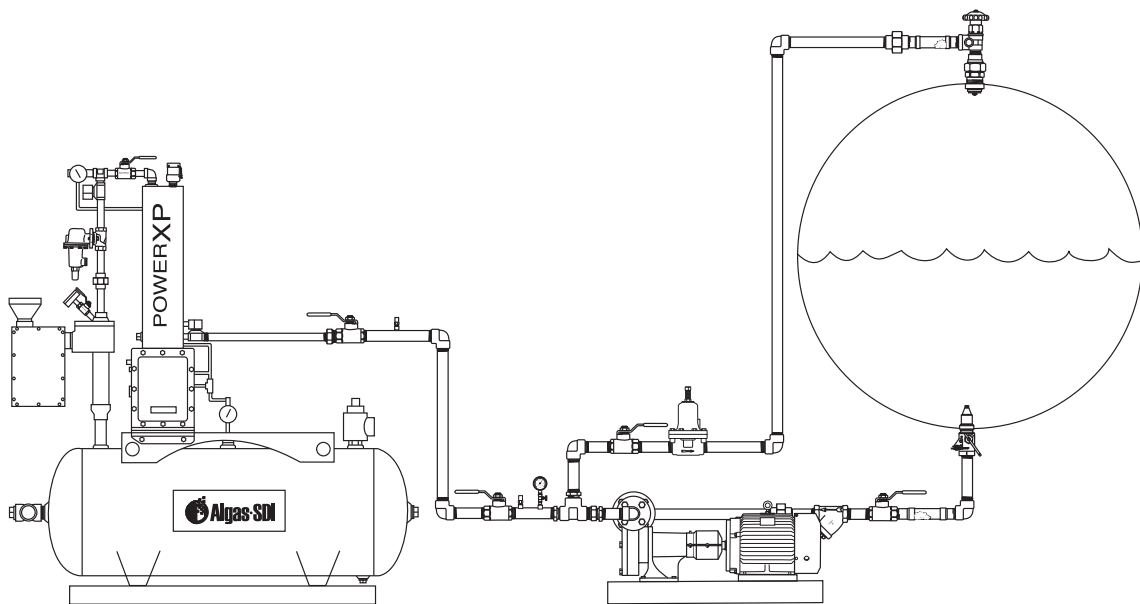


Propane/Air System Pumps



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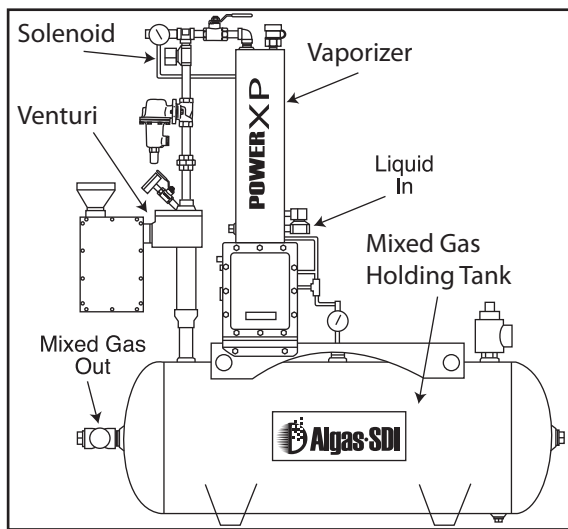
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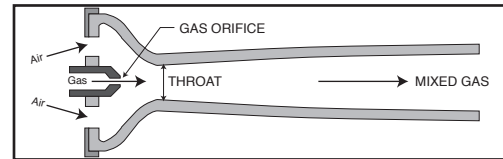
Propane/Air Mixers

Many industrial firms purchase their natural gas on an interruptible basis. Most of these firms use a propane/air mixing system as a substitute fuel during times of curtailment. While other styles of gas mixing equipment is available, the most common style is a venturi system mainly due to initial cost considerations.

The venturi mixer requires an elevated propane pressure to operate. If we drive gas through a venturi at an adequate velocity, we can entrain enough air to develop a usable mixture and then store this mixture in a holding tank to be used in the building's gas system. A typical venturi mixer requires an inlet pressure between 80 and 125 psig. Because this required pressure is not naturally available from a propane storage tank, we use a pressurizing pumpset to deliver the elevated pressure to the mixer.



Mixer Components



Venturi Diagram

Pump Considerations for Propane/Air Mixers

A pumpset for use in a propane/air mixing system is similar in design to the familiar pumps used for liquid propane transfer operations such as storage tank or truck filling. But unlike liquid transfer operations which use a varying differential pressure to effect the product transfer, a mixing system requires a steady elevated pressure to ensure a consistent velocity through the venturi to maintain an accurate mix. This requires a few specialized components in the pumpset.

Bypass Valves

The bypass valve which controls the pump discharge pressure must be of the so-called absolute style. A conventional bypass valve commonly used in liquid transfer operations senses the difference in pressure between the storage tank and the pump discharge. This style bypass valve by design allows the line delivery pressure to vary with changing tank pressure and is inappropriate for a mixer system. By contrast, the absolute style bypass valve senses the difference in the line delivery pressure and atmospheric pressure. The line delivery pressure can be held at a constant value as required by the venturi regardless of the tank storage pressure.

Pump Considerations for Propane/Air Mixers (cont.)

