Fall 2023
Volume 37, Issue 4 | ISSN 1069-2010

The Shot Peener

Sharing Information and Expanding Global Markets for Shot Peening and Blast Cleaning Industries

The new 600 Series MagnaValve®

The Smart Valve with SteadyFlow Technology

PLUS: THE MAGIC STEEL ■ WHEN LOGIC TAKES OVER INTUITION ■ AN INDUSTRY WISH LIST
NOZZLE PRODUCT DEVELOPMENT ■ AMS2432 REV E

Peening Innovation

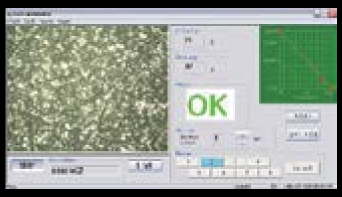
COVERAGE CHECKER

COVERAGE CHECKER the device for easy and precise coverage measurement

UV Light version
New arrival!

- UV light version Coverage Checker measures coverage by the fluorescent paint peeling rate, using UV light.Therefore, measurement result will not be affected by surface condition.
- UV light version Coverage Checker can measure the coverage even on oxidized surfaces and uneven peened surfaces, which was difficult to measure with normal version.

Coverage Checker (Original)
Easy USB connection to your PC



※PC is not included ※Device image

※Specifications of this device may be changed without notification.

Positron Surface Analyzer

PSA Type L-Ⅱ

PSA Type L-P

Non-Destructive Inspection

by Anti-coincidence System

US Patent : US 8,785,875 B2

Application

- Shot peening inspection
  (Inspection Depth : Down to 100 micron)
- Evaluation of Fatigue behavior
- Evaluation of sub-nano size defect
- Free volume on Polymer and Glass

Specification

Device size : Type L-Ⅱ W400 X L400 X H358 [mm]
Type L-P W125 X L210 X H115 [mm]

Positron source : Na-22(under 1MBq)

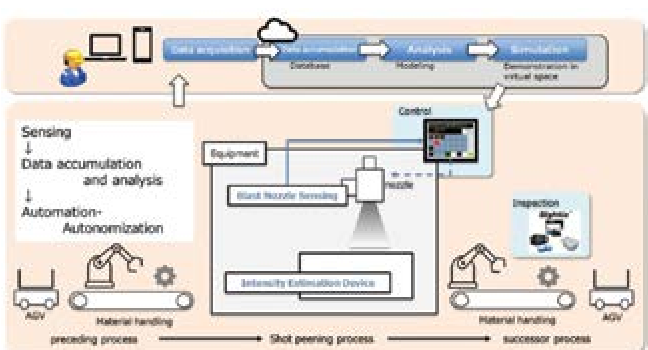
Option : Autosampler function (4 - 8 stage)

Distributor

Country	Company	TEL	E-MAIL
USA	Electronics Inc.	+1 574-256-5001	sales@electronics-inc.com
CANADA	Shockform Inc.	+1 450-430-8000	sales@shockform.com
EUROPE	SONATS	+33 251-700-494	sonats@sonats-et.com

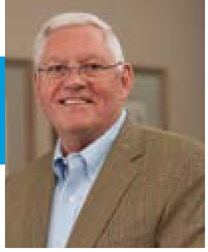
TOYO SEIKO CO.,LTD.
World Leading Company for Shot Peening

TEL:+81-567-52-3451 FAX:+81-567-52-3457
toyo@toyoseiko.co.jp
https://toyoseiko.co.jp



Concept Overview

THE SHOT PEENER
Sharing Information and Expanding Global Markets for Shot Peening and Blast Cleaning Industries



Product Evolution

I remember my first and second generation MagnaValve and the companion FC controller from a very long time ago. Now, I look at our new model 600 series MagnaValve with built-in servo and wonder, "How did this all happen?" The answer: Five decades of progress and a great group of engineers working hard. The performance of the new model 600 series valve is outstanding. No longer tethered to the FC controller's servo feature, there can be an unlimited number of valves connected to the customer's PLC. The addition of the LCD (liquid crystal display) is like the cherry on top of ice cream. This gives the operator (or maintenance person) a quick view of the set point, the actual flow rate, and the servo output. My how times have changed.

1st Generation

2nd Generation

Model 600

Product Development (Page 18)
I was intrigued by a US Patent (US 8,375,757 B2) assigned to Sintokogio involving the addition of a sensor (i.e., microphone) onto a peening nozzle. This concept was an update to two of their earlier patents on peening intensity (US patent 5,113,680 and US 6,640,596 B2). The big difference is the newest model provides continuous monitoring of peening intensity as opposed to the "look-aside" techniques of their earlier units.

US Patent 8,375,757 B2

US Patent 5,113,680

US Patent 6,640,596 B2

THE SHOT PEENER

Editor
Jack Champaigne

Associate Editor
Kathy Levy

Publisher
Electronics Inc.

For a free subscription of *The Shot Peener,* go to www.theshotpeenermagazine.com

The Shot Peener
56790 Magnetic Drive
Mishawaka, Indiana, 46545 USA
Telephone: 1-574-256-5001
www.theshotpeenermagazine.com

PRODUCT INTRODUCTION

Bryan Chevrie | Lead Engineer | Electronics Inc.

The 600 Series MagnaValve®

The Smart Valve with SteadyFlow Technology

INTRODUCING the 600 Series MagnaValves—a revolutionary advancement that surpasses its predecessors in terms of performance and user experience. This latest iteration comes equipped with a host of cutting-edge features that set it apart from previous versions of the MagnaValve, making it the ultimate choice for industrial applications.

One of the standout features of the 600 Series MagnaValves is the incorporation of a built-in servo. This innovative addition eliminates the need for a separate controller or the requirement for customers to write and implement a PID controller. This not only simplifies the installation process but also enhances operational efficiency—this makes it easier to integrate the MagnaValve seamlessly into existing machinery.

Another remarkable enhancement is the Jump-to feature. In contrast to previous versions that gradually ramped up media flow rates from 0 lb/min when enabled, the 600 Series starts at the desired flow rate instantaneously. This elimination of slow ramp-ups translates to shorter cycle times and significantly higher throughput, contributing to improved productivity and cost-effectiveness in industrial operations.

The 600 Series MagnaValve also embraces the advantages of modern technology with its embedded webpage. Unlike the costly and specialized communication cables required by its predecessors, the embedded webpage utilizes a standard Ethernet cable, reducing setup costs and complexity. This intuitive embedded webpage facilitates quick and easy setup and allows for seamless changes in settings and enhances user-friendliness and accessibility.

In summary, the 600 Series MagnaValves represent a major leap forward in industrial flow control. With its built-in servo, Jump-to feature, embedded webpage, simplified calibration, and LCD screen, this advanced device not only simplifies installation but also optimizes performance and productivity. By addressing the limitations of previous versions but keeping the field-tested benefits of the MagnaValves' unique construction, the 600 Series MagnaValves stand as a testament to innovation and excellence in industrial automation, making them the preferred choice for businesses seeking enhanced flow control solutions. ●

The LCD screen on the 600 Series MagnaValves provides critical process information at a moment's notice. It indicates that the "Enable" signal has been received and it displays the selected configuration table setting. The setpoint and the actual media flow rate are shown in the active bar graphs and digital formats. The "Servo" bar graph displays the output capacity of the valve from 0-100%. This is very helpful for diagnostics: If the Servo shows 100% output but the actual flow rate is zero (or very low), the valve has opened fully but the hopper is out of media.

The 678-24 MagnaValve

Flow Rate Ranges

676-24	.2 - 2 lb/min (.1 - 1 kg/min)
677-24	1 - 10 lb/min (.45 - 4.5 kg/min)
678-24	3 - 30 lb/min (1.4 - 13.5 kg/min)
679-24	10 - 100 lb/min (4.5 - 45 kg/min)
680-24	20 - 200 lb/min (9 - 90 kg/min)
690-24	30 - 300 lb/min (13.6 - 136 kg min)

Flow rates based on S230 cast steel shot

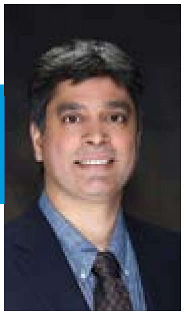
Features

- 24 Vdc
- Non-pulsing media flow
- ±10% setpoint accuracy (meets AMS 2432 Rev E)
- Ethernet with Embedded Webpage
- Normally closed
- Built-In Servo
- No moving parts for low-maintenance operation
- Desired Flow Jump-To (US Patent Pending)
- Meets SAE AMS 2430 and 2432 Rev E specifications
- Customizable LCD screen
- Simplified installation and calibration
- CE compliant
- 0 - 10 Vdc, 4 - 20 mA, I/O

Specifications

Power	+24 Vdc @ 2A (50 VA)
Temperature Range	32˚F - 131˚F (0˚C - 55˚C)
Media	Ferrous media
Flow Enable Input	24Vdc ±2 into 20K
Setpoint Input	0 - 10 Vdc / 4 - 20 mA
Maximum Pressure	100 PSI
Mode	Normally Closed
Ethernet	10/100 Mbps
Flow Sensor Output	0 - 10 Vdc, max output 11.5 Vdc 4 - 20 mA, max output 15 Vdc

For more information on the 600 Series MagnaValve, contact the EI Customer Service staff at 1-800-832-5653 or visit *www.electronics-inc.com.*



AN INSIDER'S PERSPECTIVE

Kumar Balan | Blast Cleaning and Shot Peening Specialist

More Can Be Done

BACKGROUND

In a past column[1], I shared a wish list of items pertaining to cleaning and peening machines. One of them was the endemic issue of leakage and the resulting unintentional skating rink around your machine combined with the loss of good usable peening or cleaning media. Another undesirable feature is the inability to conduct an audible conversation around a machine due to the high decibel levels. We discussed the common issues faced by Applications Engineers regarding the afterthought that blast machines have been and the lack of space to accommodate them after every small piece of machinery has claimed its space in the layout! I expressed a desire to have "prescriptive maintenance" as part of the machine diagnostics (a feature that some new equipment designs incorporate). Another topic plaguing the end-users in our industry is the difficulty to tangibly measure part coverage. Finally, I pointed out the importance of maintaining a healthy working mix in a foundry blast machine—a concept that is not relevant to peening applications that are strictly reliant on a constant shot size for their operational efficacy.

