Assuring Quality During Abrasive Blasting Operations

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The performance of a coating depends in large part on the quality of surface preparation. This is because coatings have been formulated to perform properly under particular conditions, such as over a specified degree of surface cleanliness and a specified anchor profile, and under certain environmental conditions. If these and other conditions are not met, coatings may not achieve their expected performance.

When dry abrasive blasting is the specified method of surface preparation, many conditions must be taken into consideration by the blaster. Some of these conditions have been addressed in earlier Bulletins, such as “Assuring the Quality of Abrasives” (February 1990), “Setting Up Air Abrasive Blast Equipment” (November 1989), “Techniques of Air Abrasive Blasting” (April 1989), and “Assessing Surface Cleanliness and Profile” (July 1990).

Other topics, such as detecting and removing non-visible contaminants from steel, will be detailed in a future issue.

This Bulletin will focus on field tests or checks that should be conducted to assure that the blasting operation takes place under conditions favorable to successful coatings application and performance.

These include assuring that environmental conditions are suitable for blasting, that contaminants are not retained or introduced by the blasting process, and that equipment does not hamper productivity. There is, of course, some overlap between the quality assurance measures described here and those given in other Bulletins.

While inspectors or owner’s representatives often perform many of these quality assurance tests, the contractor is ultimately responsible for the quality of the work and should also conduct field checks.

Checking Conditions before Blasting

Most coatings do not adhere well to surfaces contaminated with oil and grease. Blasting actually drives them further into the steel rather than removing these contaminants and thus contributes to premature coating failure. Therefore, you should always check for visual surface contaminants before blasting. If oil and grease are present, they should be removed with solvent cleaning, as specified in SSPC-SP 1. All of the blast cleaning specifications, SP 5, SP 6, SP 7, and SP 10, require this step with the statement, “Before blast cleaning, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP 1.”

One piece of equipment for checking for the presence of contaminants is a black light, available from blasting equipment manufacturers. It operates on the same principle as black lights in discos.
When you shine the light on the substrate, the clean part of the surface will appear to be dark, while areas with oil or grease typically will be shiny, although not all oils will fluoresce under the black light. Ambient conditions should be measured before blasting. If blasting is not to be followed immediately by coating application, then it may be all right to proceed first with rough blasting to remove the existing coating, rust, and mill scale, and to check ambient conditions before the final blast. If blasting is to be followed immediately by coating, then ambient conditions should be checked before blasting begins.

You will want to make sure that the dew point, air temperature, relative humidity, and surface temperature are suitable for blasting. This insures that condensation will not be forming on the steel during or after blasting and cause flash rust, which can be detrimental to the overall quality of the coating performance.

To measure ambient conditions, you will need the following:

- a surface temperature gage or surface thermometer (Fig. 1),
- a psychrometer for measuring dry bulb (air) and wet bulb temperature (Fig. 2), and
- psychrometric tables for calculating dew point and relative humidity (Fig. 3).

Dew point is the temperature at which moisture condenses on a surface. If the dew point is 70°F (21°C), condensation will occur if the steel is at or below this temperature. As a general rule, final blast cleaning should take place only when the surface is at least 5 degrees F (3 degrees C) above the dew point. For example, if the dew point is 70°F (21°C), the steel temperature should be at least 75°F (24°C). This rule provides a margin of error, in case of instrument inaccuracies, quickly changing weather conditions, or human error.

Dew point is calculated using the psychrometer and psychrometric tables from the US Weather Bureau Service. The psychrometer is a hand-operated or motorized instrument that has 2 glass thermometers. One thermometer has on its bulb a clean sock or wick made of cloth. To use the psychrometer, first wet the sock thoroughly. Then, whirl the psychrometer if it is hand-operated, so that the instrument spins at a steady, medium speed for about 2 minutes. Observe the temperatures at 20 to 30 second intervals.

When you obtain 3 consecutive readings of the same temperature on the wet bulb thermometer, record the readings from both thermometers. In the case of the fan...
operated psychrometers, turn on the fan and allow it to run for approximately 2 minutes.

Using the psychrometric tables for dew point, find the dew point in the following way. Subtract the wet temperature from the dry temperature, and find this value on the top row of the dew point chart labeled 30-inch barometric pressure. On the side of the chart, locate the air temperature reading from the dry thermometer. Draw a vertical line from the top value down to the row where the air temperature is found. Draw a horizontal line from the air temperature value to the right side of the chart. The dew point is the value found at the intersection of the horizontal and vertical lines (Fig. 3).

Then, measure the surface temperature. The simplest instrument is a magnetic temperature gage that attaches to the steel. Place the gage on the steel and allow it about 2 minutes to stabilize. If the surface temperature is 5 degrees F (3 degrees C) above the dew point, then conditions are suitable for final blasting.

Generally, the coldest part of the steel should be measured because dew point problems will occur there first. The shaded portions of the steel are generally coldest.

Relative humidity can be calculated using the values obtained from the psychrometer and the psychrometric charts labeled “relative humidity.” The same procedure described above is followed. As a general rule, final blasting should not be done if relative humidity is at or above the maximum relative humidity for coating application.

### Checking Blasting

#### Abrasives and Equipment

Abrasives and equipment should also be checked for cleanliness before blasting, and the equipment should be checked for efficiency.

