

CHAPTER 2.4

ABRASIVE AIR BLAST CLEANING

by
P.J. Bennett

Abrasive air blast cleaning provides a method of surface preparation that is rapid, proven, and well established. An understanding of air blast cleaning with various abrasives is essential for a successful operation.

Proper surface preparation by this method provides a foundation for the paint system, resulting in a clean surface, uniform etch, and a long, economical coating life. In abrasive air blast cleaning, surface preparation can be achieved on parts or weldments that are not uniform in size or shape. Uniform or flat pieces may, especially on new work, be cleaned more efficiently with mechanical cleaning machines.

I. DESCRIPTION

Air blast equipment contains and meters abrasive into a compressed air stream through conveying hoses and nozzles to the work piece. In effect, the part being cleaned is eroded away by a mass of abrasive particles until a firm, clean surface results. Abrasive blast cleaning with a compressed air source, air hose, abrasive blast machine, abrasive hose, and nozzle imparts a velocity to the abrasive particle that becomes a working force. Because of its effectiveness in cleaning metals, the process has been widely accepted to remove mill scale, rust, paint and other contaminants.

Various abrasives are used in the process, but the most widely used abrasive is silica sand that has been processed for a blasting abrasive. Respiratory protection must be given to the operator and workers in the blast cleaning area because of spent abrasive and the contamination being removed from the surface. Selection of the abrasive in this process becomes a major factor in cleaning speed, surface etch and coating adhesion. The trend is to a finer size of abrasive because of increased cleaning speed on new or lightly rusted steel; a coarser size of abrasive is used for more corroded steel or harder-to-clean surfaces. Paint coating manufacturers have found a uniform etch with a cleaner surface much more effective for coating adhesion than an overly smooth surface of similar cleanliness. It is important to maintain a proper size of abrasive for air blast cleaning.

II. TYPES OF AIR BLAST EQUIPMENT

A. PRESSURE TYPE

In a pressure-type abrasive blast system the abrasive machine is under the same pressure as the entire system,

i.e., the compressor, air lines, abrasive blast machine, abrasive blast hose and nozzle. This cleaning method is the most productive of abrasive blast cleaning. The efficiency is largely dependent on actual nozzle pressure, which should be 90-100 psi range. The pressure blast machine, or "pot", varies in size, but must be under pressure for an even flow of abrasives. Velocity of the abrasive in the pressure method is greater than the abrasive velocity found in suction equipment (Figures 1, 2, 3, 4).

B. SUCTION BLAST EQUIPMENT

This equipment utilizes the suction jet method of obtaining abrasive from the abrasive tank that is not under pressure. The jet of air blasts the abrasive against the surface after sucking abrasive from the container. Cleaning speed is approximately 1/3 slower than that of pressure blast cleaning with similar size air jets. Its use should be limited to touch-up or spot cleaning jobs, where high speed cleaning is not a factor (Figures 5 and 6).

C. VACUUM BLAST EQUIPMENT

In the vacuum blast cleaning method, air and abrasive are captured in a rubber-hooded enclosure. They are drawn by suction back to the blast unit where reusable abrasive is separated from blast-cleaned surface contaminants, recycled, and reused.

This is considered a "dust free" abrasive blast cleaning because it shields the blast surface area from flying particles and dust. It will not disturb adjacent machinery and workmen. Cleaning speed is limited because the surface is not visible to the operator.

There are two methods of vacuum blast cleaning. In the suction type the abrasive is siphoned from container to the blast head. The pressure type machine delivers sand under pressure through a blast hose to the surface. The pressure method provides greater production. The process is limited to the use of reusable abrasives, such as metallic, steel shot or steel grit, aluminum oxide or garnet. In some cases, where moisture is a problem due to high humidity, a mixture of steel grit and aluminum oxide or garnet is recommended because it keeps the metal abrasive from "lumping" or congealing due to moisture (Figure 7).