Following this publication, a few of you met me at various industry events over the past year and offered suggestions that prompted me to continue on with the list, appropriately titled—More can be done!

A LEARNING FORUM

A few years ago, I was introduced to CSEE[2]. The depth of knowledge and information surrounding surface engineering in addition to blast cleaning and peening was highly motivating. This center works with large organizations to solve their fatigue enhancement issues and advance their adoption of shot peening for critical components. This led me to believe that some of the prevalent issues in our industry, including those listed earlier, can be sorted out by a collective assimilation of brain power. In other words, a forum such as *https://www.shotpeener.com/forums* should be widely utilized to discuss common issues faced by many end-users. I remember attending a class by Kevin Young of Progressive Surface where he explained the loss of energy and resulting lower arc height from peening inside hollow tubes. I am sure this prompted the attendees of his class to think about energy compensation by adjusting process parameters when faced with this situation. Another discussion Kevin led was about a batch of defective Almen strips due to a heat treatment glitch. This helped me avoid a wild goose chase with achieving target arc heights when attempting to dial-in a process. There needs to be more such forums where information exchange can take place unfettered.

These are healthy discussions that do not have to present a competitive challenge or disclosure concerns within the industry. I have often said that most concepts that we deal with regularly, though ingrained in basic physics, are not easy to find elaborated on in textbooks. This prompted me to publish a series titled "Tribal Knowledge"[3]. After five parts on this subject, I am certain that I have barely scratched the surface, which leads me to my next topic…

MENTORING

Recently, during an opportunity to work with a new recruit in the industry, I was transported to my early years as a trainee engineer where I was handed a machine manual to read for the first two weeks. Those two agonizingly long weeks aged me by about two years in fatigue with little imbibed by way of knowledge! This may not be the best approach to introduce a new recruit to any industry. Our industry needs to have a non-partisan bank of mentors that a new recruit can choose from based on his or her career goals. A fruitful mentor-mentee relationship will not only promote sustained interest for the new entrant but also provide the satisfaction to the mentor as having contributed to the industry's growth. To kick this off, I offer myself as a mentor for anyone that is genuinely interested in knowing the entrails of this industry and getting reasonable access to information that I have integrated over the past three plus decades without the need to pour over maintenance manuals. Though I hardly claim to know everything there is to be known, I do offer the distinct possibility to research a qualified response to most technical problems.

To enhance the quality of our discussion, I sought input from Kaitlin Beach, a Continuous Improvement Engineer at Peening Technologies. Peening Technologies is a peening service provider and equipment manufacturer that specializes

[1] "I wish my machine did this," *The Shot Peener*, Summer 2022
[2] CSEE – Center for Surface Engineering and Enhancement, Purdue University, (https://engineering.purdue.edu/MSE/CSEE)
[3] Tribal Knowledge, Parts 1 through 5, *The Shot Peener*, 2020-2022

in high-end shot peening machines for aerospace and other advanced manufacturing sectors. With a graduate degree in mechanical engineering and experience in the medical device industry prior to her current role, Kaitlin recognizes the importance of understanding specifications and the need for conformance. "For someone starting new, it'll be useful to obtain a high-level overview of all the established shot peening specifications and how they relate to one another," said Kaitlin. It does not end there: Service providers are also faced with individual PRIME specifications that add to the list of variables! Outside of aerospace, MIL-S-13165C[4], though redundant, continues to be an often referred to specification. More needs to be done to make specifications easily decipherable to anyone that picks up the document for the first time. The language needs to be less open to interpretation and confusion. As part of the SEC committee, I can attest to the efforts of committee members to work toward this goal during every five-year review of the documents.

PARTNERSHIPS: OEM - SUPPLIERS

I came across an insightful article that highlighted the semiconductor crisis[5] and it offers a timely learning opportunity. Most of us have experienced the impact of supply chain disruptions, whether it be begrudgingly owning a brand-new car minus heated seats, or worse, not being able to take delivery of a car at all for months after you had paid for it! A frustrated aerospace customer recently disclosed that they had to wait for almost 30 months post-order for a shot peening machine to be tested and delivered. The above referenced article cites the example of tech companies that have an established pattern of collaborating with their direct and indirect suppliers. They view procurement vastly different from auto companies who were hardly aware of where the chips in their vehicles came from! On a side note, anyone with some exposure to this industry will have associated stories to relate about doing business with automotive. Let us see how this concept can be made relevant to our industry by adopting some of the big-tech inspired steps listed in this article:

- Establish a bill of material for critical components along with long-term arrangements with suppliers of components such as PLCs, HMIs, pneumatic and flow-control valves, and blast tanks.
- Share potential growth plans and targets with suppliers of critical components (with adequate non-disclosure protection) and make commitments for a two-year horizon.
- Commitment from suppliers to "hold" critical components on consignment exclusively for the OEM.
- Track usage, particularly for consumables such as abrasive and peening media, and report on this data so that a calculated inventory of product can be made available when needed.
- Encourage suppliers to use OEM products as their "launch vehicles" when they introduce innovative technology to replace or enhance existing products.

PARTNERSHIPS: END-USERS - SUPPLIERS

I interviewed select end-users to understand and compile a list of common themes within our industry where suppliers can play a useful role in mutually rewarding partnerships.

1. Fixtures and masking – A large peening service provider in Ontario, Canada processes high volumes of automotive components. High-intensity values often require peening at air pressures such as 80-90 PSI (5 to 6 bar). Overspray and drifting of parting lines between peened and unpeened surfaces are not acceptable. All these present unique challenges for designing fixtures and selecting masking materials that can withstand wear. Though a unique situation for this end-user, such applications promise to be prevalent in many workshops. It presents a rich opportunity for vendor partnership and potential testing ground for new masking/fixturing materials and techniques.
2. Innovation with hybrid machines – Compliance with audit criteria and other prime specifications requires significant effort and has to be repeated for every machine in process. When the application demands the use of wheel and air media propulsion for large surfaces as well as intricate areas, both machines must be certified for the process. Hybrid machine solutions that employ both media propulsion techniques eliminate the need to certify two machines.
3. Fire and explosion protection – This is a subject that needs careful analysis and lots of education. Industry guidelines on handling explosive dust from processing aluminum, magnesium and titanium parts could vary by geography, company standards, and liability insurance requirements. Though a common solution may not be adaptable to all situations, suppliers of dry and wet dust collectors are encouraged to increase their presence within our industry forums and educate end-users on the required safety components, legislation, risks of non-conformance and available solutions.
4. On the topic of dust, its disposal has been a highly debated topic for decades! A Canadian customer in a rural part of the country operates several wheelblast machines that generated a fair amount of dust in the process. Disposing this dust was challenging since local municipalities refused to accept it in their landfill. Consider a wheelblast machine with 8 x 25 HP wheels. With the breakdown of media and pulverization of scale, this machine generates well over 100 pounds of waste

[4] "Are you still using MIL-S-13165?", *The Shot Peener*, Summer 2020
[5] "The semiconductor crisis should change your long-term supply chain strategy", *Harvard Business Review*, May 2022

comprising of dust and fines during operation. This calls to action waste disposal companies to find an innovative solution to make this product usable in some form. An airblast machine that peens with two nozzles may not pose a formidable threat in this arena, but the reality is that our blast cleaning industry has invested a high percentage in wheelblast machines.

5. Kaitlin Beach from Peening Technologies brought up an aspect of her job that shifts our focus from routine, task-oriented activities. Kaitlin explained, "Because I have experience in a different industry, I know it helps to understand the function of the parts we process or what assemblies they fit within." Why is this important? As shot peeners, we have honed our skills so we can provide productive recommendations on the customer's process and part design that will benefit their end goal if that is known clearly. This speaks to the significance of a healthy end-user–supplier partnership.

6. Blast cleaning and shot peening machines are self-consuming. Every sub-assembly and component that comes in contact with the abrasive or peening media is subject to wear. In an airblast machine, it's the blast nozzles and hoses. In a wheelblast machine, it's the wheel parts and cabinet liners. Though wear is inevitable, minimizing or delaying it with sound design practices and planning for wear using preventive maintenance predictors are useful tactics. An aerospace customer recently gave me an example of the former. Tight spaces inside the blast cabinet where blast hoses are forced to change directions should be avoided at all costs by designing a larger size cabinet. Tight hose bends accelerate wear and result in energy loss as the hose degrades. Similarly, there is little benefit in waiting for the nozzle bore to wear to greater than 1/8" its original size before replacing it. If an acceptable and previously established wear life has been reached, replace the critical component without delay.

