THE APPLICATION OF COMPUTER-DIAGNOSTICS TO HIGH PRODUCTION SHOT PEENING SYSTEMS

Raymond M. Leliaert, Sr.

Materials Cleaning Systems Division, Wheelabrator-Frye Inc., Mishawaka, Indiana, USA

ABSTRACT

The automotive industries are increasing their use of shot peening. This is attributed to the need to improve corporate average fuel economy (CAFE) by weight reduction of component parts. Shot peening is used as an aid in assuring satisfactory fatigue life and reliability of these components. High production requirements combined with stringent shot peening specifications have required the use of automated shot peening machines utilizing advanced technology such as computer-diagnostics, high energy airless shot blast wheels and stress peening techniques.

KEYWORDS

Computer-diagnostics, high energy airless shot blast wheels, almen intensity, percent coverage, pre-stressing compression fixtures, CRT (cathode/ray/tube) messages & printer messages.

INTRODUCTION

A manufacturer of automotive leaf springs had a production requirement of 3200 stress peened leaf springs per hour. The springs were to be peened to a coverage of 98% and an almen intensity of "C" 0.010 to 0.020.

A series of tests were performed simulating production conditions as nearly as possible to establish system and design parameters. A study of the test results established a need for four automated shot peening machines, each equipped with its own computer diagnostic system. All four of the shot peening machines are each equipped with four high energy airless, shot blast wheels. Each wheel is driven by individual 30 KW electric motors. These wheels each throw 1,814 kilograms of steel shot per minute at a velocity of 76 meters per second. A complete shot recycling system including an airwash shot separator to remove undersized and broken shot is a part of each machine. The cabinets have replaceable wear resistant alloy wear plates, baffled entrance and exit vestibules, noise attenuation systems and ventilation to provide environmentally effective machines. Each machine is equipped with ten pre-stressing compression fixtures. Each fixture is designed to hold two leaf springs which are manually loaded onto and off of the fixture. To maintain production rates and peening specifications, each step of the shot peening process is controlled and monitored by the computer

diagnostic system through its programmable controller. This system will indicate any active faults as they occur, report the last twenty faults that have occurred on a CRT monitor and generate a Printer Message Report of the last sixty faults per eight hour shift.

PRODUCTION CYCLE

A production cycle for two leaf springs is as follows:

1. Manually load two leaf springs onto a pre-stressing compression fixture.
2. The loaded pre-stressed compression fixture advances to the compression station.
3. A pneumatic cylinder stresses the springs which are safely held in place by safety latches on the fixture.
4. The stressed springs in their fixture next pass through the shot peening zone at a set conveyor speed to assure that the projected shot from the four airless shot blast wheels will peen the two stressed springs to an intensity of almen "C" 0.01 to 0.020 at 98% coverage.
5. The fixture next advances to the de-compression station where a pneumatic cylinder deactivates the safety latches on the fixture and releases the shot peened springs from the pre-stressed configuration to permit manual removal of the two springs at the unload station.
6. After unloading, the springs are transported by a separate conveyor to the next work station.
7. The unloaded pre-stressing compression fixture is automatically returned to the load station for recycling.

PROCESS CONTROL

In order to maintain production rates and shot peening specifications for the leaf springs, it is important to monitor the following shot peening machine components and their specific functions:

1. Shot blast wheel motor drive current (amperage). Low amperage can result in insufficient coverage and almen intensity. High amperage can effect intensity and fatigue life.
2. Shot hopper (level) supplying the shot blast wheels. Low level can indicate a malfunction at the automatic shot adder system or that the supply hopper on the automatic shot adder requires replenishing.
3.* Shot recycle system - any malfunction of components in this system can cause a stoppage of the shot peening machine. Components include: Helicoid screw conveyors transporting spent shot from the cabinet to the belt and bucket elevator which elevates the spent shot to the shot separator which removes broken and undersized shot from the operating shot mixture prior to its discharge into the shot hopper supplying the shot blast wheels.
4. Compression station - slow cycle time
5. Shot peening zone - slow cycle time
6. De-compression station - slow cycle time
7.* Cycle stop by the operator manually loading springs to be shot peened.
8.* Cycle stop by the operator manually unloading shot peened springs.
9.* Fixture safety latch malfunction at the load and unload stations.
10.* Shot peen cabinet access doors unlocked or accidentally opened.
11. Failure of the shot peening machine to start after activating the start button.
12. Activation of the emergency stop button.

* Indicates a malfunction which will stop the machine.

The CRT messages will display:

1. Machine malfunction (faults).
2. The last twenty malfunctions.
3. Why machine did not start after activating the start button and message describing same.
4. Access door(s) open.
5. Number of slow cycles at specific stations.
6. The total production count.

Typical CRT messages are shown in Figs. 1, 2, 3, & 4.