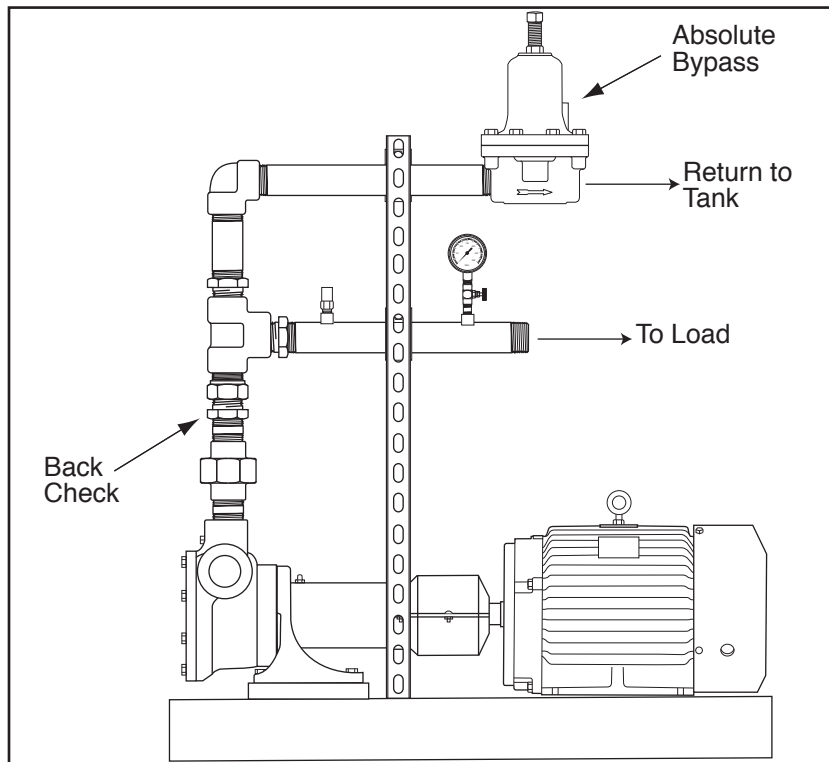
Check Valves

A check valve is required on the pump discharge to isolate the pump from the line delivery pressure. It is important to understand that the pump is delivering product to a vaporizer on the mixer assembly and not to a venturi. As the liquid propane is heated in the vaporizer, it expands significantly and drives liquid back toward the pump. The check valve “hides” the pump from this back flow which streams through the bypass and back to the storage tank.

System Pressure

The required delivery pressure to a particular venturi mixer is set by the mixer manufacturer and can be found in the spec sheets for the unit. In general, a higher mixed gas delivery pressure from the mixer to the load will require a corresponding higher pump delivery pressure to the mixer. As an example, a mixer with a 2 psig discharge pressure may only require a pump pressure of 60 psig. A similar mixer with a 5 psig discharge pressure may require a pump pressure of 80 psig.

Because a pump’s capacity falls and the the motor’s HP climbs with increasing discharge pressures, great care must be taken in selecting the correct pump for any particular application. Additionally, curtailment from natural gas nearly always occurs during the coldest days of the year when the storage tank pressure is low (even down to 5 psig). The pump is quite often required to provide nearly all the motive pressure to the mixer without the aid of any inlet pressure from the storage tank.



Pressurizing Pumpset

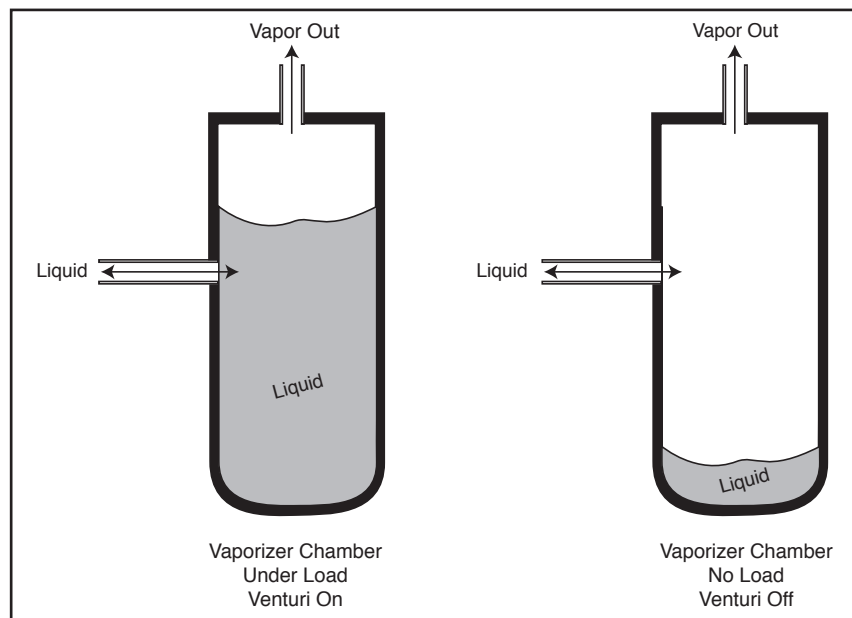
Pump Considerations for Propane/Air Mixers (cont.)

Pump Volume

As mentioned earlier in our discussion, the pump is delivering product to a vaporizer on the mixer assembly and not to the venturi. This is very important to understand during pump selection. When the mixed gas holding tank is fully charged, the venturi solenoid valve turns off stopping the flow through the venturi. The vaporizer continues to heat and boils the remaining liquid out of the vaporizer chamber until it is filled with vapor. The liquid volume displaced by this expanding vapor is pushed back toward the pump. The entire pump volume is now flowing through the bypass valve and is returning to storage.

