Volume 3
Issue 3

THE SHOT PEENER

Fall, 1989 INTERNATIONAL NEWSLETTER FOR SHOT PEENING – SURFACE FINISHING INDUSTRY

In This Issue

Running Shot Flow Rate Catch Test 1

Design Contest 2

Application Notes Available 3

Shot Peening Workshops 4

Shot Peening Article Available 4

ICSP 4 - Makuhari, Japan 5

THRESHOLD 21 ... 5

Company Profiles 6-7

Course on Shot Peening Theory & Applications 8

New Product Announcement 9

Information Manual Available 10

Summer Survey Results 11

RUNNING SHOT FLOW RATE CATCH TESTS

by Jack Champaigne

Many design engineers are reluctant to include shot peening as a component process because of inconsistent peening results. Operating a consistent process implies maintaining a calibrated machine. This article addresses the procedure for shot flow rate calibration. This becomes particularly important now that MIL-S-13165C requires record keeping of air pressure and shot flow rate for each Almen strip specimen.

Calibration of a shot peening machine includes:

1. Air pressure (wheel speed)
2. Shot flow rate
3. Turntable speed
4. Nozzle motion and speed
5. Cycle timer
6. Nozzle (wheel) aiming (angle, stand-off)
7. Nozzle size (and condition)

None of the above tasks are difficult. However, one of them is unpopular because it tends to be a dirty job requiring much physical effort. Because of that, the shot flow rate calibration is often ignored. The assumption that the Almen strip will always display shot flow rate problems is incorrect. Flow rate problems may be intermittent, and unless they occur during Almen strip exposure time, they may be undetected.

Shot peening operators often monitor air pressure as a matter of course. Now that shot flow monitors are available, the operator can also easily monitor and maintain the shot flow rate. Calibration of the air pressure gage is quite straight forward. Calibration of flow rate, whether regulated by

1. Orifice plate
2. Grit valve
3. MagnaValve
4. Dipper valve
5. None of the above

requires that shot be diverted to a suitable container for a known period of time and then the quantity of shot is weighed. The amount of shot caught in, say, one minute, is then expressed as the flow rate in pounds per minute, or kilograms per minute. Three consecutive catch tests with no adjustments to the machine, will display the degree of repeatability available. (See side bar "Catch Bucket Design Contest")

Although air pressure gages are generally calibrated to an accuracy of 1% or 2%, present peening practice "seems to accept" a 5% accuracy and repeatability for shot flow rate calibration. For a 10 pound per minute shot flow rate, a weigh scale resolution of at least 0.5 pounds would be necessary. For increased resolution, and experimental accuracy, longer catch periods may be used. A two minute catch test at 10 pounds per minute, using a container that weighs 8 pounds, would then require a weigh scale capacity of at least 28 pounds. Wheel machines that are capable of 800 to 1600 pounds per minute pose an additional challenge. How do you place that much shot onto the weigh scale?

Air Blast Calibration

Suction (Gravity) Type

This is the easiest class of machine to calibrate. The blast hose tends to be lighter and therefore easier to manipulate. If the machine uses a MagnaValve at the top of the blast cabinet, then the catch test can be done without blast air pressure. Remove the blast hose from the nozzle, enable the shot flow for one minute, catch the shot into a small container, weigh the container, subtract the container weight, record the net shot weight.

Repeat the above test three times to assure repeatability. If the actual flow, as shown by the catch test, is not the desired or intended flow rate, then adjust the MagnaValve controller and repeat the tests.

If the machine is a suction-type then the blast air is needed to convey the shot to the nozzle for the catch test, and it is necessary to construct a suitable catch bucket. The bucket should include a means to accept the nozzle in a manner that prevents shot escaping from the bucket. A method of venting the blast air through a screen must be provided. Care must be taken that the blast hose cannot come lose during the test and cause a safety hazard.

...continued on page 2

SURVEY

INTENSITY VS. COVERAGE

We continue hearing people ask for the procedure to determine peening exposure time. The three methods commonly seen are peening to intensity (Almen strip saturation), peening to coverage (surface denting) and tracer removal.

The next issue of The Shot Peener will be devoted to this topic. Contributing articles, comments, standard operating procedures, etc. are welcome. The results of the following survey will also be included.

DEFINITIONS

Intensity - time required to deflect an Almen strip to saturation.

Coverage - time required to achieve 100% denting coverage.

Tracer - time required to remove 100% of tracer.

FOR PEENING EXPOSURE TIME, WE PEEN TO:

INTENSITY **COVERAGE** **TRACER REMOVAL**

WE REQUIRE EXPOSURE AT LEAST:

100% **101% - 150%** **151% - 200%** **Over 200%**

(Please circle answer on "Survey Response" section of Bingo Card.)

Catch Tests continued from page 1...

Good work area ventilation should also be provided to prevent inhalation of the dust that is generated. Several styles of catch buckets are shown in the accompanying figure.

Air Blast Calibration

Direct Pressure Type

This class of machine is more challenging because the blast hose is usually very heavy, flow rates are usually higher and air pressure is usually higher.

Since the MagnaValve will deliver a constant flow rate within a 20 PSI to 90 PSI range, a low air pressure setting may be used for the catch test. This reduces a safety hazard in the event a hose breaks or the nozzle disengages from the catch bucket during the test. However, since fixed orifice shot flow rates vary substantially as the air pressure is changed, the catch test must be performed at operating air pressure.

Some catch buckets have a permanent nozzle attached to them allowing quick connection of the test blast hose to the shot flow regulator or MagnaValve. Other catch buckets require the nozzle be dismounted from its holder (gun rack) and inserted into the bucket. This latter method may be more accurate due to its ability to include effects of nozzle wear. But then again, the nozzles should be checked for replacement prior to affecting flow rate and intensity. Whichever method is used, operator safety should be a high priority.