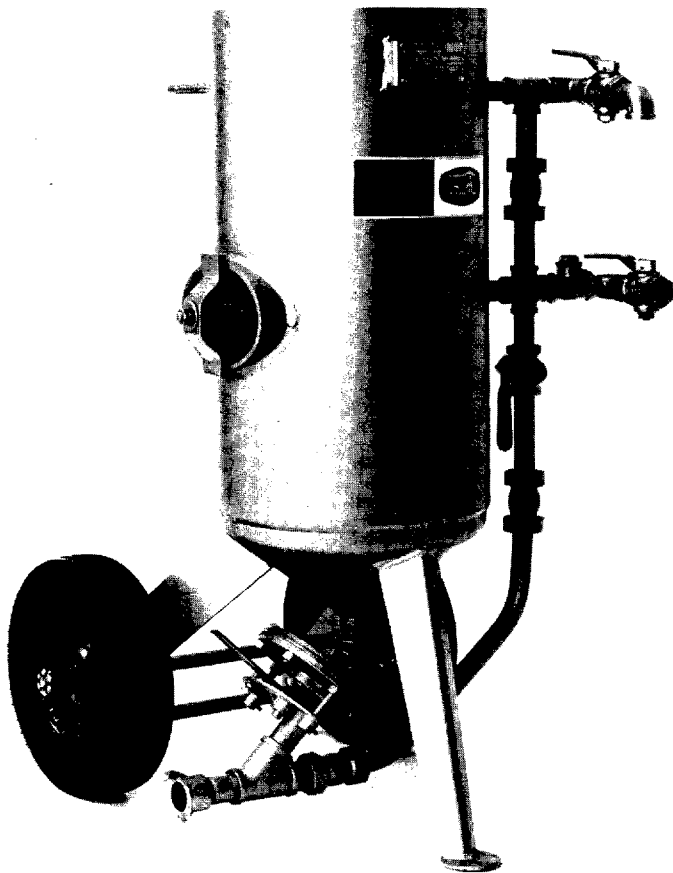


FIGURE 1

Pressure blast machine.

Courtesy of Clemco Industries.

III. ESSENTIAL INGREDIENTS OF AIR BLAST EQUIPMENT

To achieve efficient abrasive air blast cleaning, specific attention must be given to each component of the air blast equipment (Figure 8).

Components are air supply, air hose and couplings, abrasive blast machines, abrasive blast hose and couplings, nozzles, operator equipment, air-fed hoods and control valves, and oil and moisture separators.

A manager of an abrasive air blast operation should

have a check list of each component to ensure peak performance. Each component is discussed in detail.

A. AIR SUPPLY

Air supply provides energy for the entire operation and is responsible for maintaining pressure and volume. Volume requirement is determined by the orifice nozzle size.

The nozzle size in Table 1 indicates air consumption in cfm (cubic feet per minute) at 100 psi (pounds per square inch) without abrasive going through the nozzle.

When determining the compressor size the next larger size compressor available for the nozzle should be used. It is also wise to consider other air requirements from the compressor, such as for an air-fed hood (20 cfm) and air-driven ventilating equipment (approximately 120 cfm). A separate air source for air-fed hoods may be required, unless a carbon monoxide detector is installed in the air system. Insufficient air supply results in excess abrasive and slower cleaning rates.

B. AIR HOSE AND COUPLINGS

Recommended size of the air supply hose should be 3 or 4 times the nozzle orifice. On lines over 100 feet, four times should be the minimum size. Often, the size hose used requires a coupling installed on the inside diameter of the air hose, which further restricts air flow. The I.D. of the coupling should be considered along with hose size. Another problem is the size of the air compressor manifold valve. It is common for air compressor manufacturers to furnish compressors with 1-inch outlets and valves. These should be removed and replaced with 1½" or 2" outlets to match the main air supply hose.

C. ABRASIVE BLAST MACHINES

The pressure machine is a non-fired pressure vessel, built to ASME code requirements for 125 psi working pressures, sized to maintain an adequate volume of abrasive for the nozzle orifice.

TABLE 1
AIR CONSUMPTION

NOZZLE ORIFICE	CFM REQUIRED @ 100 PSI	ABRASIVE CONSUMPTION PER HOUR
3/16"	60 CFM	260 Lbs.
1/4"	105 CFM	490 Lbs.
5/16"	160 CFM	812 Lbs.
3/8"	232 CFM	1152 Lbs.
7/16"	315 CFM	1584 Lbs.
1/2"	412 CFM	2024 Lbs.
5/8"	580 CFM	2518 Lbs.
3/4"	840 CFM	3174 Lbs.