When the venturi solenoid valve reopens to provide mixed gas to the load, the vapor volume in the vaporizer tank empties rapidly. To maintain the operating pressure, this vapor volume must be replaced just as rapidly by a liquid volume from the pump. The resulting surge in liquid volume is quite a bit larger than the system's normal load and can create extreme vapor formation in the pump and the line feeding the pump. A pump not sized with this additional volume requirement in mind will surely vapor lock and drop the system out.

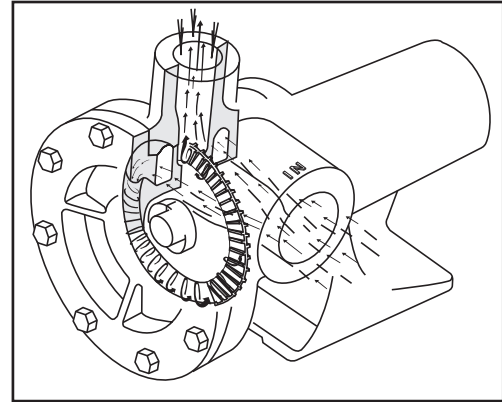
We must also keep in mind that during venturi off time, the entire pump volume is running through the bypass valve. During the short but definite time that it takes for the bypass valve to close in reaction to the new load, the pump must supply both the liquid volume surge to refill the vaporizer and the liquid volume still running through the bypass valve.



Vaporizer Chamber Diagram

Pump Design

For Propane/Air mixer feeds, the preferred pump design incorporates the regenerative turbine such as the Corken Coro-Flo models. The Coro-Flo pump handles volatile liquids smoothly and quietly without the noise, vibration and pulsations of positive displacement gear and sliding vane pumps. The one moving part, the impeller, floats on the shaft with no rubbing, grinding or metal-to metal contact. The free floating impeller with teeth cut on both sides picks up the fluid and creates a spiraling motion around the circumference of each side. The fluid is slightly accelerated and pressurized in dozens of small steps creating a smooth, quiet, overall product flow. With only a single pump seal and it's free-floating impeller, the maintenance on these pumps is easy and very infrequent.



Regenerative Turbine Pump

From both an operational and maintenance perspective, the Coro-Flo pump provides superior performance. As just mentioned, propane is a volatile fluid. Because the product is stored at its boiling point, any fluid flow, say from the storage tank to the pump inlet, creates vapor bubbles in the liquid stream. This makes smooth, consistent flow difficult even under the best of conditions. The regenerative turbine tends to smooth out these blips in flow in large part by a stepwise fluid acceleration within the pump.

Pumps used in Propane/Air mixer service are also called upon to perform nonstop for extended periods of time. When the facility is required to go on propane backup service, the pump is turned on and runs continuously while the mixer is running. The pump may run nonstop for hours or even days. The Coro-Flo pump with no abrading parts is designed for this service.

Pump Flow Requirements

The required load capacity of a mixing system is commonly given in BTU/HR. Because there is approximately 91,690 BTU/gallon of propane, dividing by this number will convert the load to the required GPH of liquid propane (that's Gallons per Hour). Because the pumps are rated in GPM, we must also divide the GPH by 60.

Example:

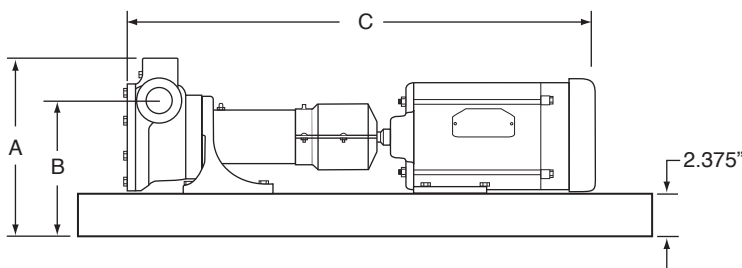
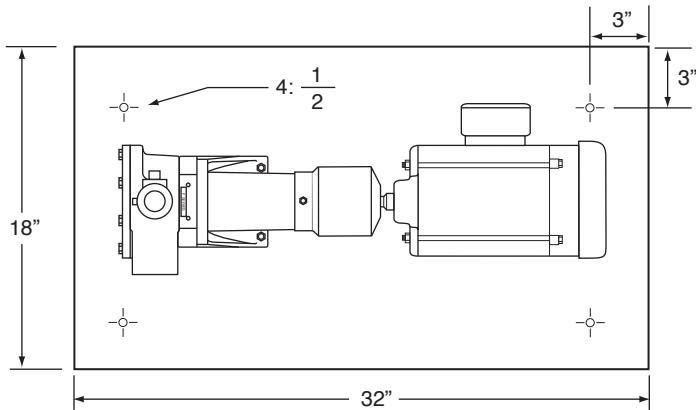
A 14,000,000 BTU/HR mixer represents a pump load of 2.5 GPM ($14,000,000 \div 91,690 \div 60$). This is the rated full load of the mixer in terms of GPM. It is the GPM the pump is required to provide to the mixer when the mixer is running at full capacity. But as discussed earlier, the pump also needs to provide capacity to vaporizer chamber refill and pump bypass flow. The pump we select must be 2 to 3 times this value. A pump with a rating of 7.5 GPM (2.5×3) is the correct choice for this 14,000,000 BTU/HR system.

$$\text{Pump Flow} = \text{Mixer Flow} + \text{Vaporizer Chamber Flow} + \text{Bypass Flow}$$