WHEEL BLAST MACHINE

Catch Test

Since wheel blast machines generally throw 250 to 1800 pounds per minute of shot, special catch techniques must be used. The first one described allows the regulated flow to by-pass the wheel and enter the catch bucket.

Although the test concept is simple, it is cumbersome due to the large amount of shot to be manipulated. The shot flow is diverted prior to entering the wheel and directed into the bucket. Caution should be exercised due to the health hazard of inhaling the dust and adequate ventilation should be provided. A fork-lift truck or other means to maneuver the catch bucket will greatly improve the test method. Be sure the weigh scale has range necessary for the intended test duration plus the weight of the bucket. Also, be sure the weigh scale is calibrated through the range of use. (See side bar "No Weigh - Man")

Another technique that may be used will allow the wheel to be operated. Load cells (or weigh scale) designed to exhibit the shot hopper weight can be used to show shot weight before and after the one minute catch test period. Assuming recycled shot is prevented from returning to the hopper during the test, this test method is easier to conduct than the former method. An additional advantage of this technique is its increased accuracy, since wheel suction may influence shot flow rate through a fixed orifice. Higher resolution is also easier to obtain because the catch test period might be longer. The thrown shot can accumulate in the machine, the elevator or into a temporary holding hopper installed for the test. This temporary hopper can then be emptied into the main hopper at the end of the test.

CATCH BUCKETS

The accompanying figures illustrate several styles of catch buckets used for air type peening. Several things should be noted.

A static electrical charge is likely to accumulate on the shot. A discharge means should be provided to prevent injury. If a non-metallic bucket is used, then a conductor should be placed inside the bucket and connected externally to an earth or machine grounding point. Electric sparks 3" long are not uncommon during these tests.

A catch bucket will eventually deteriorate. Directing shot tangentially along the inside wall instead of perpendicular to it will increase bucket life. Use of a rubber liner or abrasive resistant material will also prolong bucket life.

Catch bucket failure or deterioration can be dangerous. Good design and periodic inspection can reduce this hazard. Emergency procedures should be planned in advance. A broken hose, fitting, air vent, or thin wall section can allow high velocity shot to endanger personnel.

Weight of bucket (plus shot) should be considered when deciding where to locate the bucket during the test (inside or outside the machine). Will special maneuvering be required? How will shot be weighed? Will it be transferred to another container? Is a weigh scale available nearby, or does the shot have to be transported to another department? If transportation is necessary, are multiple containers available to minimize the number of trips required? Does the weigh scale have the capacity and resolution required? Is weigh scale calibration required?

Most catch tests are controlled by the machine's cycle timer. When this is not possible, then external means are necessary. A stop watch may be used, but this is often unsuitable due to operator inaccuracy.

SAFETY FIRST

All calibration personnel should be instructed in the proper methods to be used and what procedure should be followed in the event of an emergency. This is especially important if the catch bucket is located outside of the machine and the blast hose is brought out through an access door. Most (all?) access doors have a safety interlock switch to instantly halt the machine and discontinue air pressure. This switch would probably be bypassed electrically or physically in order to perform the test and therefore some other method of emergency shutdown should be provided. Some machines provide an "E-Stop" button at several locations around the machine as a safety practice.

Another catch test technique that is not recommended involves intercepting the shot between the cabinet and the recycling system. Not all of the shot might come out of the cabinet (at least not where expected). Shot can become lodged in the machine and prevented from exiting the machine for recycling. Some shot might be carried out by the dust collector or on a turntable. Although this test may show consistency, it may not be accurate. Eight pounds per minute of shot may come out the recycle exit while five pounds per minute may leak out through a gap in the cabinet or be carried away by the turntable. The eight pounds per minute may be repeatable, but not correct.

You should visualize each step of the test during the design stage to include every needed element. Describe the procedure to an associate and have it repeated to you. Can the test be simplified? Made more accurate? Made safer?

Once the calibration procedure is finalized, plan a periodic review to improve the method. Also describe what records are to be maintained and how they are to be interpreted and reviewed. Apply "recalibration due date" labels to the machine and establish what conditions might require recalibration prior to schedule.

DESIGN CONTEST
$100 FIRST PRIZE

A contest to design a novel, useful, simple catch test bucket is being sponsored by The Shot Peener. Designs submitted may be simple sketches as long as adequate description of form and function is included. First prize of $100 will be awarded to best over-all design. Second and third place prizes of $50 will also be awarded.

All designs submitted will become "public domain" and made available to other subscribers. The Shot Peener assumes no liability for designs used in this contest.

All entries must be received by December 1, 1989. The winning design will be published in the Winter issue of The Shot Peener.

"NO WEIGH - MAN"

In 1978, I was conducting calibration tests for the first shot peen forming machine using flow rate display. Wheelabrator was supplying a 12-wheel peen forming machine to Boeing Commercial Airplane in Auburn, Washington. Early tests of shot flow rate accuracy and repeatability up to 800 pounds per minute had been satisfactorily completed. Above this range, a problem occurred. Although the shot flow rate display indicated 1000 pounds per minute, only 800 pounds were displayed on the platform scale. Repeated tests continued to show the same results.

At 1200 pounds per minute, the scale showed 1000 pounds. Eventually, at 1600 pounds per minute the scale showed 1550 pounds.

After several days of "extensive effort" the culprit was unmasked. Sufficient amount of shot was lodged in the scale beneath the platform to prevent proper scale deflection above 800 pounds. Above 1600 pounds the "mound" of shot could be displaced to allow more scale deflection.

***MORAL**: Calibrate the scale through the intended range of operation.*