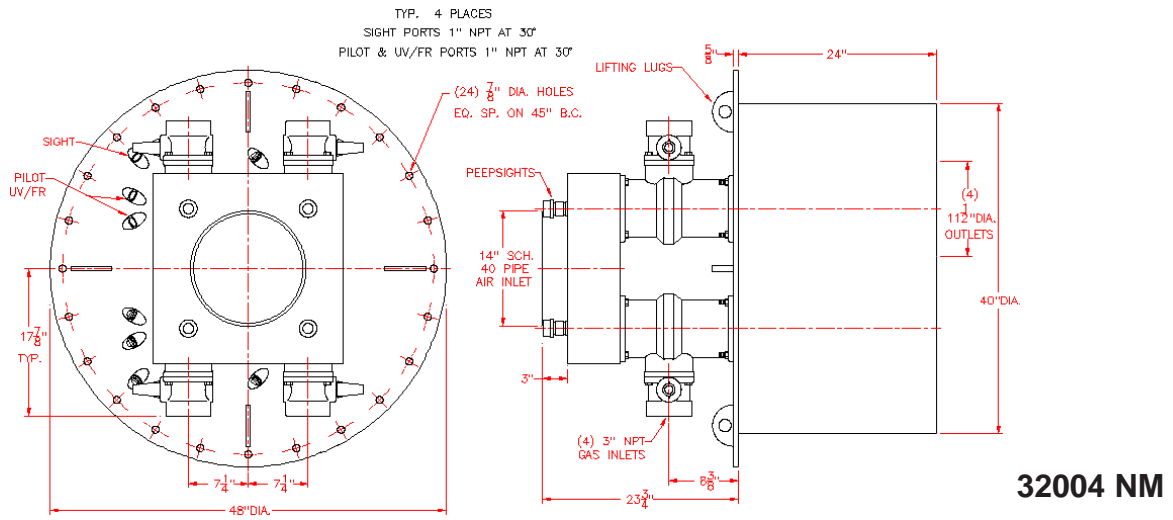


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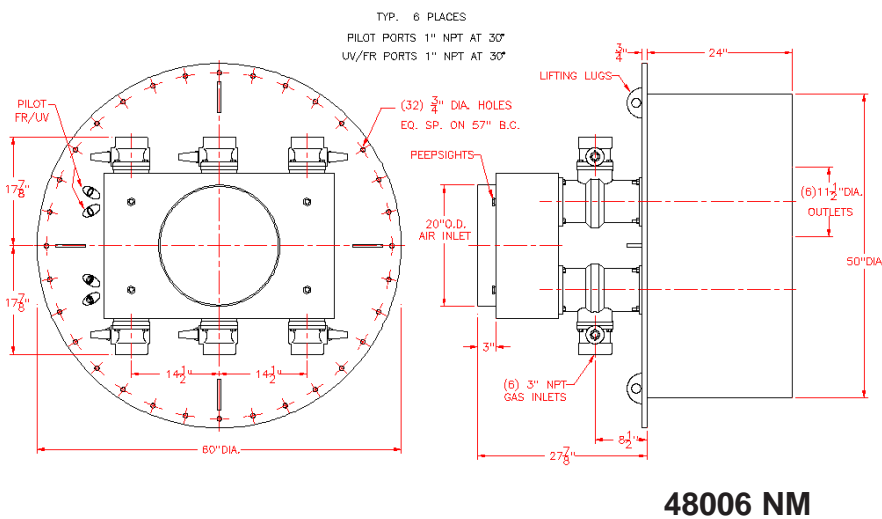
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BURNERS NOZZLE MIX SINGLE TUNNEL MULTIPLE TUNNEL

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WEIGHTS



| Model No. | Round | | Square | |
|-----------|--------|---------|--------|-------|
| | Lbs. | Kgs. | Lbs. | Kgs. |
| 101NM | 13.5 | 6.14 | 14 | 6.36 |
| 201NM | - | - | 21 | 9.55 |
| 301NM | 45.0 | 20.45 | 50 | 22.73 |
| 601NM | 45.0 | 32.27 | 100 | 22.73 |
| 1001NM | 71.0 | 31.82 | 95 | 45.45 |
| 1501NM | 70.0 | 71.82 | 95 | 43.18 |
| 2501NM | 158.0 | 71.82 | - | - |
| 4001NM | 260.0 | 118.18 | - | - |
| 6001NM | 330.0 | 150.00 | - | - |
| 8001NM | 330.0 | 150.00 | - | - |
| 2002NM | - | - | 148 | 67.27 |
| 4004NM | 300.0 | 136.36 | - | - |
| 6006NM | 520.0 | 236.36 | - | - |
| 10004NM | 885.0 | 402.27 | - | - |
| 12002NM | 1860.0 | 845.45 | - | - |
| 16002NM | 1860.0 | 845.45 | - | - |
| 18003NM | 1960.0 | 890.91 | - | - |
| 24003NM | 1990.0 | 904.55 | - | - |
| 32004NM | 2290.0 | 1040.91 | - | - |
| 48006NM | 2290.0 | 1327.27 | - | - |

Shipping weights are approximate, and will vary \pm 5% due to block styles.