Coro-Flo F Series Pumps

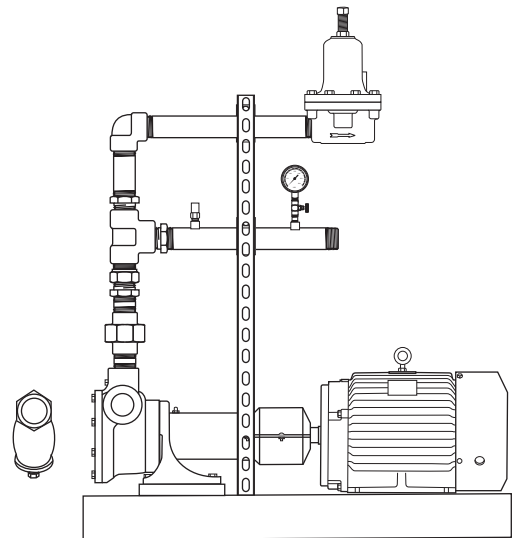
These assemblies provide a complete pump pressurizing package specifically for continuous duty, steady pressure applications. Well suited to standby work.

Assemblies include a single Corken pump, inlet strainer, absolute bypass, discharge check valve and all necessary relief valves and gauges. All components are prepped on a common base for ease of installation.



CAPACITIES (AT 80 PSID)

PUMP	INLET	OUTLET	GPM
F12	1-1/2"	1"	11
F13	1-1/2"	1"	16
F14	1-1/2"	1"	24



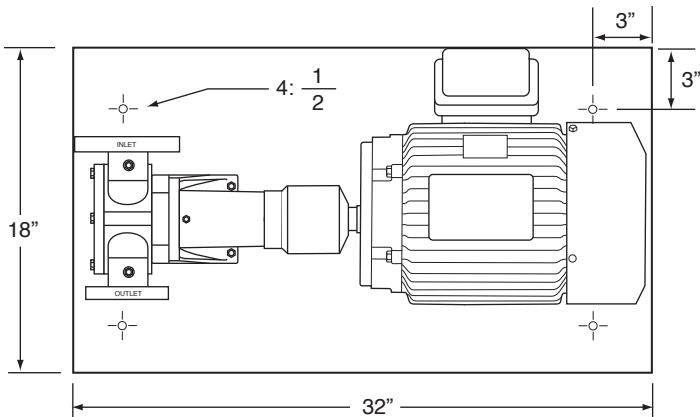
SPECIFICATIONS

PUMP	HP	PHASE	VOLTS	FRAME	A	B	C	WEIGHT NO MOTOR	WEIGHT W/MOTOR
F12	2	1	115/208-230	145T	10.875"	8.125"	29.11"	125#	185#
		3	230/460	145T	10.875"	8.125"	28.23"	127#	177#
F13	3	1	115/230	184T	10.875"	8.125"	30.42"	125#	206#
		3	230/460	145T	10.875"	8.125"	30.48"	125#	194#
			208-230/460	184	11.875"	9.125"	28.55"	125#	189#
F14	5	3	230/460	184T	11.875"	9.125"	31.12"	140#	218#

Coro-Flo FF Series Pumps

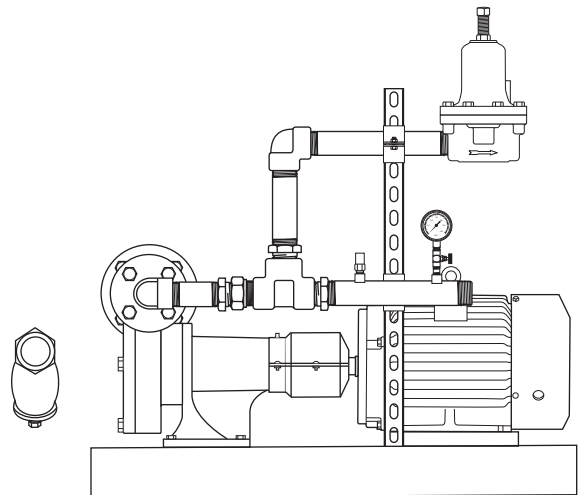
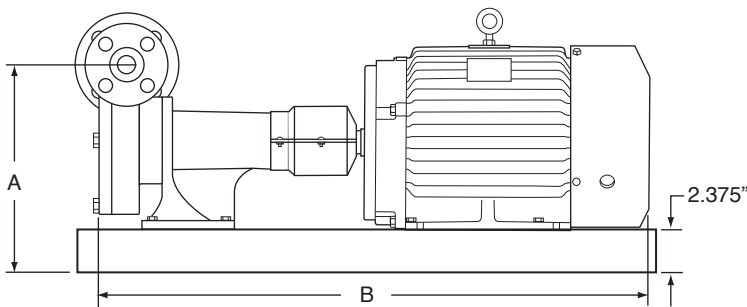
These assemblies provide a complete pump pressurizing package specifically for continuous duty, steady pressure applications. Well suited to standby work.

Assemblies include a single Corken pump, inlet strainer, absolute bypass, discharge check valve and all necessary relief valves and gauges. All components are prepped on a common base for ease of installation.