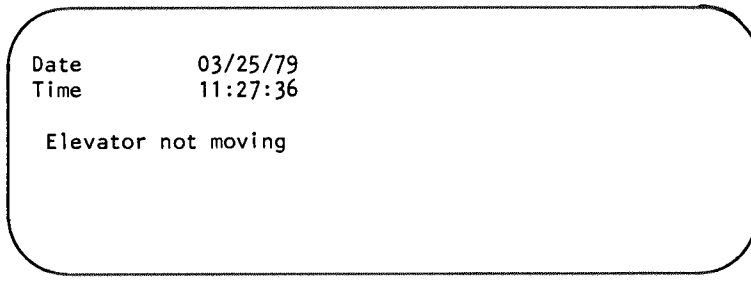

Fig. 1 CRT-Malfunction (fault) message

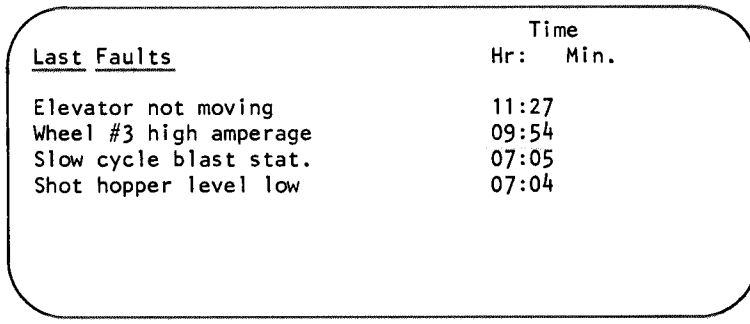

Fig. 2 CRT-Last faults message up to twenty faults with most recent on top

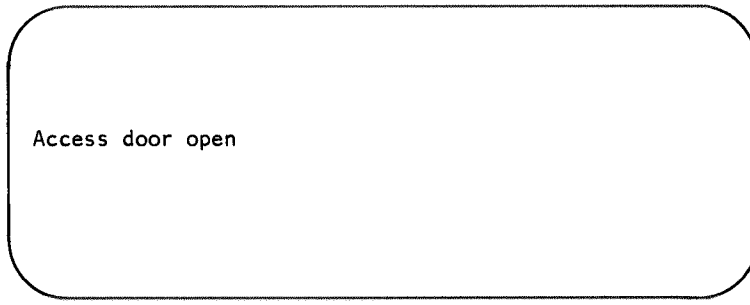

Fig. 3 CRT-Malfunction (fault) message No time or date display

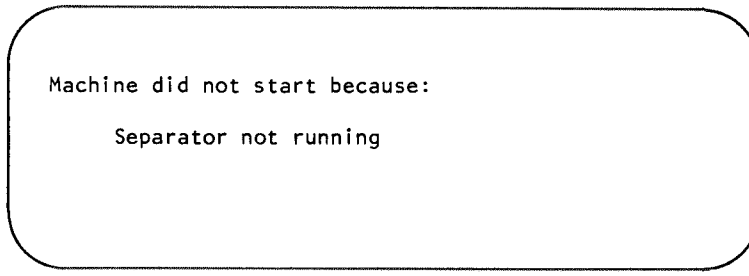

Fig. 4 CRT-Failure to start message
No time or date display

The Printer Message Report will print:

A production report consisting of:

1. Wheel low and high amperage with accumulated times.
2. Hopper low level, accumulated time.
3. Conveyor equipment down, accumulated times.
4. Number of slow cycles at stations.
5. Total production count.
6. Totals for up, down and wait times.
7. Number of cycle stops originating at the load and unload stations.
8. Summary of machine malfunctions (faults) detected with times for this last shift as reported.

Some typical Printer Message Reports are shown in Figs. 5, 6, 7, 8, 9, 10, 11, 12, & 13. Accumulated or total times printed in minutes.

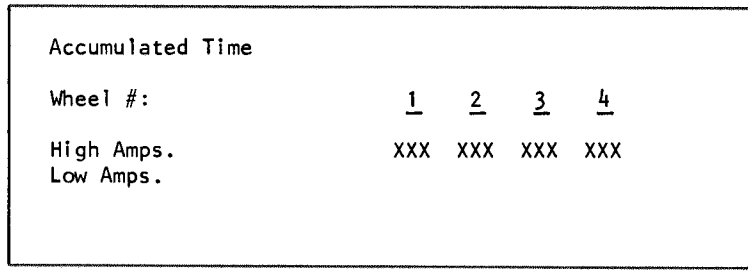

Fig. 5

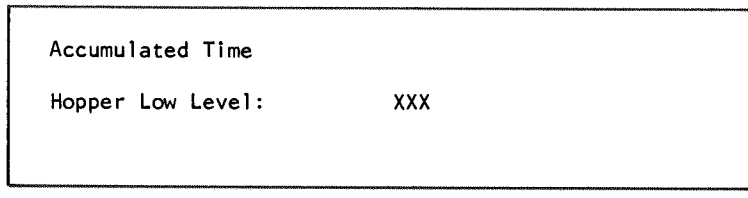

Fig. 6

Accumulated Down Time

Elevator:	XXX
Separator:	XXX
Long Worm:	XXX
Cross Worm:	XXX

Fig. 7 (Worm-Helicoid Screw Conveyors)

Slow Cycles

Station	Number
Compression	XXX
Blast	XXX
De-compression	XXX

Fig. 8

Total Production Count:	XXX

Fig. 9

Time Totals

Uptime:	XXX
Wait Time:	XXX
Down Time:	XXX

Fig. 10

Cycle Stoppage Due To Station	Number	Time
Load Stat:	XXX	XXX
Unload Stat:	XXX	XXX

Fig. 11

Last Faults	Time Hr: Min:
Elevator not moving	11:27
Wheel #3 high AMPS	09:54
Slow Cycle Blast Stat	07:05
Shot Hopper low level	07:04

Fig. 12

Date 02/21/79
Time 13:22:31
Product Report - Complete
Wheelabrator Machine #1234-X*
Shift #1**

Fig. 13 *Machine serial number
**Reported as time of day

SUMMARY

In summary, the addition of computer diagnostic systems to the four high production shot peening machines has resulted in a system that provides for:

1. Maximum utilization of machine(s) capacity.
2. An improved management tool for scheduling production.
3. An effective quality control system for the shot peening process and minimizing scrap.
4. Effective scheduling of maintenance procedures with a printed message on trouble areas or areas of potential malfunction.
5. Energy conservation by means of monitoring motor loads.
6. An environmentally effective system.