

Analysis and Optimization of various parameters in Dot Peen Marking

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ABSTRACT: Due to the increasing demand of faster production, the need of technology for faster marking machines and marking techniques has developed to a greater extent. Markmate Pneumatic machine of Marks Pryor is a machine used for quiet, efficient and fast marking using the technique of dot peen marking. This paper focuses on effects of change in the parameters of Markmate Pneumatic machine for the improvement of utility and efficiency of the machine which will eventually lead to better marking. Keeping the pin angle for penetration constant, other parameters like marking pressure and sample materials are changed turn by turn to provide optimum results for each material. The results are checked and verified by using appropriate optimization technique using Minitab.

KEYWORDS: Marking, Markmate Pneumatic, Dot Peen Marking, Stylus Pin System, Minitab

I. INTRODUCTION

This paper analyses the effects of various parameters of dot peen marking on various materials using an appropriate optimization technique. Dot marking technology also called dot peen marking, stylus pin system or micro-percussion marking consists of indenting series of dots into materials to form human readable alphanumeric identification, logos and 2D Data Matrix codes. These systems are well known in the aerospace industry for extremely high quality of marks but are also appreciated by many other industrial customers for their robustness and reliability. It requires compressed air supply, powered by a standard 240 volt electric source. The system is a single marking system used for all requirements of materials.

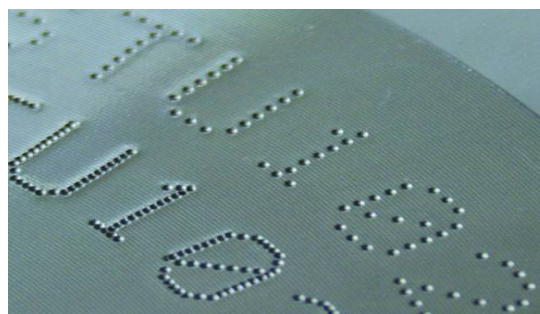


Fig 1: Dot peen marking

The above figure denotes indentations done with the help of dot peen marking process. These indentations are done on chassis of vehicles for unique identification. Various fonts can be used for indentation.

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II. RELATED WORK

The Pryor Bench Dot is a bench mounted dot-peen marking (also known as impression marking or dot marking) machine. These are robust and compact marking devices that can easily integrate into a workshop environment due to their quality build and compact size. The Bench Dot is ideal for marking small to medium sized components of unusual shapes and dimensions with alphanumeric information and 2D barcodes. Suitable for marking small to medium sized components of unusual shapes and dimensions Ideal for marking alphanumeric identification and Data Matrix codes available with a wide range of accessories to tailor to your specific marking requirements Machine of choice for rigorous specifications of dot matrix marking in the aerospace industry A single marking system for all requirements. Benefits of direct part marking with Data Matrix: Unique, permanent component identification; In-service tracking of parts; Work-in-progress tracking; Effective supply chain management; Deter counterfeiting; Increased security of data: Variable data range; Elimination of human transcription errors .A 2D machine readable code capable of a higher data capacity than a standard 1-D linear barcode. A public domain code and a recognized international standard. An approved code for use within Aerospace. Considerably more information can be stored in a smaller area. Automatic data acquisition/transfer with high accuracy and reliability. Elimination of human transcription errors through use of automatic data collection. Controlled dot peen can be done with the help of 2-D Dot Matrix. The optical and contact sensors of CMM are integrated; the convenient CALYPSO 3D CAD software merges the measurement data, thus ensuring that users trust in the reliability of their measuring results. 3D from the start: Where other machines can only offer single-point scanning and thus relatively high probing forces, O-INSPECT 322 offers scanning as a standard feature, in which the VAST XXT probe enables precision probing with forces in the millinewton range. Therefore, true 3D measurements with form and position statements are possible.

III. SCOPE OF RESEARCH

- To generate and store data in tabular form regarding dot peen marking on various materials.
- Optimum depth identification for post machining processes like painting. The coats should not cover the indents making them invisible.
- Increased life of depths and reduction in overall energy consumption to generate the same effect.

IV. PROPOSED METHODOLOGY

- Study of Markmate pneumatic dot peening machine
- Selection of plate of different materials
- Selection of a pin
- Actual experimentation (Marking)
- Experimental readings (Depth and pressure)
- Analysis of readings
- Study of various optimization techniques
- Selection of appropriate optimization technique
- Optimization
- Approval
- Preparation of data book
- Final Project Report

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V. STRUCTURAL ANALYSIS

With the help of ANSYS software theoretical deformation can be calculated.

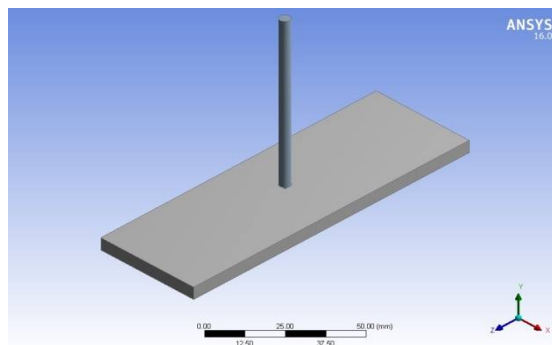


Figure 2: Plate and tool model

A CAD model of plate, tool is imported and analysis is done in ANSYS workbench software. The figure shows the tool and the plate model used for analysis.