CAPACITIES (AT 80 PSID)

PUMP	INLET	OUTLET	GPM
FF060	1-1/2"	1"	16
FF075	1-1/2"	1"	32
FF150	1-1/2"	1"	44



SPECIFICATIONS

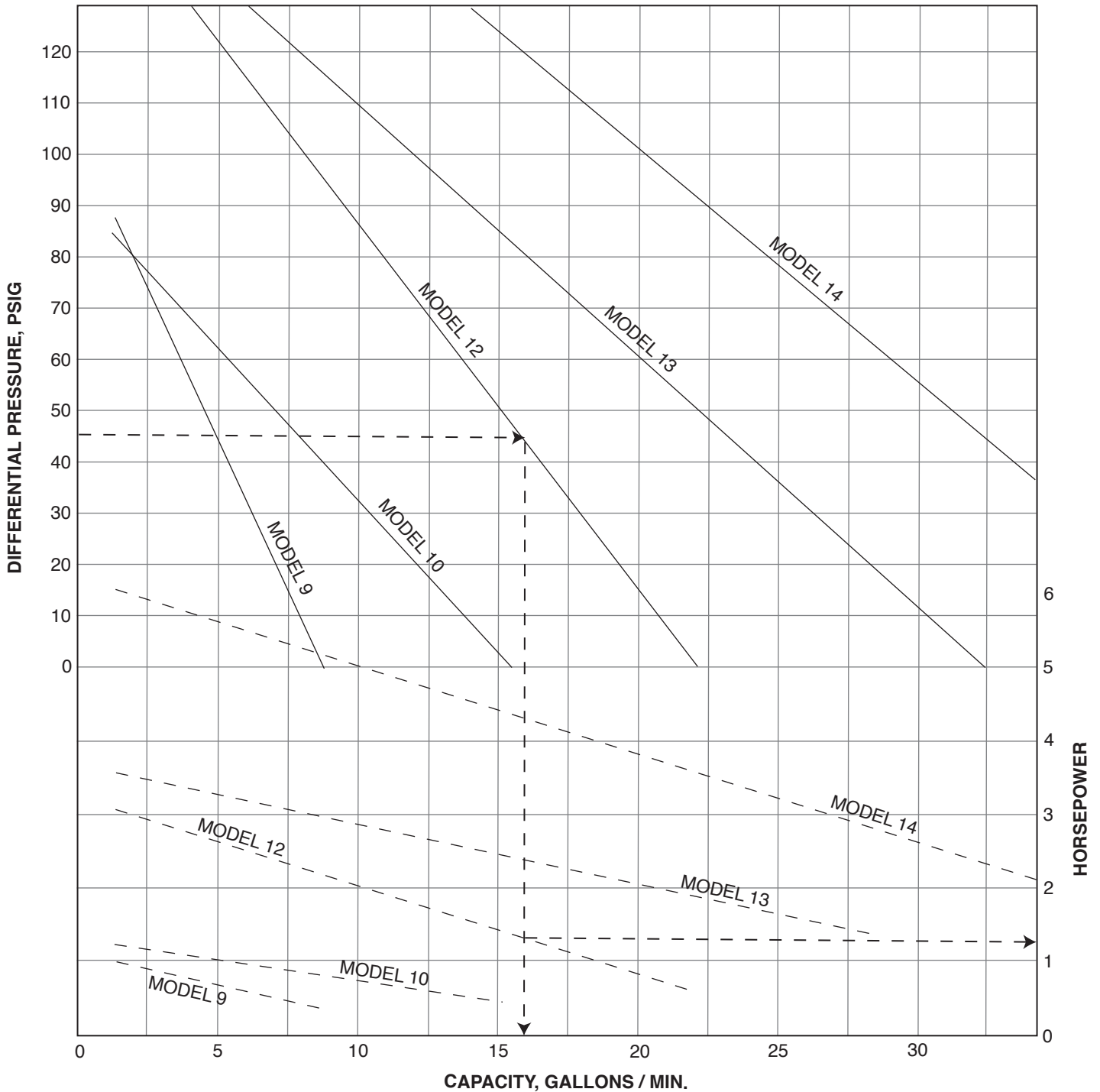
PUMP	HP	PHASE	VOLTS	FRAME	A	B	WEIGHT NO MOTOR	WEIGHT W/MOTOR
FF060	5	1	230	215	12.078"	31.125"	140#	265#
FF060	5	3	230/460	184T	12.078"	31.125"	140#	193#
FF075 or FF150	7.5	3	230/460	184T	12.078"	31.125"	140#	234#
	10	3	230/460	215T	12.078"	31.125"	140#	302#

**CORO-FLO F SERIES PUMPS
CHARACTERISTIC CURVES
3450 RPM**

Curves Are Based On LPG

CAPACITY - Enter curves at pressure in PSIG, read horizontally to intersect solid capacity line for model required, then vertically down to read capacity in Gals/Min.

BRAKE HORSEPOWER - Enter curves at pressure in PSIG, read horizontally to intersect solid capacity line for model required, then vertically down to intersect dashed horsepower line, then across horizontally to read brake horsepower.

