"Practicing Diligence in Shot Peening of Metal Parts for Fatigue Life Improvement"

A metal finishing process called shot peening is used to enhance the fatigue strength or fife of critical aerospace or auto-. motive components. It is vitally important to focus on certain aspects of this process to insure product integrity. Not only is this an obvious benefit to the manufacturing process, but when shot peened components suffer fatigue failures which result in a lawsuit for loss of life or property - the first line of defense is to demonstrate diligence in the component's manufacturing process. h seems important, therefore, to focus on three aspects of the process:

Product uniformity
Adherence to standard practices
Real time process control

Product Uniformity: This focal point is often characterized by statistical process controls (SPC). Some aspects of the shot peening process are easy to measure and record, while others are not. Referring to the diagram in Figure One (from "Controlled Shot Peening") we see that items below the line, referred to as casual or process inputs, *2* easy to monitor and record. Data logmay be used to continuously record air pressure (or wheel speed), shot flow rate, speeds and exposure times. Conventional SPC techniques can demonstrate consistent practice and call attention to trends or out-of-tolerance conditions.

Above the line in Figure One we see that the Almen strip records are likewise not difficult to obtain. Charts of Almen strip intensity taken 3t time or quantity intervals, can a: ....;played with SPC techniques. The quality control department should indicate tolerance limits of operation and acceptable standard deviations. If averaging is to be used the trial size should be clearly stated and averaging technique identified.

The measurement of the resultant residual stress, the goal of the peening process, is not obtained as easily. The nondestructive X-ray method will only reveal the surface stress level. To provide a stress profile requires destructive testing. Random sampling techniques must be used and, again, the methods must be clearly stated. Detection of out-of-tolerance stress profiles beyond a certain level might initiate a higher frequency of sampling until the n measurements return to acceptable levels.

Adherence to standard practice: This aspect of controlled shot peening is usually formalized in either internal processing standards or external owning specifications. For military work in the U.S.A. the specification for Shot Peening of Metal Parts, MIL-S-13165 usually applies. Industry standards include the SAE specification AMS 2430.

Most large companies, and many shot peening job shops, require more stringent process monitoring and control than the above mentioned specifications. h is common for requirements to be annotated on the component fabrication drawing or routing sheet Generally the drawing information will supersede the referenced specifi- rations, but there are exceptions to be aware of. When conflicts arise careful coordination is prudent to insure achieving proper treatment

Real time process control: Recent trends in shot peening indicate a desire to continuously monitor the peening process parameters and signal deviations from expected values in real time. Additionally. with the advent of the microprocessor and computer machine control, it is becoming common to provide a data logger output record of the entire peening cycle. Such parameters as air pressure, slow rate, speed and cycle time are easily recorded for QC review. Improperly operating equipment can be quickly and easily identified and corrected. Maintenance can be performed that prevents the manufacturing of

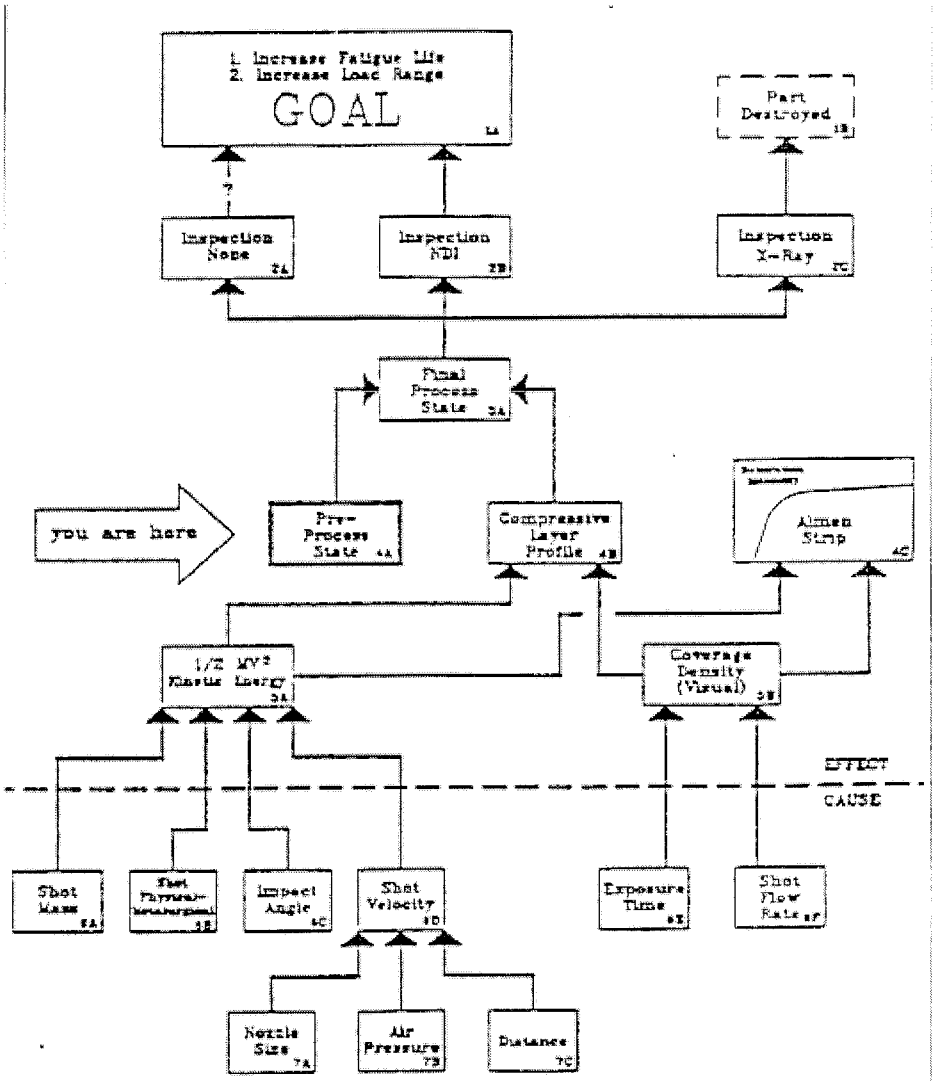

Fig. 1. Controlled Shot Peening Process

defective parts and thus keep scrap rates low.

An additional benefit of the data logger is the ability to analyze the machine processing which allows machine optimization. While there may be many "rules of thumb' for machine operation, it doesn't take long to build a matrix of operating points to realize the optimum operating point for maximum production that assures proper processing.

Use of robots and computer controlled machine cycles is becoming more common. This advanced technology allows the use of stored programs in place of operator set-up, thereby assuring consistent ma. chine performance. Many machines are adapting a knowledge base system of artifical intelligence to provide assistance in operation and maintenance of the machine. Substantial progress has bean made on a knowledge base expert system for the shot peening process that will allow very fast review of a wide range of rules used in the process. Eventually this program will write prescriptions for shot peening treatment The metallurgist will only need to specify the material the thickness and the desired fatigue strengthen/life improvement to obtain a recommended stress profile and a list of operating machine parameters. Until then, the shot peener today must practice the "Art of Shot Peening" with the utmost of care. Diligence is the key word.