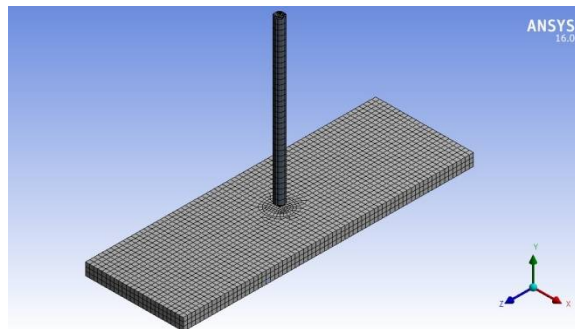


Figure 3: Meshing of the plate

The above figure shows the meshing of plate in ANSYS. The meshing helps in analyzing micro parts and finds deformation. It also helps in calculating stress and strain.

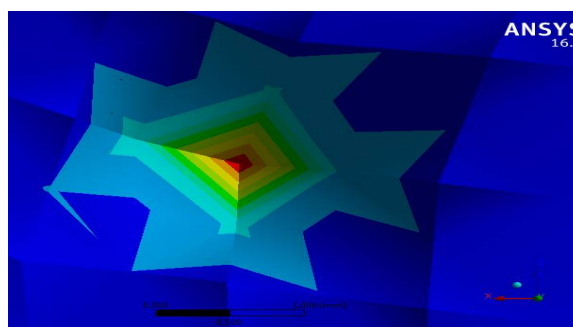


Figure 4: Total deformation at the point

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Deformation after dot peen marking is shown in the above figure with maximum deformation at the centre shown in red colour. The deformation decreases away from the centre.

VI. EXPERIMENTAL RESULTS

Minitab, originally intended as a tool for teaching statistics, is a general - purpose statistical software package designed for easy interactive use. Minitab is well suited for instructional applications, but is also powerful enough to be used as a primary tool for analyzing research data.

Terminologies:

ANOVA:

Analysis of variance (ANOVA) tests the hypothesis that the means of two or more populations are equal. ANOVAs assess the importance of one or more factors by comparing the response variable means at the different factor levels. The null hypothesis states that all population means (factor level means) are equal while the alternative hypothesis states that at least one is different. To perform an ANOVA, you must have a continuous response variable and at least one categorical factor with two or more levels. ANOVAs require data from approximately normally distributed populations with equal variances between factor levels. However, ANOVA procedures work quite well even if the normality assumption has been violated, unless one or more of the distributions are highly skewed or if the variances are quite different. Transformations of the original dataset may correct these violations.

GENERAL LINEAR MODEL:

Use General Linear Model to determine whether the means of two or more groups differ. You can include random factors, covariates, or a mix of crossed and nested factors. You can also use stepwise regression to help determine the model. You can then use the model to predict values for new observations, identify the combination of predictor values that jointly optimize one or more fitted values, and create surface plots, contour plots, and factorial plots.

MULTI-VARI CHART:

A multi-vari chart is a graphical representation of the relationships between factors and a response. Use a multi-vari chart to present analysis of variance data in a graphical form especially in the preliminary stages of data analysis to view data, possible relationships, and root causes for variation. Multi-vari charts are especially useful in understanding interactions.

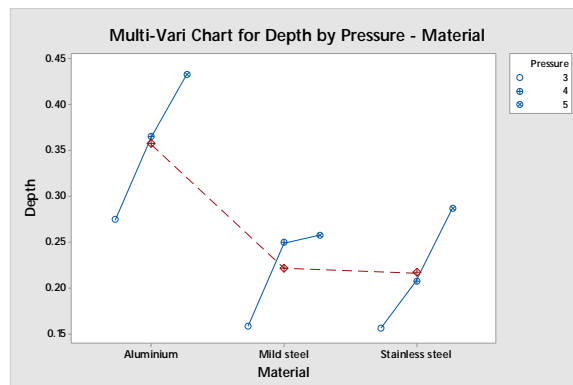


Figure 5: Multi - Vari chart for Depth by Pressure – Material

The above is a Multi – Vari chart for depth by Pressure Material. Following observations are done from the chart:

- Depth of indentations is highest in aluminium at 5 bar pressure.
- Depth of indentations is lowest in stainless steel at 5 bar pressure.

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- The depth of indentations increases with increase in pressure.

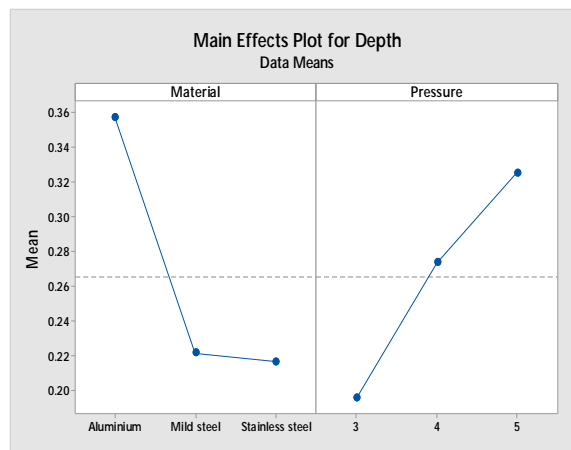


Figure 6: Main Effects Plot for Depth

The above is a Main Effects plot. Following are the observations taken:

- Variation is more between the groups.
- Mean depths of all materials are shown with respect to pressure.

VII. CONCLUSIONS

- Dot peen marking does not damage the materials structure at right choice of pressure and pin size.
- Depth of indentation increase with increase in pressure.
- Dot peen marks are clearer and more readable than the laser ones.
- Dot peen method is environmentally friendly and does not harm the environment; no chemicals are used in this marking method.

VIII. ACKNOWLEDGEMENT

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