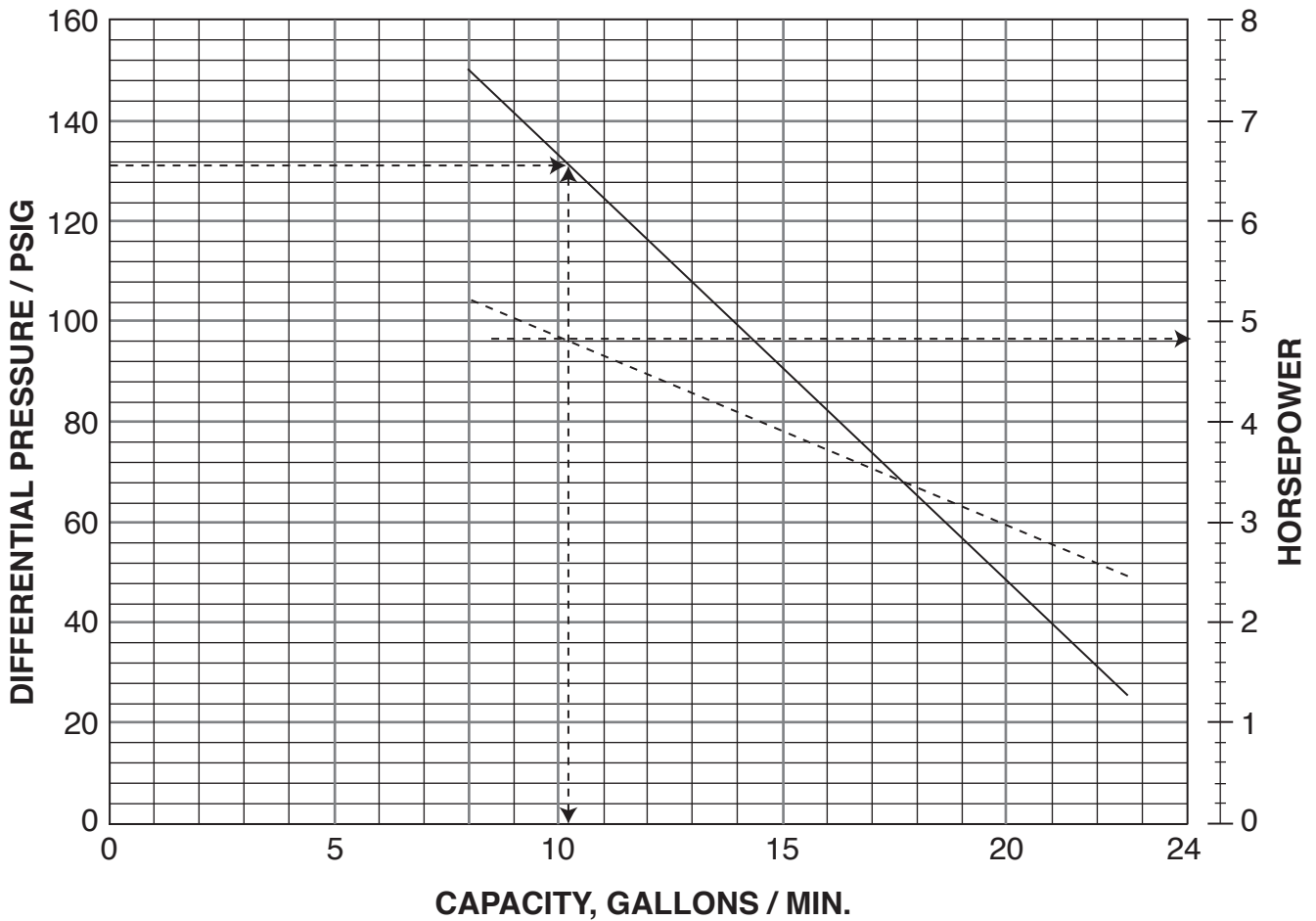


**CORO-FLO FF-060 PUMP
CHARACTERISTIC CURVES
3450 RPM**

Curves Are Based On LPG

CAPACITY - Enter curves at pressure in PSIG, read horizontally to intersect solid capacity line, then vertically down to read capacity in Gals/Min.

BRAKE HORSEPOWER - Enter curves at pressure in PSIG, read horizontally to intersect solid capacity line, then vertically down to intersect dashed horsepower line, then across horizontally to read brake horsepower.