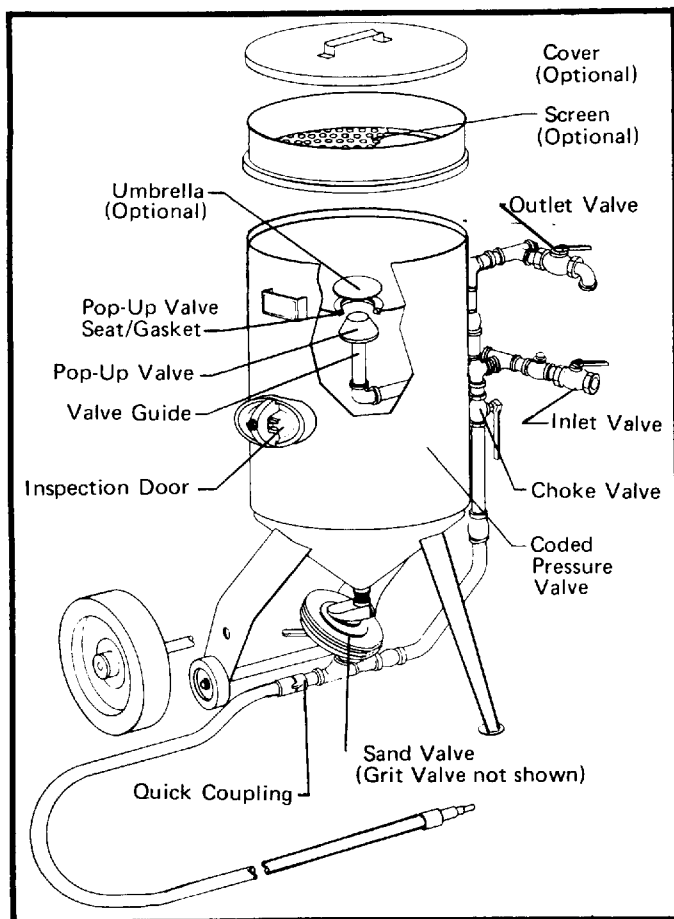


FIGURE 2

Diagram of pressure blast machine.

Courtesy of Clemco Industries.

It should have a sloping bottom for free flow of abrasives and be constructed with an abrasive metering valve to provide the correct abrasive-to-air mixture. The pressure tank, with pressurizing and depressurizing valves, becomes an abrasive blast machine, pressure type. Figures 9-11 illustrate various size machines. Smaller machines are adaptable to small nozzles and to smaller inaccessible type work, whereas larger machines can accommodate multiple large nozzle outlets for large flat areas.

Suction machines are little more than small, non-pressured containers with screens and a bottom outlet for abrasive flow to a suction blast nozzle. Hose distance is less than 25 feet where abrasive can be vacuumed to the blast nozzle.

D. ABRASIVE BLAST HOSE AND COUPLINGS

Recommended size of the blast hose is important to an air blast operation because of friction loss measured in pressure drop of conveying abrasive. The recommended size is three to four times the nozzle size, except near the

nozzle end. There, a short hose of smaller diameter should be used for operators' convenience and flexibility. Typical abrasive blast operations will be 100 ft. of 1 1/4-inch sand-blast hose and 10 ft. of 1-inch hose (called a tail line or whip hose) for a 3/8-inch orifice nozzle.

Hose construction is normally 1/4-inch thick rubber tube with carbon black compounding for the dissipation of static electricity generated by an abrasive flow through tube. Dissipating static electricity prevents build up and shock to operator.

The tube is covered by 2- or 4-ply wrapping to provide strength for pressure requirements. Normal working pressure should not exceed 125 psi.

A wear-resistant cover is applied over the ply to protect it against premature wear.

In some cases an additional static wire or two is wrapped spirally around the tube between the ply to ensure drain of static electricity. In areas of volatile liquids this type of hose should be used. Parts that are abrasive

