



## BOOSTERS, INTENSIFIERS, AIR-OIL TANKS

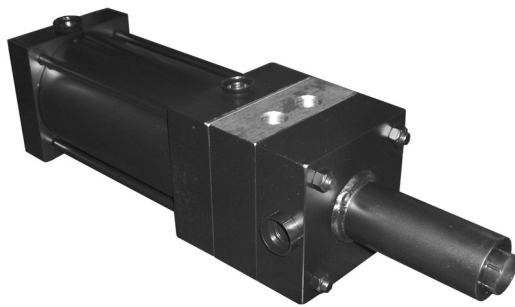
### DESIGNING WITH BOOSTERS: AIR-TO-OIL and OIL-TO-OIL

The terms BOOSTER and INTENSIFIER are used interchangeably to describe these practical devices that typically multiply standard shop air into higher hydraulic pressure (air-to-oil), although hydraulic fluid may also be the input medium (oil-to-oil). INTENSIFIERS tend to describe those products that provide very high pressure ratios. BOOSTERS generally provide lower pressure ratings and higher volume.

There are two basic styles of BOOSTERS and INTENSIFIERS. They are the "single" and the "dual" pressure styles. The SINGLE pressure device increases the pressure in the entire non-obstructed circuit. The DUAL pressure device increases the pressure only in the portion of the circuit after the high pressure output port.

### BOOSTER AND INTENSIFIER SELECTION

Proper selection of a booster or intensifier requires the following information:



1. The input air (fluid) pressure
2. The desired output pressure
3. The bore and stroke of the high pressure cylinder in the application
4. The desired output force from the high pressure cylinder
5. A sketch of the fluid power circuit (see page 48 for examples)
6. The type of line conductors and fitting connectors used in the circuit
7. How fast the system must operate (cycles per minute)
8. Booster or intensifier mounting style
9. General description of the application and environment (temperature, wash down, etc.)

### SELECTION FORMULAS

Using the above information, calculate the required values:

$$\frac{\text{HIGH PRESS. CYL. FORCE}}{\text{HIGH PRESS. CYL. AREA}} = \text{OUTPUT PRESSURE}$$

$$\frac{\text{OUTPUT PRESSURE X 1.05}}{\text{INPUT PRESSURE X .8}} = \text{PRESSURE RATIO}$$

$$\text{HIGH PRESSURE CYLINDER STROKE X HIGH PRESSURE CYLINDER AREA} = \text{HIGH PRESSURE CYLINDER VOLUME}$$

$$\frac{\text{HIGH PRESS. CYL. VOLUME}}{\text{RAM ROD AREA X .95}} = \text{MINIMUM STROKE LENGTH}$$

$$\text{MINIMUM STROKE LENGTH} + .25 = \text{EFFECTIVE STROKE LENGTH (ROUND UP TO NEAREST .25 INCH)}$$

The .95 and 1.05 multipliers allow for friction and expansion in the hydraulic system. The .8 multiplier allows for normal variations in air line pressure. These values are general guidelines and must be adjusted accordingly.

## BOOSTERS, INTENSIFIERS, AIR-OIL TANKS (Cont.)

### SAMPLE CALCULATION: BOOSTER / INTENSIFIER SIZING

Assume a 2-1/2" dia. bore cylinder with 6" stroke. The cylinder must push 10,000 pounds for .250 inches. The cylinder must extend and retract on pressurized air or oil at 100 PSI.

What size intensifier is required?

What size air-oil tank?

$\frac{\text{HIGH PRESS. CYL. FORCE}}{\text{HIGH PRESS. CYL. AREA}} = \text{OUTPUT PRESSURE}$	$\frac{10,000 \text{ POUNDS}}{2.5^2 \times .7854} = 2,037 \text{ PSIG}$
$\frac{\text{OUTPUT PRESSURE} \times 1.05}{\text{INPUT PRESSURE} \times .8} = \text{PRESSURE RATIO}$	$\frac{2,037 \text{ PSIG} \times 1.05}{(100 \text{ PSIG} \times .8)} = 26.74$
<p>HIGH PRESSURE CYLINDER STROKE X HIGH PRESSURE CYLINDER AREA = HIGH PRESSURE CYLINDER VOLUME                  The high pressure cylinder stroke is .250 x .490 square inches = 1.23 cubic inches</p>	
$\frac{\text{HIGH PRESS. CYL. VOLUME}}{\text{RAM ROD AREA} \times .95} = \text{MINIMUM STROKE LENGTH}$	$\frac{1.23 \text{ Cubic Inch}}{.31 \text{ (from Ratio Chart below)} \times .95} = 4.17 \text{ Inches}$
<p>MINIMUM STROKE LENGTH + .25 = EFFECTIVE STROKE LENGTH (ROUND UP TO NEAREST .25 INCH)                  The minimum stroke length 4.17 plus .25 = 4.42 inch effective stroke, rounding up to 4.5 inches total stroke</p>	

The following intensifiers can be used for this sample application. Choose among the three by the space available for the intensifier. Consult Lehigh for additional application assistance. (See page 48 for air-oil tank selection.)