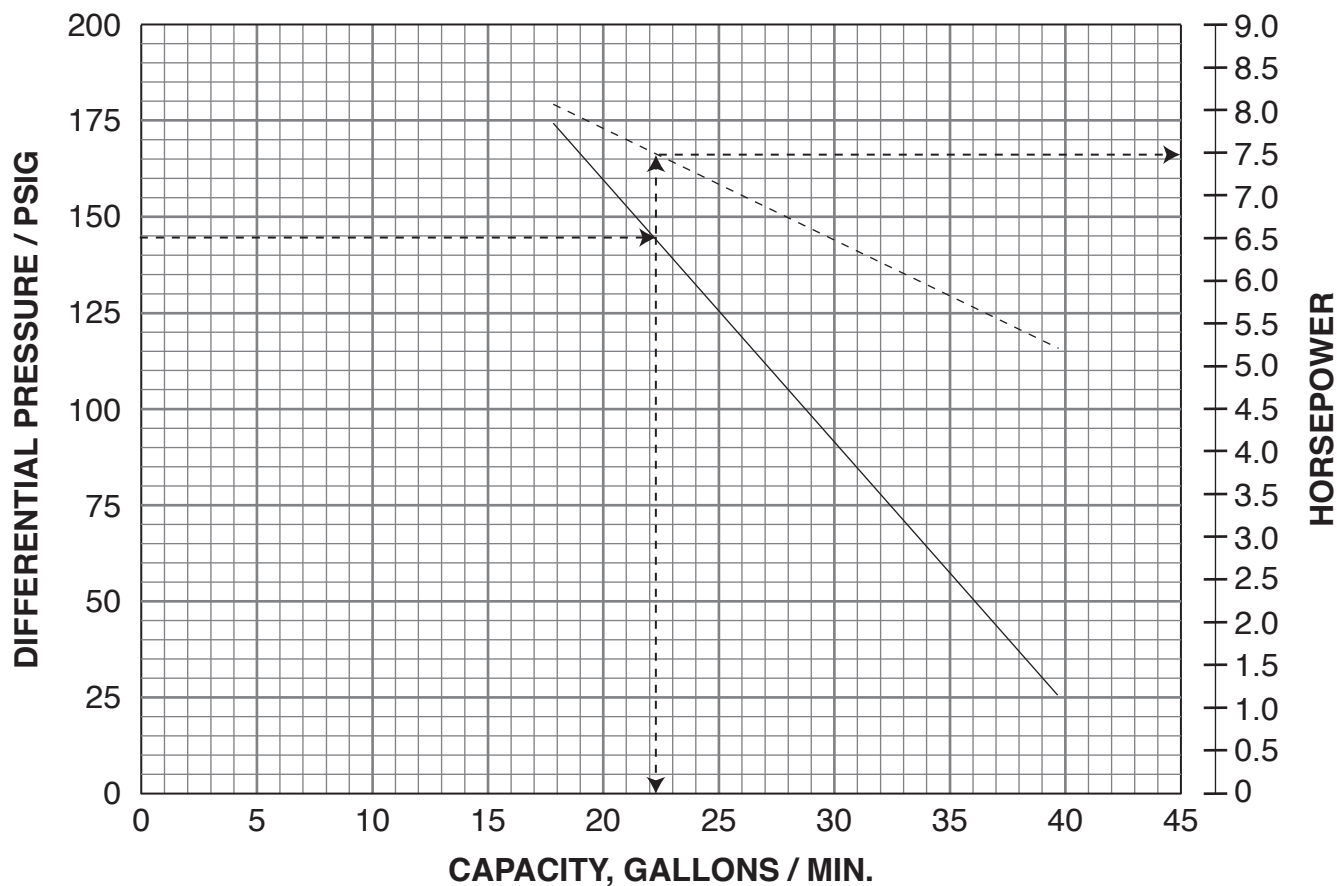


**CORO-FLO FF-075 PUMP
CHARACTERISTIC CURVES
3450 RPM**

Curves Are Based On LPG

CAPACITY - Enter curves at pressure in PSIG, read horizontally to intersect solid capacity line, then vertically down to read capacity in Gals/Min.

BRAKE HORSEPOWER - Enter curves at pressure in PSIG, read horizontally to intersect solid capacity line, then vertically up to intersect dashed horsepower line, then across horizontally to read brake horsepower.

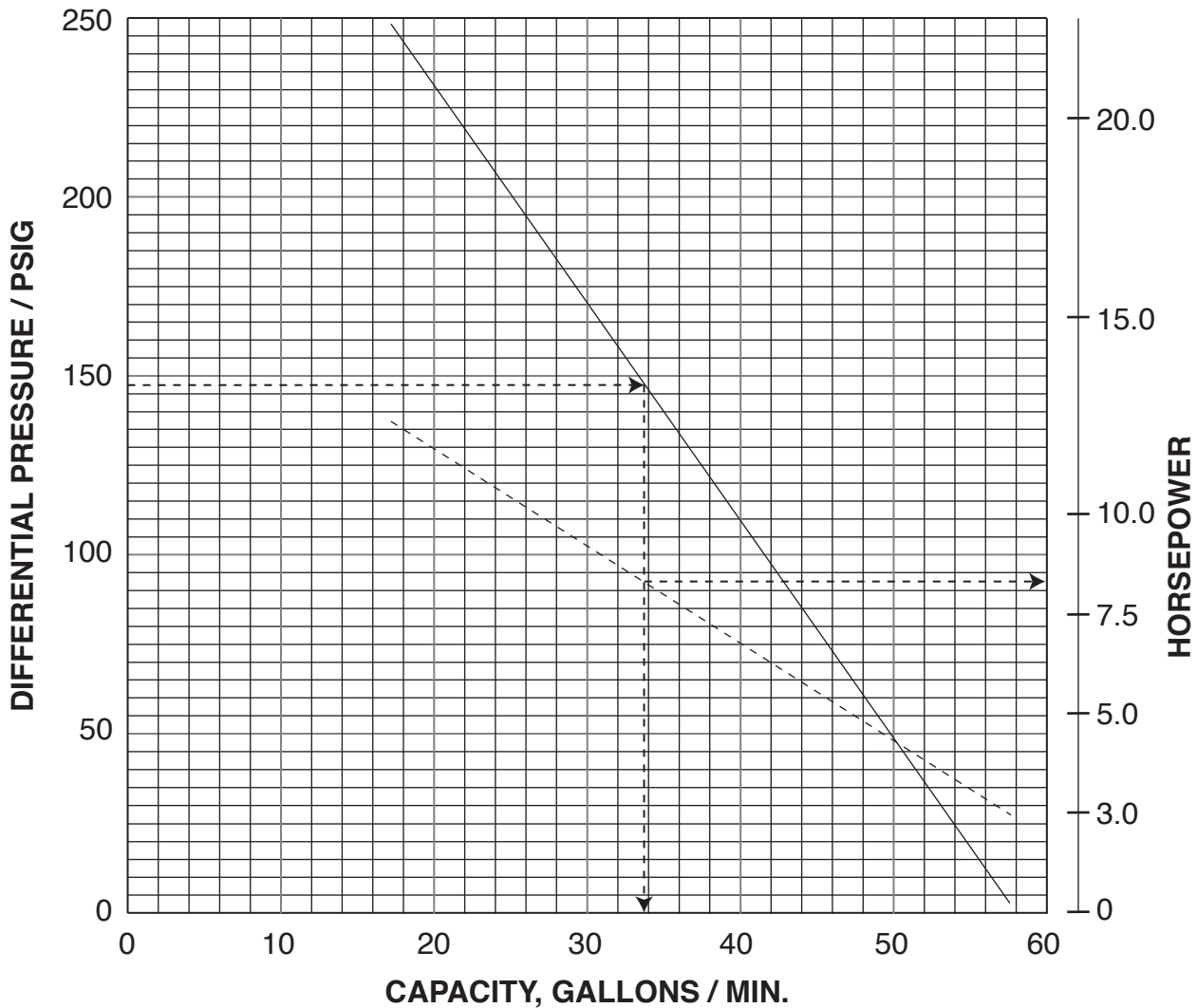


**CORO-FLO FF-150 PUMP
CHARACTERISTIC CURVES
3450 RPM**

Curves Are Based On LPG

CAPACITY - Enter curves at pressure in PSIG, read horizontally to intersect solid capacity line, then vertically down to read capacity in Gals/Min.