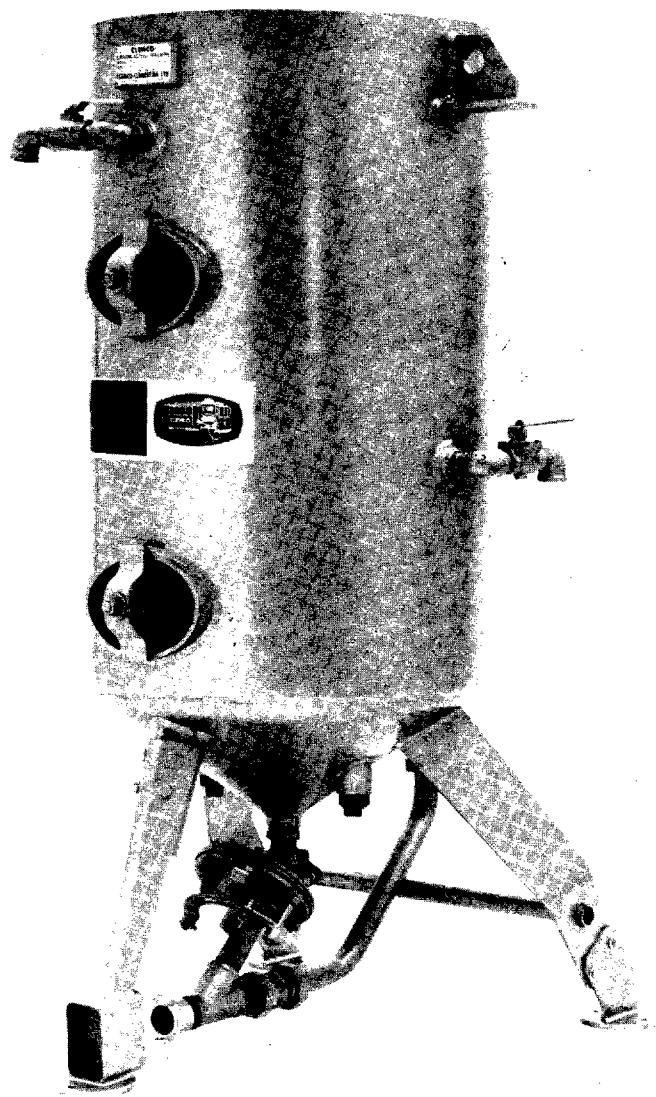


FIGURE 3

Two chamber continuous action pressure blast machine.

Courtesy of Clemco Industries.

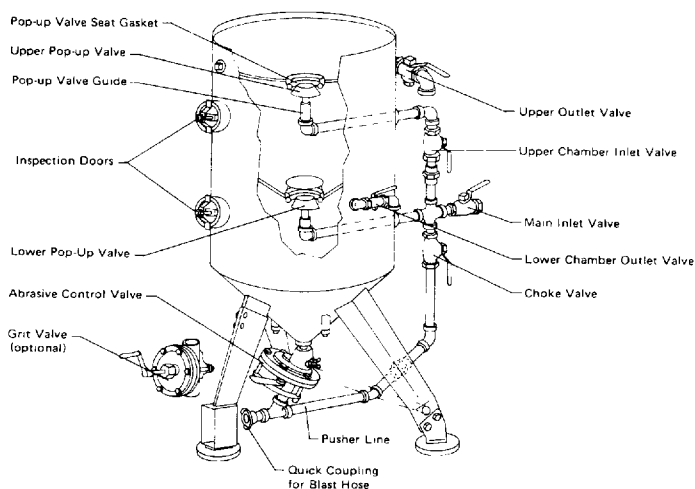


FIGURE 4

Diagram of two chamber continuous action pressure blast machine.

Courtesy of Clemco Industries.

blast cleaned should be grounded to prevent a spark that could ignite flammable material. Proper grounding prevents the spark and ensures safe working conditions.

Couplings used on blast hoses should always be exterior and should be fitted to the hose in a snug, tight condition. Small screws through the coupling into the cover ply tube completes sure fastening of the coupling to the hose. The advantage of exterior couplings is that they do not contribute to friction loss.

Normal pressure drop of sandblast hose with $\frac{3}{8}$ -inch orifice nozzle is 5 psi per 50 ft. length. Therefore, it is important to use large hose as short as practical.

A word of caution: too large an abrasive hose (1-inch) on small nozzles ($\frac{3}{8}$ -inch) may result in uneven abrasive flow.

E. NOZZLES

There are many types of blast nozzles, but construction material used in liners of nozzles determines the life and cost. Liners are constructed of ceramic, cast iron, tungsten carbide and boron carbide. Ceramic and cast iron are short life nozzles. Carbide nozzles are long life. Average life of tungsten nozzles is 200 hours. Ceramic and cast iron are 2-4 hours. Boron carbide nozzles can maintain their size for 1500 hours if properly handled to prevent cracking of the brittle carbide material.

During construction of these nozzles a soft metal (lead and aluminum) is used to absorb shock and protect the liner. It is common to put a small, 4-6 inch piece of rubber hose over these nozzles for added protection. A polyurethane cover is also used over liners, but they should be checked for threads wearing.

Nozzle shapes provide great advantages to nozzle construction. Venturi style nozzles (large throat converging to the orifice and then diverging to the outlet) pro-

vide rapid speed of abrasive particles through the nozzle, increasing cleaning rate compared to a straight bore nozzle of the same length.

Nozzles are a very important part of an air blast operation and should be inspected regularly for orifice size and wear. Worn out and cracked nozzles result in increased compressor wear, increased abrasive usage, and poor nozzle pattern (Figure 12).

F. CONTROL VALVES

Pressure abrasive blast machines have an inlet, outlet or depressurizing and choke valve and an abrasive metering valve. The abrasive inlet on air blast machines is called an air operating and sealing valve, but is not common to all machines (Figure 2).

Valves mentioned are all manual because of safety requirements, the need for fewer operating personnel and the use of pneumatic valves controlled by operation. Two



FIGURE 5

Suction blast equipment.

Courtesy of Clemco Industries.