THE COST-BENEFIT EQUATION

Very often, we are faced with the "refurbish or replace" question for our equipment. This question is often addressed by the logic that if refurbishment costs are over 40% the price of a new machine, choose the latter. More importantly, the irony of this question speaks to the inability of the current state of the equipment in maintaining required tolerances, accuracies and operating efficiencies. With our goal being the protection of capital and operating costs, we are provided tight constraints within which to operate. The only way this can be done is to increase efficiencies within our individual groups of suppliers, OEMs, end-users, and research institutions.

Editor's Note: This is Kumar's 75th article for *The Shot Peener* magazine. *The Shot Peener* staff greatly appreciates his contribution to our publication.

Erik Waelchli | Owner of IBD Connection, Inc. and Consultant for Electronics Inc. | www.IBDConnection.com

When Logic Takes Over Intuition

This is simply a story of events from the production shop at Electronics, Inc. It is a story about false intuition and where logic finally triumphed. Yes, some of you peening experts must be thinking "greenhorns", but some of you might be caught off guard, as I was.

HERE IT GOES: Electronics, Inc. has a significant variety of media types in inventory which are used to test valves, sensors and Almen strips. Recently we reviewed the inventory list, and for some of the containers we had actual weight-in-stock. We looked for a way to get an approximate weight simply by measuring the fill-level of the container. Intuition struck and the need for a bulk-density table based on media type was on the table. Intuition said, smaller media equals higher bulk-density!

No problem we thought—let's call the experts at Ervin Industries! Michael Konecny and Rick Payne with Ervin promptly fed us the answers: 7.14 – 7.69 g/ccm (~7.5 g/cm3) for the shot-material density and 286.82 lb/cu-ft for the shot-media bulk-density—the handwritten note said: "currently 280 shot". A bit frustrated, having now only one data point, the 280 shot, I decided to make a simple test, weighing some different sizes of cast-steel shot in EI's inventory. The results baffled me as the given volume for all shots had approximately the same weight! How could this be? Smaller media has smaller voids around itself, while larger shot has bigger voids. I was convinced, therefore, the larger shot would have a smaller bulk density over the smaller shot. So, I consulted "Uncle Google"! (See QR codes at the end of the article.)

Here is what I learned quickly: While smaller media has smaller voids and larger shot has bigger voids, for smaller shot there are many more of these voids, while for larger shot there a fewer of them. This balanced things out, simply by geometric volume ratio.

One reference[i] gave a nice table with packing-density equations based on different mathematical models and packing processes (see Table One). Another reference[ii] pointed out the "wall effect" where the bulk-density is affected by the ratio of the wall-area to the sample volume and the size of the spheres. Higher wall-area to sample volume results in lower bulk density. This phenomenon was apparent on my first, crude weight test with a tall, narrow lab measuring cylinder. The larger media sizes weighed noticeably less.

Table One
Packing Density Equations

packing	analytic η	η	reference
loosest possible	--	0.0555	Gardner (1966)
tetrahedral lattice	$\frac{\pi\sqrt{3}}{16}$	0.3401	Hilbert and Cohn-Vossen (1999, pp. 48-50)
cubic lattice	$\frac{\pi}{6}$	0.5236	
hexagonal lattice	$\frac{\pi}{3\sqrt{3}}$	0.6046	
random	--	0.6400	Jaeger and Nagel (1992)
face-centered cubic close packing	$\frac{\pi}{3\sqrt{2}}$	0.7405	Steinhaus (1999, p. 202), Wells (1986, p. 29; 1991, p. 237)
body-centered cubic close packing	$\frac{\pi\sqrt{3}}{8}$	0.6801	
hexagonal close packing	$\frac{\pi}{3\sqrt{2}}$	0.7405	Steinhaus (1999, p. 202), Wells (1986, p. 29; 1991, p. 237)

A third reference[iii] got so much into the packing theory with differential, integral and matrix math, I did not take the effort to absorb all the details of the article. Instead, we decided to make two additional tests with six (6) cast-steel shot sizes and two (2) different sample volumes:

- Test #2a the media was "as-poured" into a 20 cu-in volume cylinder with a diameter/length ratio of 1.06 (~1.0) [-]
- Test #2b the media was "as-shaken" (not stirred! - 007 ☺) into a 20 cu-in volume cylinder with a diameter/length ratio of 1.06 (~1.0) [-]
- Test #3a the media was "as-poured" into a 5.22 cu-in volume cylinder with a diameter/length ratio of 0.37 [-]
- Test #3b the media was "as-shaken" into a 5.22 cu-in volume cylinder with a diameter/length ratio of 0.37 [-]

20 cu-in volume

5.22 cu-in volume

These are the results of these two tests.

20 cu-inch Volume Test #2

El-Test #2a		Diameter	3.000 inch
As Poured		Length	2.830 inch
		Volume	20.00409 cu-in
Media	Weight [g]	Weight [lbs]	Bulk Density [lbs/cu-in]
S-930	1430	3.14600	0.1573
S-660	1425	3.13500	0.1567
S-230	1470	3.23400	0.1617
S-170	1455	3.20100	0.1600
S-110	1455	3.20100	0.1600
S-70	1445	3.17900	0.1589
		Avg	**0.1591 lbs/cu-in**
			274.93 lbs/cu-ft
		Packing Density	**63.0%**

El-Test #2b		Diameter	3.000 inch
As Shaken		Length	2.830 inch
		Volume	20.00409 cu-in
Media	Weight [g]	Weight [lbs]	Bulk Density [lbs/cu-in]
S-930	1515	3.33300	0.1666
S-660	1505	3.31100	0.1655
S-230	1550	3.41000	0.1705
S-170	1520	3.34400	0.1672
S-110	1520	3.34400	0.1672
S-70	1520	3.34400	0.1672
		Avg	**0.1673 lbs/cu-in**
			289.18 lbs/cu-ft
		Packing Density	**66.2%**

5.22 cu-inch Volume Test #3

El-Test #3a		Diameter	1.350 inch
As Poured		Length	3.645 inch
		Volume	5.21741 cu-in
Media	Weight [g]	Weight [lbs]	Bulk Density [lbs/cu-in]
S-930	367.86	0.80929	0.1551
S-660	371.28	0.81682	0.1566
S-230	383.24	0.84313	0.1616
S-170	378.16	0.83195	0.1595
S-110	376.14	0.82751	0.1586
S-70	374.52	0.82394	0.1579
		Avg	**0.1582 lbs/cu-in**
			273.38 lbs/cu-ft
		Packing Density	**62.7%**

El-Test #3b		Diameter	1.350 inch
As Shaken		Length	3.645 inch
		Volume	5.21741 cu-in
Media	Weight [g]	Weight [lbs]	Bulk Density [lbs/cu-in]
S-930	389.17	0.85617	0.1641
S-660	389.41	0.85670	0.1642
S-230	400.76	0.88167	0.1690
S-170	395.74	0.87063	0.1669
S-110	397.79	0.87514	0.1677
S-70	395.77	0.87069	0.1669
		Avg	**0.1665 lbs/cu-in**
			287.65 lbs/cu-ft
		Packing Density	**66.1%**

Here we draw the conclusion for the two tests combined:

- **Bulk-density "as poured"** 273.4 to 274.9 lb/cu-ft
  → **avg. 274.2 lb/cu-ft**
  Packing density 62.7 to 63.0%
  (see Table 1: ≈ "random" - Jaeger & Nagel 1992)

- **Bulk-density "shaken"** 287.7 to 289.2 lb/cu-ft
  → **avg. 288.5 lb/cu-ft**
  Packing density 66.1 to 66.2%
  (see Table 1: ≈ "body-centered" - cubic close packing)

The numeric results are very consistent between the two tests.

In both the "as-poured" tests, the wall-effect manifests itself by the slightly lower weights at coarser media. In the "as-shaken", only the test 3b with the lower diameter/length ratio volume indicates some wall-effect.

Comparing these numbers with the value given by Ervin Industries shows the consistency of data:

"as-poured" = 274.2 lb/cu-ft → "ERVIN" = 286.82 lb/cu-ft → "as-shaken" = 288.5 lb/cu-ft

Bottom line, our friends at Ervin Industry, in their wisdom, gave us the correct, single number—yes, there is only one bulk density for shot-peen media, independent of the different sizes.

While these tests were made with spherical, cast-steel shot media only, the single value feature of different size bulk-density translates to other media types: i.e., cut-wire, ceramic, glass, etc. However, the single, numeric value will naturally change as the particular material density of different media types varies greatly.

The days are not lost—we learned something!