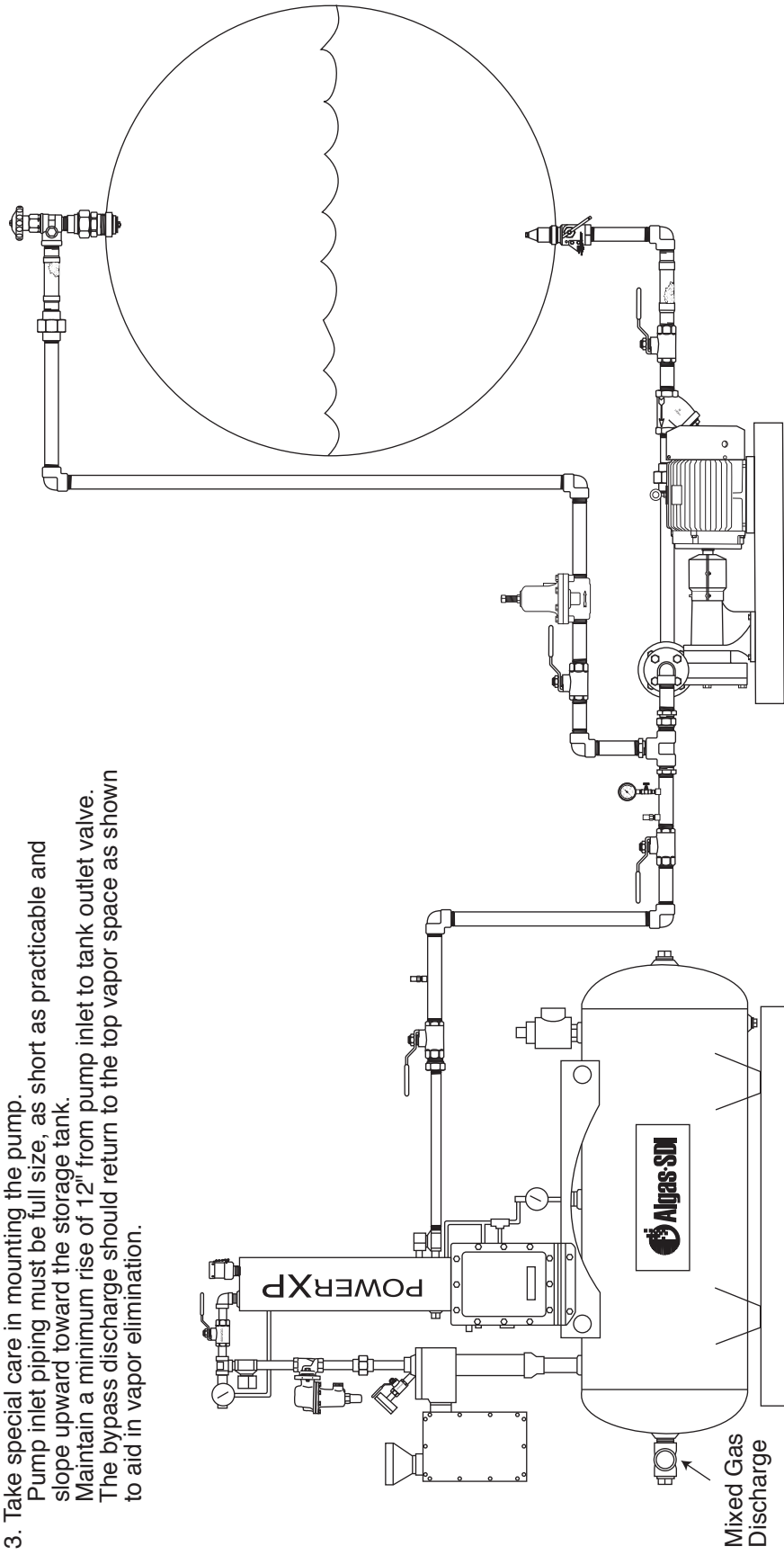
BRAKE HORSEPOWER - Enter curves at pressure in PSIG, read horizontally to intersect solid capacity line, then vertically down to intersect dashed horsepower line, then across horizontally to read brake horsepower.



Typical Piping Arrangement Vaporizer/Mixing System

NOTES

1. Sketch is not to scale and is simplified for conceptual clarity.
2. Install system per NFPA 58, 70 and other applicable codes.
Equipment location must meet applicable separation distances.
Pipe, pipe fittings, valves etc. suitable for liquid propane service.
3. Take special care in mounting the pump.
Pump inlet piping must be full size, as short as practicable and slope upward toward the storage tank.
Maintain a minimum rise of 12" from pump inlet to tank outlet valve.
The bypass discharge should return to the top vapor space as shown to aid in vapor elimination.





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