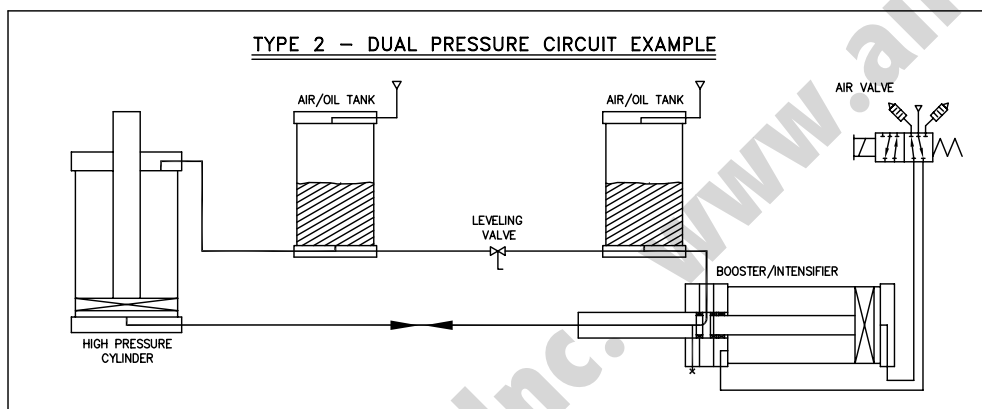
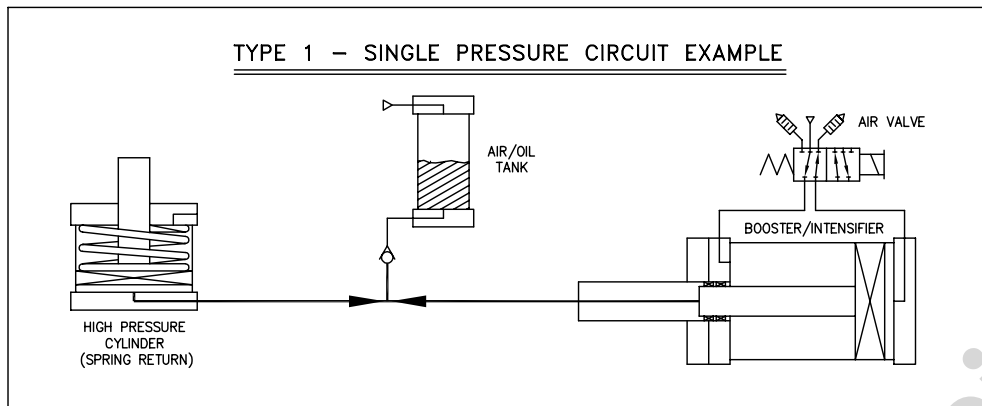
3-1/4" dia. bore x 5/8" ram dia. x 4-1/2" stroke

4" dia. bore x 5/8" ram dia. x 4-1/2" stroke

6" dia. bore x 1" ram dia. x 2" stroke

RAM ROD DIA.	RAM ROD AREA (SQ. IN.)	PRESSURE RATIOS (BORE AREA / RAM AREA)							
		BORE SIZE (BORE AREA)							
		3 1/4 (8.29 SQ. IN.)	4.0 (12.57 SQ. IN.)	5.0 (19.64 SQ. IN.)	6.0 (28.27 SQ. IN.)	8.0 (50.27 SQ. IN.)	10.0 (78.54 SQ. IN.)	12.0 (113.10 SQ. IN.)	
5/8	.31	26.74	40.55	63.35	---	---	---	---	
1	.79	10.49	15.91	24.86	35.78	63.63	---	---	
1 3/8	1.49	5.56	8.44	13.18	18.97	33.75	52.71	---	
1 3/4	2.41	3.44	5.22	8.15	11.73	20.86	32.59	46.93	
2	3.14	2.64	4.00	6.25	9.00	16.00	25.01	36.02	
2 1/2	4.91	---	---	---	5.76	10.24	15.99	23.03	
3	7.06	---	---	---	---	---	11.12	16.02	
3 1/2	9.62	---	---	---	---	---	---	11.76	

## BOOSTERS, INTENSIFIERS, AIR-OIL TANKS (Cont.)



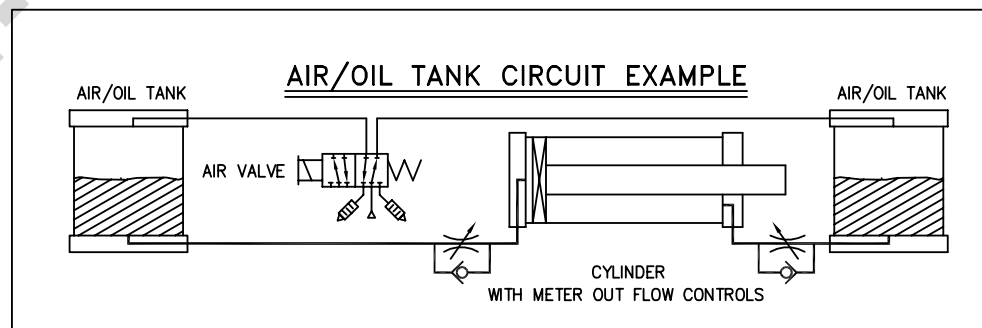
### SAMPLE CALCULATION: AIR-OIL TANK SIZING

$$\frac{\text{BORE}^2 \times .7854 \times \text{STROKE} \times \text{TANK FACTOR}^*}{\text{TANK VOLUME PER INCH}} = \text{MINIMUM TANK LENGTH} \quad \frac{2.5^2 \times .7854 \times 6 \times 2.5}{8.3 \text{ (from chart on p. 50)}} = 8.87 \text{ INCHES}$$

(Use the bore diameter of the working cylinder for  $\text{BORE}^2$ . Use the stroke of the working cylinder for  $\text{STROKE}$ . The  $\text{TANK VOLUME PER INCH}$  is from the chart on p.50. The volume selected for the formula yields the minimum tank length for the associated tank bore.)

ROUND THE TANK LENGTH UPWARD TO THE NEAREST WHOLE INCH: 8.87 rounds to 9.0 inches long

\*The "Tank Factor" varies with tank length, but is generally between 2 and 3 depending on the tank application.



**Note:** Sample circuits are for concept illustration purposes only. Additional safety devices, controls and lockouts are required for safe operation.