Google Search References

[i] *https://mathworld.wolfram.com/SpherePacking.html*

[ii] L. Burtseva, B. Valdez Salas, F. Werner, V. Petranovskii - **Packing of monosized spheres in a cylindrical container: models and approaches**; Revista Mexicana de F'ısica 61 (2015) 20–27 – Wall Effect paragraph 4.2

[iii] H. Cuhn (Microsoft) – **Conceptual Breakthrough in Sphere Packing**; Feb2017_rnoti-p102

PRO-LOADER

BARREL/DRUM MEDIA TRANSPORT

DESIGNED FOR BULK MEDIA TRANSFER

*Empire's **Pro-Loader** is designed for bulk media transfer in an Empire blast system, with no lifting and minimal attention by an operator.*

Yuji Kobayashi and Akinori Matsui | y-kobayashi@sinto.co.jp and a-matsui@sinto.co.jp | SINTOKOGIO, LTD

Development of a Device for Evaluating Media Injection State in Air-Type Shot Peening Nozzles

1. INTRODUCTION

Recently digital transformation (DX) initiatives have been increasing in the industrial world. It is not something special, but many of them are already implemented in our daily lives. Examples include cloud-connected smart devices and music and movie subscription services. These digital solutions are having a significant impact on our lives.

The steps to promote DX are digitization, digitalization, and digital transformation. The first step is the transition from analog to digital (digitization), which is required for both processes and facilities. After digitalization, it is expected to improve productivity and create new businesses by utilizing the data obtained from the digitalization.

In addition, simulation and analysis using data will eliminate the need for trial manufacture, which has been done in the past, and equipment settings can be set automatically according to the equipment and environment (automation and autonomization of equipment). If these are realized, the number of man-hours spent on work and the reduction of waste will be solved, leading to sustainable business.

From another perspective, what used to rely on the worker's experience, intuition, and know-how can now be visualized as numerical data, leading to technological improvement and the transmission of skills.

On the other hand, from a carbon-neutral perspective, it is possible to optimize energy consumption. If the current processing conditions can be quantified, it is possible to obtain optimal conditions through simulations in a virtual space and feed them back to the real world to optimize the processing.

Equipment manufacturers believe that digitization of processes and facilities is the first step in the process. The items include process condition monitoring and equipment operation status. This data can be visualized as numerical data, and the obtained data can be used to provide useful feedback for customers' facility operation.

However, it is difficult for a single company to achieve this, and we believe that companies and research institutes with knowledge in each technical section should work together to achieve DX as an industry.

2. CONCEPT

The flow of DX promotion in the shot peening process may include (1) sensing, (2) data accumulation, (3) data analysis, and (4) feedback to the equipment. These steps should be repeated to optimize the process and equipment.

For sensing, it is necessary to visualize parameters related to processing and equipment operation. Data accumulation and analysis can be done either on the site side (edge computing) or in the cloud, depending on the desired parameters. Analysis results are fed back to the facility (on-site) to achieve or maintain optimal conditions.

There are various methods to achieve these goals, and it is difficult to select a single method. We would like to discuss the optimal method in cooperation with users and partner companies.

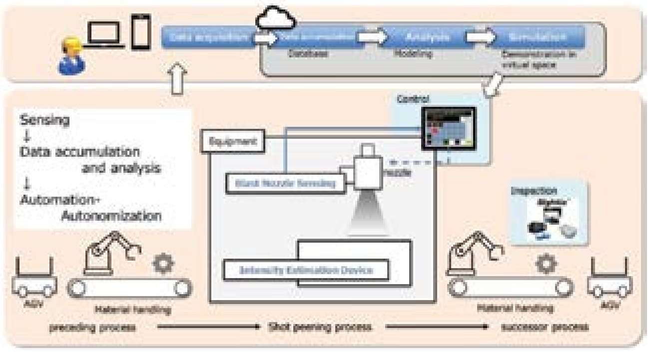


Figure 1 Concept Overview

3. OVERVIEW OF SINTOKOGIO'S INITIATIVES

The following is an example of Sintokogio's efforts to study sensing methods. In the past, our company has obtained a patent for this type of sensing (Suzuki-type nozzle sensing method: US patent 8375757). The purpose of this patent is to check the condition of shots passing through the nozzle. Although arc height and intensity are used to evaluate the peening process, they had not been linked to the peening process at the time the patent was obtained. One of the reasons for this is that it was difficult to extract the feature values that were associated with them from the sensor output using the technology available at that time.

However, recent technological advances have made it possible to extract parameters for intensity estimation. This can be done in real-time for continuous monitoring and control. This is accomplished in the following steps. (1) Attach a sensor to the nozzle and acquire its output waveform (2) Extract features from the raw waveform (3) Estimate the intensity from the features.

Experimental results are presented below.
Figure 2 shows experimental system of this study. A gravity suction type blasting machine was used with the sensor attached on the blast nozzle. It was connected to the measurement device by cable. The device acquires sensor output values and calculates parameters. Media used in this experiment are shown in Table 1.

MagnaValve®

The New LM Series MagnaValve®

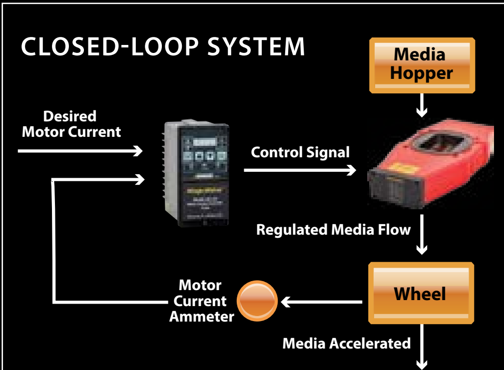
Steel Shot Media Valves for Wheel Blast Machines

LM2000-24

IDEAL FOR FOUNDRIES AND OTHER HIGH-VOLUME APPLICATIONS

- Flow rate up to 2,000 lb/min (907 kg/min) for S230 shot
- Flow control for wheels up to 50 Hp (37 kW) for S230 shot
- Replaceable wear plate*
- Polycarbonate casing for lighter weight
- Built-in cooling air aspiration inlet*
- No moving parts for low-maintenance operation
- Normally closed

CLOSED-LOOP SYSTEM



The LM Series MagnaValve and Electronics Inc. AC-24 Controller provide motor amperage control

Electronics Inc.
Shot Peening Control

www.electronics-inc.com 1-800-832-5653 or 1-574-256-5001

* Patents pending

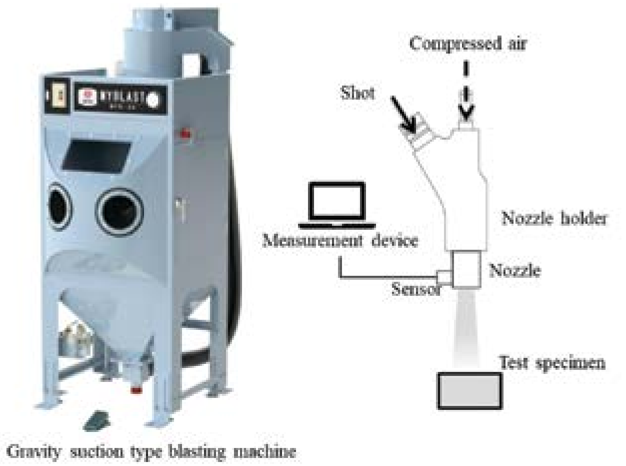


Figure 2 Experimental system

Table 1 Media used in this experiment

Media type	Diameter[mm]	Hardness[HV]
Cast steel	0.1	390~510
CCW	0.3	450~550
CCW	0.6	780~850

Figure 3 shows an example of the acquired waveforms: the compressed air injection starts at 0.8 seconds and the media injection starts at 1.2 seconds. Waveforms overlap each other, making it difficult to extract features from them.

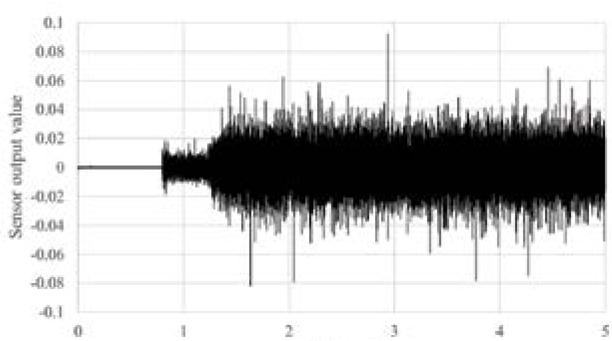


Figure 3 Sensor output waveform

Next, the results of the calculations to extract features from the acquired waveforms are shown below. The calculation result in Figure 3 is Figure 4.

The waveform is relatively stable in the time region where the media is injected. It can also be seen that the calculated values are different when only compressed air is being injected and when media is being injected. This can be used to confirm whether the media is coming out of the nozzle or not.

The parameter calculated by averaging the calculated values when the media is injected in the figure below is called the "mean value," and this value was compared with the intensity.

The results which compare with peening intensity and the mean value are shown. The dashed line shows the approximate line.