Abrasives can be easily and economically checked for oil, dirt, and salts in the field with the following equipment: clear jars with tight lids, distilled water, and chemical test papers. A small amount of the abrasive is placed in the jars, covered with distilled water, and shaken. The abrasive will settle to the bottom of the jar. If the water appears cloudy or an oily film appears after the abrasive settles, the abrasive is contaminated and should not be used.

Test papers and portable meters will indicate the presence of some soluble salts, and litmus paper will indicate the presence of some acids or bases.

If you are using recyclable abrasives, the abrasive should be tested during the job (using the jar and water) to make sure the reused abrasive is clean.

ASTM D 4940 is another method for evaluating the presence of soluble salts on abrasives. It involves measuring the conductivity of a water/abrasive mixture.

There are several parts of the blasting equipment that need to be checked for contaminants: the compressor, the moisture trap or moisture separator, and the air that comes through the hoses.

The compressor has oil and moisture separators that remove oils and moisture from the air passing through the compressor. Make sure the compressor is level. Otherwise, the separators will not work properly, and oil or moisture will get into the hoses (and onto the steel).

A second moisture trap or moisture separator, not part of the compressor, should be used to catch any remaining moisture that might be trapped in the hose that connects the compressor to the blast pot (Fig. 4). Be sure that this separator is as close to the blast pot as possible to
catch any moisture that has condensed in the hose. Also be sure that the moisture trap is set on automatic bleed so that moisture drains out of the trap to the ground and does not remain in the blasting system. These measures will help keep the abrasive and substrate dry during blasting so that rust bloom does not appear.

You should also check the air that comes from the blasting equipment for moisture and oil. This can be done with a blotter test.

Clean white rags, blotters, or even coffee filters can be used to test the blast air. To conduct the blotter test, close off the abrasive valve so that no abrasive gets into the air stream. Place the rag or blower in front of the nozzle or other air outlet, and turn on the air for 1 minute. If the rag is wet, then moisture is escaping, so you should adjust the moisture separators. If the rag is dirty, oil is in the air stream, and the oil separator should be checked (Fig. 5).

Before beginning blasting operations, you should also check for the proper pressure at the nozzle. Generally, 90-100 psi at the nozzle is the pressure range suited for efficient production. The pressure reading should be obtained at the nozzle, not at the compressor. Pressure at the nozzle can be checked with a needle pressure gage (Fig. 6). This device consists of a hypodermic needle attached to a pressure gage with pressure increments marked on its face.

The hose should be directed toward the substrate and turned on, with air and abrasive flowing. The needle should be inserted into the hose right behind the nozzle in the direction of the flow of air and abrasive. The face of the gage can then be read. The compressor pressure can be adjusted if pressure is below 90-100 psi, or the source of the pressure drop is determined and corrected. Alternatively, changes to the hoses (diameter or length) or nozzle sizes can be made.

The nozzle lining should also be checked for wear before blasting operations begin and during blasting if your production rate drops. An orifice nozzle or throat gage can be used to check the inside diameter of the nozzle lining. The gage consists of a china marking chalk and a tapered rod that is marked to indicate different diameter readings (Fig. 7).

Using the china marker, “color” the gage around the diameter mark that represents the nozzle you are using. Put the gage in the back side of the nozzle, twist it, and pull it out. The china markings will be scored by the nozzle orifice, and you can determine the orifice diameter by reading the gage. If the diameter is larger than required (generally one nozzle size larger than a new nozzle), then the lining of the nozzle has worn out and needs to be replaced. Otherwise, your production rate may be lower than desired.

Checking the Steel after Blasting
After blasting, make sure you have removed all dust from the blast-cleaned surface, either by blowing down the surface with compressed air or vacuuming the dust with a vacuum available from equipment manufacturers. Dust on the surface can interfere with the coating’s ability to bond to the surface. If you blow down the surface, first check the cleanliness of the air again with the blotter test described earlier. After blowing or vacuuming the surface, you can brush a clean white cloth across the surface. Be sure not to touch the steel with your bare hand. Oils or salts from your hand can be transferred easily to the surface and contaminate it. If dust appears on the cloth, you need to blow down or vacuum the surface again.

You can also check for non-visible contaminants, especially soluble salts, which are detrimental to coating performance. There are portable test kits available for swabbing the surface with cotton and distilled water. These kits help you quantify the amount of chloride and other salts remaining on the steel surface after blast cleaning. You will have to get the opinion of your supervisor or the coating manufacturer to determine if the level of contaminants measured is detrimental to coating performance. These kits are available from test equipment manufacturers and from testing and inspection firms. Their use will be described in an upcoming Bulletin on non-visible contaminants.

Once the blasted surface is free of dust (and other contaminants), you should check surface profile and degree of cleanliness to see that you have met the specifications. These measures are detailed in the July 1990 Bulletin.

Record Keeping
The quality control checks that you make should be documented and kept as part of your quality control records for the job. This way, you have historical information for verifying compliance with specifications. Record keeping is detailed in the September 1989 Bulletin.

Conclusion
Remember that the quality assurance measures you take will help you ensure that abrasive blasting operations create a surface suitable for coating application. Moreover, while inspectors may be on the job conducting similar checks, you should not be intimidated by the inspectors or be hesitant to conduct your own quality assurance checks. Their efforts and your own will help you provide the high quality work needed for successful coating application and performance. ATB