In Part Two, the only miracle we asked of Cast Steel Shot/Grit and the abrasive blast equipment was to remove surface contaminants from the workpiece, and we explained how selection of abrasive size affects the effectiveness and efficiency of the operation.

Now, in Part Three, we ask for two miracles: Remove the contaminant; AND provide a controlled anchor pattern profile that will assure optimum adherence and durability when bonding, painting, or coating the workpiece.

To avoid premature coating failure, both absolute cleanliness and the proper profile must be achieved. A major advantage of the use of cast steel abrasives in the blast cleaning profiling process is that both can be accomplished in one operation. The cast steel shot or grit, and the work mix developed, removes the contaminant and provides the anchor pattern simultaneously.

The Choice: Abrasive Size
The Effect: Finish Profile (Anchor Pattern)

There are two elements involved in the choice of abrasive size:
(a) the size purchased; (b) the size distribution maintained in the work mix that is developed and does the actual work of removing contaminant and producing the profile.

The profile results from indentations in the work surface, resulting from impact of the abrasive. To describe a given profile, three characteristics of the indentations are considered: (a) Depth (peak-valley measurement); (b) Peak count (number of peaks per lineal inch); (c) Texture (a Shot-peened aspect; or a Grit etched, angular aspect).

Key factors determining depth of indentation and peak count are: Size of the abrasive impacting the work; Abrasive hardness; Velocity; and Hardness of the workpiece. That size of the abrasive is, by far, the dominant factor, will be understood upon study of the following comparison of relative size and impact power.

Consider two sizes of cast steel grit: the large size being 0.044' and the small size being 0.030'. At a given velocity, the 0.044'' grit has three (3) times the relative impact-power (based on the formula for Kinetic Energy: 1/2 MV squared). Obviously, the depth of indentation produced by the 0.030'' particle will be much shallower, but, as the illustration reveals, the smaller size will produce a higher peak count.

An inescapable fact of life: The larger the shot or grit size, the deeper and rougher the profile, and the lower the peak count. Conversely, the smaller the size, the more shallow the profile, but, the higher the peak count. How coarse or how fine a profile the user requires will vary with the application. Viscosity and flowability of the paint or coating material is a key determinant—it has to cover and protect the peaks, and it has to flow into and protect the smallest profile valleys.

Bearing in mind the dual function involved (contaminant removal and providing the required anchor pattern), a balanced work mix is required. Because of the subsequent painting or coating operation and the profile needed, selection of the new, original size abrasive is governed by the profile required. But, because the small abrasive particles in the work mix perform the function of scouring rust and scale from minute cracks and fissures that large particles cannot do, the small sizes, too, are needed.

Thus, the user needs a properly balanced work mix. For example, consider the following size distribution: 40% original-size at 0.044'' average; 30% medium-size at 0.030'' average (1/3 the impact power of 0.044''), 30% small-size at 0.018'' average (1/15 the impact-power of 0.044''). It is immediately apparent that it is the 40% of original-size abrasive, with its high impact-power, that produces the profile (peak valley height and peak count). Yet, it is extremely important to maintain proper size distribution in the work mix. Consider the following case history:

Challenge: Remove old paint from steel box cars prior to repainting. Suddenly, abrasive consumption increased 50%, time of blasting doubled, and paint usage tripled. Disaster! Why? Faulty air-wash separation was found to exhaust all the fine-size and half the medium-size particles from the work mix, wasting usable material, and causing the work mix to coarsen to 85% of the heavy hitting particles. The sharply reduced particle count in the blast stream (the larger the size, the fewer the particles per pound thrown) meant poor coverage and longer blast cycle time; high concentration of maximum impact power caused deeper indentations that required three times the paint to cover. Disaster, but correctable via proper control of operating practices!

The next issue (Chapter Four of this series) will deal with the choice of cast steel abrasive shape and hardness, and how these choices can affect finish—both contaminant removal and profile achieved.