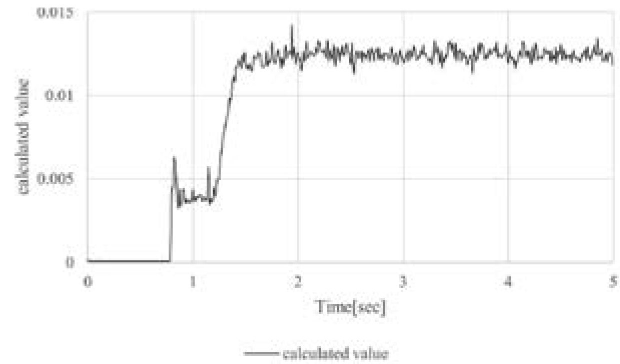


Figure 4 Waveform after calculation

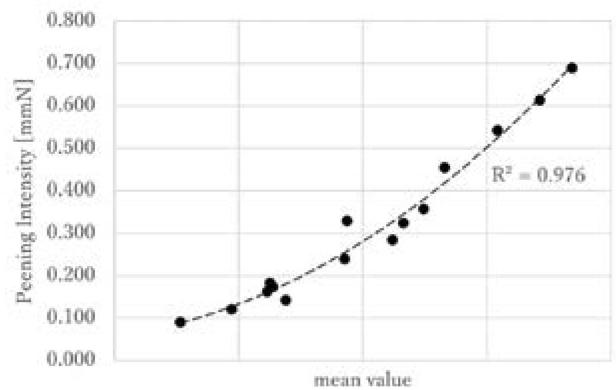


Figure 5 Comparison of peening intensity and the mean value

The result of drawing an approximate line for the parameters and intensity calculated from the acquired waveforms shows a very good fit. Intensity is estimated from this result. Then we consider that Intensity can be estimated from the relationship between Intensity and mean value.

Conventionally, arc height and intensity are checked before processing, but only indirect parameters such as pressure are available for monitoring conditions during machining. The ability to obtain numerical data on injection conditions during machining improves the certainty of the process and enables traceability.

4. CONCLUSION

Development of a device for evaluating the media injection state in air-type shot peening nozzles was introduced. Numerical expression of phenomena is important to realize DX. For this purpose, it is necessary to work on sensing technology for phenomena related to shot peening.

We are now working on the evaluation activities with the help of Electronics Inc. We also hope that the industry, not just single companies, will discuss the use of this data.

We would like to hear users' opinions on this technology and concept. If you are interested, we would be glad to hear from you. Please contact us via email:

Yuji Kobayashi - *y-kobayashi@sinto.co.jp*
Akinori Matsui - *a-matsui@sinto.co.jp*


Blasting Nozzles & Liners
Nylon Holders & Couplings
Accessories for Air & Shot Blasting
HMT GmbH
Serge Weydert
General Manager Europe
4, um Bierg
9170 Mertzig
Luxembourg
Tel: 00352 691 968613
Email: weydert.s@hmt-cera.com
URL: http://www.hmt-cera.com

Engineered Abrasives®

Manufacturers of the Finest Blast Finishing and Shot Peening Systems

(708) 389-9700 or (773) 468-0440

Email: mwern@engineeredabrasives.com Web: www.engineeredabrasives.com

IATF 16949
ISO 14001
FORD Q1
Certified
Job Services

All Engineered Abrasives® systems are available with the EA® Knowledge System®. The EA® Knowledge System® features computer animation on machine operation and maintenance, including how to do Almen Strips.

Engineered Abrasives® High-Volume Index Unit with complete Material Handling and Robotic System

60" Index Unit
Ring and Pinion Gears for High Volume

8 Pressure Nozzles with MagnaValves®, Buck Elevator, Sweco and Dust Collector

CONTROL by MagnaValve®

All Tooling and Fixtures
Tool Steel hardened to 62 RC

Engineered Abrasives® index units are the most durable machines on the market today with all our special features

Patented 72" Index Unit with Shot Flow Controls, Sweco, Bucket Elevator, 8 Nozzles and 16 Spindles. Designed for high-volume shot peening.

Look for RED components and surfaces to be sure you get Engineered Abrasives® quality equipment and OEM parts.

High-volume automotive systems for ring and pinion axle gears

Designed and built by EA®

Two (2) Index Units with complete load and unload Fanuc Robots and Conveyor System

Both machines built and tested on EA® floor

EA® 72" Flex Peener™
4 stations with 4 spindles at each station. Can do different gears on each spindle or all the same for higher volume.

Single Cell Unit, 5 Pressure Nozzles

Bucket Elevator
Sweco System
◀ MagnaValves®

◀ Dual Swing Doors for higher volume

Special safety platforms ▶ for easier maintenance

EA® 72" Index Unit


FROHN

ACADEMIC STUDY

Dr. David Kirk | Coventry University

Shot Peeners' Magic Steel MANGALLOY

INTRODUCTION

Mangalloy works magically! As shot particles it is austenitic and tough but develops a very hard martensitic skin if cold-worked by peening. When the surface wears away, very very slowly, the skin automatically repairs itself. For peening cabinet components the same applies.

Mangalloy, also called "manganese steel" or "Hadfield steel", is an alloy steel containing an average of around 13% manganese. Invented in the nineteenth century it found many applications such as railway line intersections.

This article includes elements of the alloy's history, properties, martensite formation and applications.

HISTORY

Mangalloy was invented by Sir Robert Hadfield in 1882. It was the first commercially successful alloy steel and had properties different from those of plain carbon steels. Hadfield had been searching for a steel composition that would have both hardness and toughness which plain carbon steels did not have. In the nineteenth century, steelmaking was more of an art than a science. Hadfield became interested in the addition of manganese and silicon to carbon steel. This was because ferromanganese had become available being made cheaply from manganese ores.

As the manganese content of carbon steel is raised it becomes increasingly brittle. At 4% manganese, it shatters on impact. Hadfield was interested in why this occurred. Why he produced a steel with a manganese content of about 12% is, however, unclear. The following apocryphal tale was related to the author, when he was a child, by his steelmaker father:

"Hadfield ordered a steel to be made, in his own steelworks, that contained 4% manganese. A pile of ferromanganese was delivered to the furnaceman. He added enough to produce the specified 4% manganese content—then went off for a break. The foreman came to the unmanned furnace, saw the pile of ferromanganese and wrongly assumed that none had been added. He therefore added enough to produce 4%, though actually raising it to about 8%—then went off for his break. During that break Hadfield himself came along, saw the ferromanganese and also wrongly assumed none had been added, so he did so himself. As a result the steel, when cast, had about 12% manganese."

Hadfield's hundreds of tests on his 12% manganese steel gave results that surprised him. Cast bars could not be machined, filed or sawn. On heating and quenching the steel became both hard and tough. With plain carbon steels heating and quenching increases hardness but at the expense of toughness. Hadfield's patent of 1883 was for steel alloys containing 12 to 14% manganese and 1.0% carbon. These were the very first steel alloys that were commercially viable.

MECHANICAL PROPERTIES

The variation of its mechanical properties, ductility, tensile strength, toughness and wear resistance, is basic to an understanding of why the magic alloy Mangalloy became so important. Fig.1 shows how ductility varies with manganese content. Ductility falls from about 30% to 0% with increase of manganese between 0 and 7%. Thereafter ductility rises rapidly, reaching a peak of almost 50% about 13% manganese content. Beyond 13% manganese ductility falls equally rapidly.

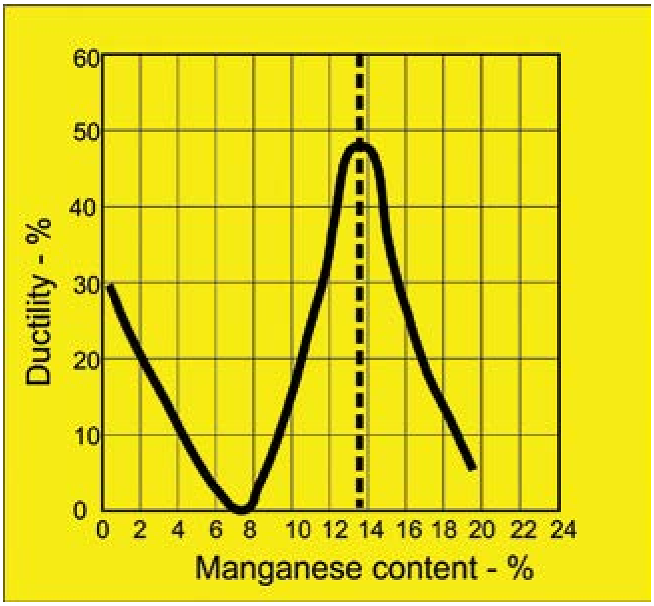


Fig.1. Effect of manganese content on ductility of carbon steel.

Fig.2 shows how the tensile strength of plain carbon steels is affected by manganese addition.


Equipos de Abrasión
PARTS AND ACCESSORIES FOR
SHOT PEENING & BLAST CLEANING
www.equiposdeabrasion.com.mx
Experts on Blast Cleaning, Shot Peening, and Rotary Flap Peening
In-stock spare parts for wheel and air blast machines
Wear resistant parts, cut wire, and peening media
Industry leaders in technical assistance for the installation, operation, maintenance, and parts supply; With more than 30 years of experience in shot peening and shot blast machines.
atencion@eab.com.mx
55-5355-0947
Equipos de Abrasión
equipos_abrasion


EMPOWERING TECHNOLOGIES SONATS
ULTRASONIC PEENING PROCESS
Repeatability • Surface quality • Precision • Homogeneity
SHOT PEENING (USP)
• Localized shot peening
• Small Footprint (6ftx6ft)
• Reduced media & energy consumption
• Portative, automatized & robotized equipment
• Smooth surface finish (low Ra)
NEEDLE FORMING (UNF)
• Quick forming capabilities
• Correct post-machining distortion
• Lower MSD
• Low to high intensity for wide range of materials (aluminium, titanium...)
IMPACT TREATMENT (UIT/HFMI)
• Deep Compressive residual stress on structure (>1.5mm)
• Admissible load increase
• Weld size reduction
• SCC resistance
• Multiple peening heads for different geometries
7630 Commerce Lane ; Suite 2 - Trussville, AL 35173, USA
contact@empowering-technologies.com
www.empowering-technologies.com

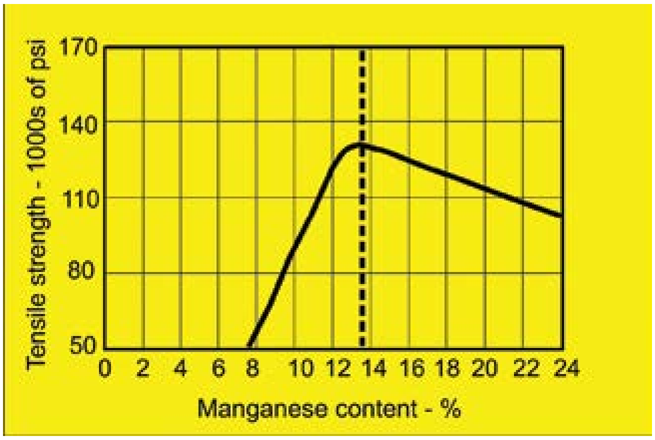


Fig.2. Effect of manganese content on tensile strength of carbon steel.

As with its effect on ductility, tensile strength reaches a peak with about 13% of added manganese.

Toughness is strength multiplied by ductility. Hence if a material is to be tough, it must be both strong and ductile. Ceramics may be strong but they lack ductility and are therefore brittle. Mangalloy is superbly tough because it has both very high strength as well as high ductility.

Wear resistance is defined simply as resistance to wear. Wear is so very important that it is a subject in its own right —tribology. A brief account was presented as "Wear and Its Reduction", TSP Winter, 2016. Suffice it to say that Mangalloy has very high wear resistance which adds to its usefulness.

AUSTENITE TO MARTENSITE

Mangalloy in its austenite form is an unstable arrangement of iron and manganese ions. The arrangement is called face-centered-cubic, (f.c.c.), and is illustrated in fig.3. Just one face of a cube is highlighted with ions at each corner and at the center of the face. These can be either iron or manganese ions. The much smaller carbon atoms randomly occupy spaces in the lattice.

Transformation from the unstable austenitic structure to a body-centered-tetragonal (b.c.t.) martensitic structure requires energy to be applied. As an analogy, consider a row of dominoes separated by less than their height. The row is unstable and only needs one end domino to be pushed over to set off the familiar chain reaction.

Martensite has a different crystal structure as illustrated in fig.4. Cold-working of Mangalloy provides enough energy to cascade the ions and atoms to their new positions.

SURFACE SKIN OF MARTENSITE

During peening with Mangalloy shot, a surface layer of martensite is induced as illustrated by fig.5. With extended peening this surface layer wears away but is automatically replaced.

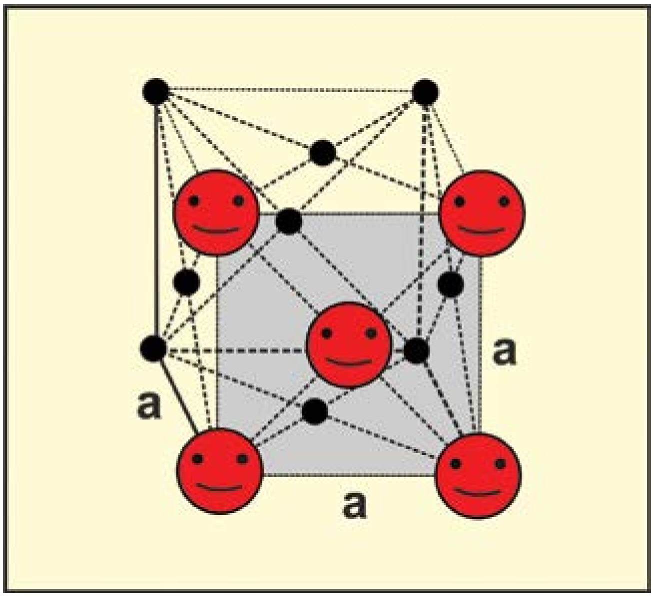


Fig.3. Face-centered-cubic arrangement of ions.

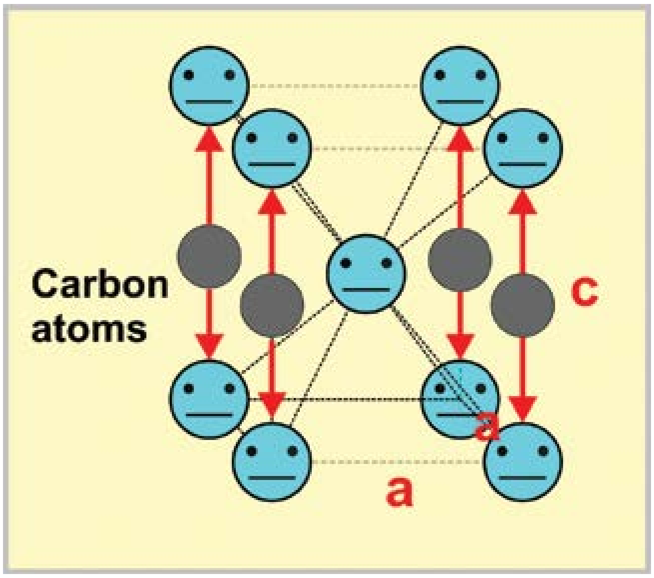


Fig.4. Body-centered-tetragonal arrangement - Martensite.

Peening cabinet components that receive impacts will also develop a protective martensitic surface skin. Fig.6 shows one example where Mangalloy plates are arranged to guide shot onto a long rod. The plates themselves develop protective surface martensitic skins.

CONCLUSION

Although Mangalloy was discovered in the nineteenth century it has taken more than a century and a half for its usefulness in shot peening to be generally recognized. Sir Robert Hadfield was necessarily protective of his inventions and published several patents. The following on page 30, downloaded using Google, is a relevant patent for Mangalloy.

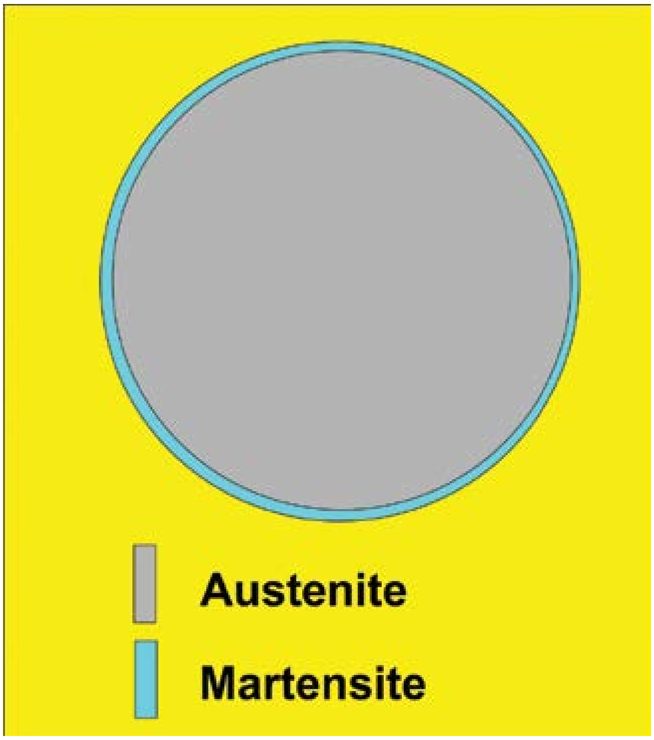


Fig.5. Surface martensitic skin.

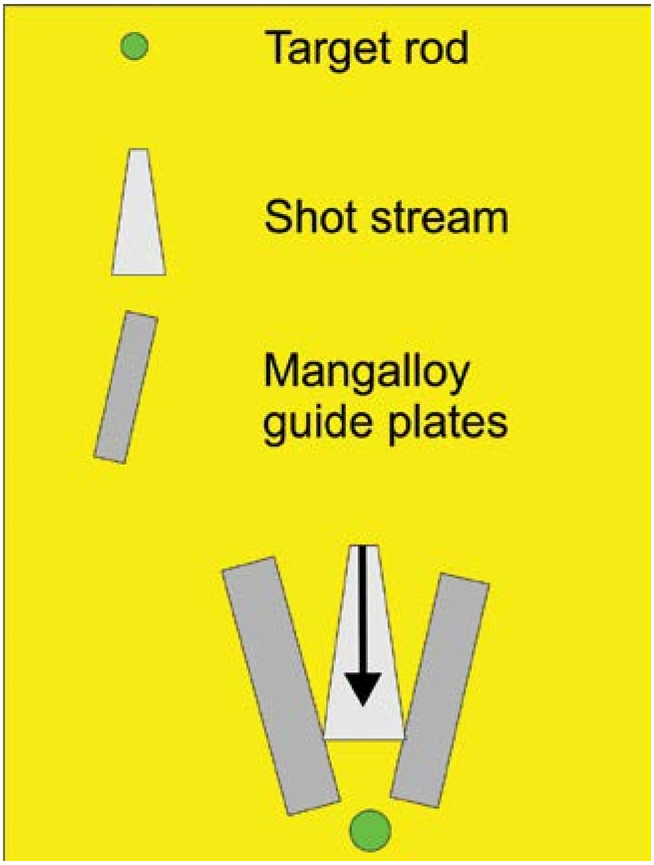


Fig.6. Mangalloy plates guiding shot stream.

Description
UNITED STATES PATENT Office,
ROBERT HADFIELD, OF SHEFFIELD, COUNTY OF YORK, ENGLAND.
STEEL.
SPECIFICATION forming part of Letters Patent No. 303,151, dated August 5, 1884.

Application filed May 5, 1884. (No specimens.) Patented in England January 12, 1983, No. 200.

To all whom it may concern:
Be it known that I, ROBERT HADFIELD, of Sheffield, in the county of York, England, have invented a new and useful Improvement in Steel; and I do hereby declare the following to be a full, clear, and exact description thereof.

In my British Patent No. 200, of January 12, 1883, and my pending application No. 120,640 for Letters Patent of the United States, I describe an improved process, which consists in the admixture of a large percentage of manganese with molten iron in a decarburized or nearly decarburized condition, or to molten steel, whereby I produce a new description of steel of great toughness and hardness, and possessing several peculiar and valuable distinguishing characteristics. The use of manganese in the manufacture of steel has been known and practiced, but only in proportions not generally exceeding one to one and one half per cent, it having always been supposed previous to my invention that the presence of any larger percentage of manganese would be injurious to the steel and result in an utterly worthless product. I have discovered, however, as the result of extensive experiments, that when manganese is added to the metal or to melted steel in the process of manufacture in any proportions not less than about seven per cent. nor more than thirty per cent. of manganese the most beneficial effects are produced and a new product results, which has the valuable qualities of ordinary steel, while differing from it in several important respects, so that my new manufacture of steel is distinguishable from the grades of steel produced by any of the ordinary processes heretofore known in the following particulars: first, in its freedom from honey-comb and other similar defects; second, in its great toughness and extreme hardness, by reason of which the hitherto indispensable processes of rolling, forging, hammering, hardening, and tempering become unnecessary and may be in many cases entirely dispensed with, though of course this material can, if desired, be rolled or forged in the usual manner third, in its great thinness and fluidity, whereby fine steel castings can be made without misrunning, and which will be nearly, if not quite, as smooth as the so-called metal castings; fourth, that when cast it does not settle much and does not draw like ordinary castings, particularly at the junction of the thin and thick parts of the casting. These characteristics of my

improved steel render it specially adapted for the manufacture of steel rolls to be used in place of chilled rolls; also, for casting guns and armour-plates, and for wheels for railroad-cars and streetcars, and for the railway plant generally; also, for the manufacture of various implements and parts of machinery, and for making articles known in the trade as steel toys, and for the larger edged tools, which, when cast of my improved steel, need only to be ground, as they can be used without forging or tempering.

In making my improved steel the ordinary manganese of commerce may be used; but I prefer in all cases a rich ferro-manganese as high as possible in manganese, containing about eighty per cent. of manganese, and as low as possible in carbon, silicon, and other foreign bodies. And here I may remark that my invention renders the presence of silicon unnecessary for producing soundness.

In making my improved steel by the process described in my said application I proceed as follows, viz: The ferro-manganese is, if desired, first carefully melted or treated in a reverberating or other suitable furnace before adding it to the molten decarburized iron or steel, into which it is poured in a melted or highly-heated state, or the molten iron or steel is added to the melted or highly-heated ferromanganese. The iron or steel for receiving or being added to the manganese is prepared in any of the known processes of melting and decarburizing cast-iron or making steel in reverberating or other furnaces, and by the Bessemer process, or that known as the open-hearth process. when the metal is decarburized, or nearly so, or the steel melted, as the case may be, in any desired manner, the melted or heated ferro-manganese is poured into it, or vice versa. The mixed molten mass is then well stirred by any known means, so as to incorporate the manganese thoroughly with the molten decarburized iron or the steel. When this has been effected, nothing remains but to pour out my improved steel thus percent. of manganese. More or less ferro-manganese into ingot or other suitable moulds, when, after cooling, it is ready for use without tempering, rolling, forging, or hardening, though it may be rolled or forged in the usual manner.

It remains only to state the proportions in which the manganese should be mixed with the iron or steel to produce the desired result. This will depend on the purpose for which the steel is desired to be used. To produce a steel suitable for armour-plates, I add such a quantity of rich ferro-manganese (containing about eighty per cent. of manganese) as to obtain in the steel, decarburized iron, &c., under treatment about ten per cent. of manganese. If the steel is to be used for making car-wheels or railway plant, I add such a quantity of ferro-manganese which yields a steel containing about eleven per cent. of manganese. In edge-tools and steel toys I add such a quantity of ferro-manganese as to obtain a steel containing about twelve percent manganese may be used, according to the hardness of steel required. The range of proportions which I have found to produce beneficial results, and which I desire to include in my invention, is from about seven to thirty per cent of manganese.

The steel thus produced I have found to be harder, stronger, denser, and tougher than steel now made, even when the latter has been forged and rolled.

Having thus described my improvement, what I claim as my invention, and desire to secure by Letters Patent, is—

As a new article of manufacture, steel containing a proportion of from about seven to thirty per cent. of manganese.

In testimony whereof I have hereunto set my hand this 23d day of June, A. D. 1884.

ROBERT HADFIELD.
Witnesses:
IIAYR. RONSON, BENJ. FREEBOROUGH.


FerroECOBlast®
EUROPE
SHOT
PEENING
DONE RIGHT
ferroecoblast.com
FerroČrtalič d.o.o. | Sela 47 | 8350 Dolenjske Toplice | Slovenia, EU | Tel.: +386 (0)7 38 45 100 | info@ferrocrtalic.com

AMS2432 Rev E

The SAE Aerospace Surface Enhancement Committee (ASEC) has released Revision E for AMS2432 Shot Peening, Computer Monitored. The previous version of the spec required only ±10 of full scale. AMS2432 Rev E has tighter tolerances for media flow rates. Revision E requires ±10% of setpoint. This revision affects the MagnaValve® product line for air-blast machines. The MagnaValve is a media flow valve manufactured by Electronics Inc.

AMS2432 is widely followed by the aerospace community and it was an aerospace prime in ASEC that initiated the revision. According to Jack Champaigne, Chairman of ASEC and President of Electronics Inc. (EI), "This specification revision brings consistency and clarity to aerospace OEMs and MRO facilities. In the past, companies had different tolerances for different flow rates—sometimes there were different tolerances within one company. EI's older MagnaValves can be calibrated to meet this revision upon request. Our new 600 series MagnaValve will be able to meet AMS2432 Rev E as a standard feature."

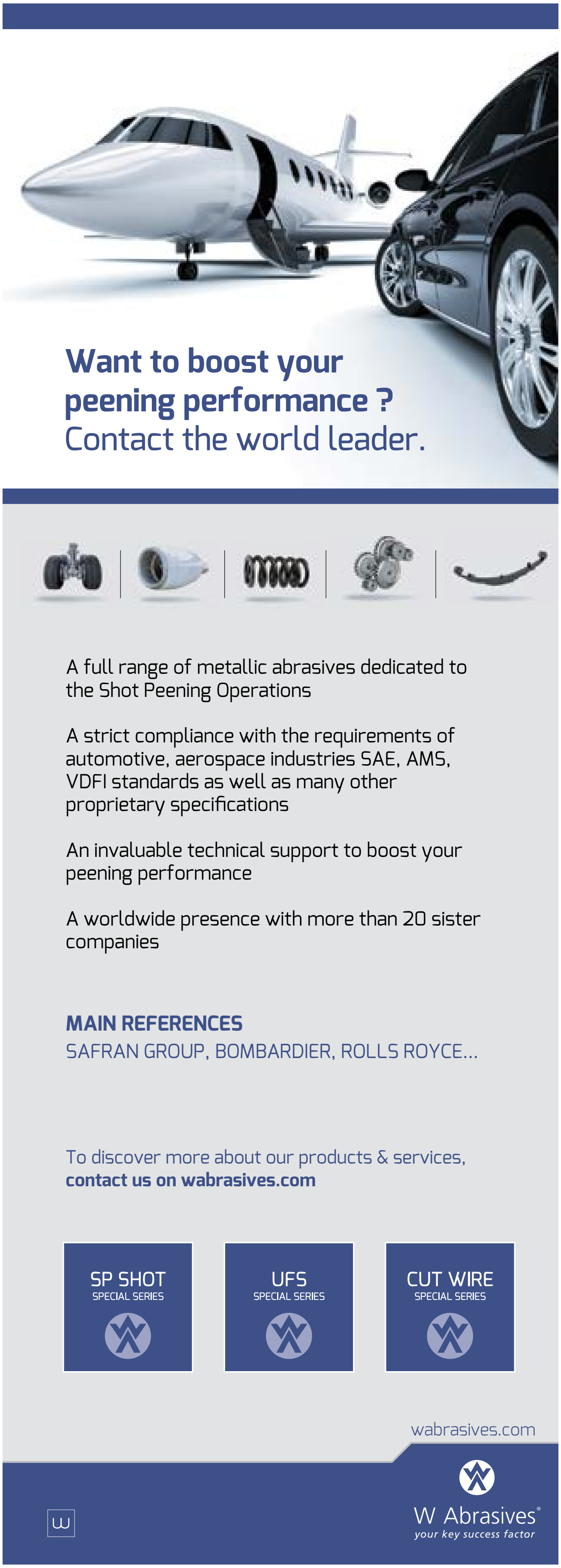
Jim Whalen, President of Progressive Surface, added: "Aligning AMS2432 with many current other OEM specifications will go a long way to improve the consistency of how the Aerospace industry controls the peening process. This will help suppliers to deliver peening equipment that can be certified to meet both the AMS2432 as well as many of the OEM requirements using consistent calibration limits."

AMS2432
The specification establishes the engineering requirements for computer monitored peening of surfaces of parts. Computer-monitored peening is intended to provide a method of process observation, traceability, and response for all process input settings, in real time, during the entire peening process to ensure with objective evidence, the desired process outputs. AMS2430 forms an integral part of this specification.

SAE Aerospace Surface Enhancement Committee (ASEC)
The aim of the Aerospace Surface Enhancement Committee (ASEC) is to provide the aerospace industry and government agencies, in the public interest, with the technical benefits which accrue from cooperative activities and through the synergistic interchange of ideas and experience of members. ASEC was created to focus on surface enhancement technologies including shot peening, laser peening, roller burnishing and other surface treatments.

SAE2432E is available for purchase at the SAE website in digital or print format. At the time this article was published, the price was $84.00.

Source: https://www.sae.org


Want to boost your
peening performance ?
Contact the world leader.
A full range of metallic abrasives dedicated to the Shot Peening Operations
A strict compliance with the requirements of automotive, aerospace industries SAE, AMS, VDFI standards as well as many other proprietary specifications
An invaluable technical support to boost your peening performance
A worldwide presence with more than 20 sister companies
MAIN REFERENCES
SAFRAN GROUP, BOMBARDIER, ROLLS ROYCE...
To discover more about our products & services,
contact us on wabrasives.com
SP SHOT
SPECIAL SERIES
UFS
SPECIAL SERIES
CUT WIRE
SPECIAL SERIES
wabrasives.com
W Abrasives®
your key success factor


ROBOTIC SHOT PEENING EQUIPMENT
PEENING TECHNOLOGIES®
WWW.PEENTECH.COM
Robotic/CNC
Shot Peening Equipment
Portable/Mobile
Systems
Complete Turn Key
Process including
Programming, Fixture
Design, and
Documentation
Patent Pending
Almen Fixture Design
EI Distributor for
MagnaValves, Almen
Gages and Strips
www.peentech.com
261 Burnham Street, East Hartford, CT 06108
860-289-4328

Project Case Study
Hybrid Modeling for Energy Efficient CNC Grinding

CESMII (The Clean Energy Smart Manufacturing Innovation Institute) invests in Smart Manufacturing innovation through projects with funds awarded by the U.S. Department of Energy (DoE). The objective of these projects is to develop emerging technologies, drive research and innovation, and deliver on their mission to democratize Smart Manufacturing.

ITAMCO (Indiana Technology and Manufacturing Companies) and the University of Buffalo were awarded the opportunity to develop "Hybrid Modeling for Energy Efficient CNC Grinding." The Project Lead is West Virginia University.

PROJECT OBJECTIVE

The principal goal is to reduce the extremely high energy consumption of grinding processes for gear manufacturing by at least 15% through hybrid modeling of the grinding system holistically.

The US demand for gears is expected to grow by 6.4% to $40 billion in sales. Grinding will remain the core technology to produce large-scale, high-quality gear components. The novel, scalable, and generalizable hybrid modeling approach and its deployment in the CESMII Smart Manufacturing Innovation Platform (SMIP) environment will provide a blueprint for other manufacturers to reduce the energy consumption of the US grinding industry.

The project showcases rapid recovery of Smart Manufacturing adoption cost through energy savings and productivity increases in an industry with energy intensive processes. The project creates an opportunity to scale its impact for other interested CESMII members across industries (automotive, aerospace, medical) and applications (milling, turning, etc.) within the larger CESMII network.

TECHNICAL APPROACH

To achieve this goal, novel hybrid modeling methods that combine multi-physics equation-based models with data-driven machine learning models will be developed. The hybrid model's output provides grinding process parameters (wheel speed, depth of cut, infeed duration) as well as grinding tool reconditioning schedule and parameters (dressing and sharpening) that reduce the overall grinding system's specific energy consumption.

The prototype model will be implemented in the industrial testbed and located on-premise at ITAMCO, a leading US gear manufacturer.

Article's Source: Case Study at www.cesmii.org.

ACCOMPLISHMENTS

- Created a unique hybrid model to optimize the grinding process energy consumption combining the physics model with the Deep Neural Network (DNN).
- Validated a hybrid model approach based on quantitative analysis of the physics model assumptions and boundary conditions. Pushing limits within boundary conditions can aid optimization.
- The pretrained hybrid model is used to develop a Jupyter Notebook that can now easily acquire minimal grinding time/energy usage with the optimal grinding settings.
- Developed a white paper that will serve as a practical guide on developing hybrid models for manufacturing use cases.

DELIVERABLES

- Delivered complete data model template for machine tool messages
- Collected and validated grinding manufacturing process sample data set
- Documented generalized hybrid model for grinding
- Documented development framework for hybrid model
- Hybrid model Smart Manufacturing App source code submitted to CESMII GitHub repository
- Functional Hybrid model Smart Manufacturing App implemented at ITAMCO

REUSABLE OUTCOMES

- Smart Manufacturing profile for CNC grinding made available for reuse by the broader CNC grinding community.
- Data-driven and physics-based predictive models for CNC grinding.
- Hybrid model analytics for generic grinding applications.

RESULTS

- 41% decrease in processing time equal to 222 minutes per part.
- $6.9k potential savings with a 37% decrease in energy consumption per year.
- $107k per year in potential cost savings per manufactured part due to decrease in part processing time.

FOR MORE INFORMATION

Case Study:
Name: Thorsten Wuest
Position: Associate Professor, West Virginia University
Phone: 310-869-4897
Email: thwuest@mail.wvu.edu

CESMII:
www.cesmii.org

PRESS RELEASE

Anand Kishore Modi | Managing Director | Mec Shot Blasting Equipments Pvt. Ltd. | www.mecshot.in

Surface Preparation Solution for Gear Cutter Tools

MEC SHOT is a renowned name in Design, Development and Manufacturing Surface Preparation, Finishing, Shot Peening Machines, Media Conveying, Blast Room, Paint Booth and Dust Collectors and Accessories. MEC SHOT provides services of Air Operated Abrasive Blasting / Airless Shot Blasting and Shot Peening machines to various industries in India as well as globally since 1992. MEC SHOT provides various types of custom-built Automated or semi-automated machines, dust collectors and accessories to industries for achieving different substrate finishes, surface preparation, de-burring, de-flashing, peening with protection and safeguarding of working environment and human resource. The customers are finding that MEC SHOT machines are cost effective by way of purchase or in operation.

During manufacturing of gears, the gear cutters tools wear out. To reclaim or after manufacturing of cutters they do Physical Vapour Deposition (PVD) Coating process to enhance the life circle of gear cutters. Before PVD Coating process the cutter surface requires to removal of oxide layers and surface roughness.

PVD coating is a vacuum coating technique in which a film is created to maintain a harder surface on the target material. This film extends the life of the tool, lowers tool maintenance and improves overall part quality.

SPL Micro Blasting Machines

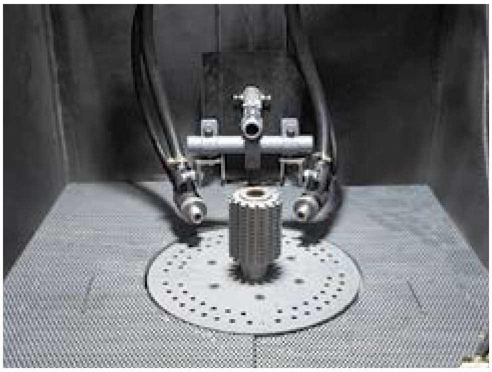
MEC SHOT has recently designed, manufactured, erected and commissioned Special Micro Suction Blasting Machines for removal of oxide layers from the gear cutters before PVD Coating. The motorized turn table rotates the job and the reciprocating blast guns blast cleans the gear cutter to preset required parameters. One manual operated air wash gun is also provided in the cabinet to manual touch up.

The machine provides for recovery and reclamation of used abrasive from blasting cabinet and cyclonic separation of dust and reusable abrasive. The very fine dust is trapped in cartridge bags filters and clean air is discharged in atmosphere, keeping the environment clean and eco-friendly.

Machine Features:

- Automatic PLC Controlled Machine
- Recipes facility for different jobs in auto / manual mode
- Provide Pressure Control Valve (Festo Make)
- Turn Table and Gun Reciprocation speed variable through AC Drive
- Spark Arrestor provide to avoid fire from sparking
- Fluidizing Sheet provide for Moisture Free Media Flow

Gun Reciprocation



Cabinet Inside View panel

PLC-Controlled Electric Control panel