Design and Implementation of Laser Marking with OCR/OCV Vision Inspection System

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ABSTRACT

The laser marking process is aimed to create a permanent identification and/or descriptive information on the surface of metallic spinal implants to provide full traceability for the products being manufactured at Medtronic Spinal Humacao. The process, as its name implies, utilize a laser equipment to produce the required reference marks. Products are marked with their respective size, lot number and part number. Identification tags are also laser marked for product identification. In addition, products are 100% inspected during routine manufacturing activities to guarantee that marking information, location and legibility are met per print specifications.
The DMAIC methodology was used as part of this research project to improve and optimize the Laser Marking and Inspection manufacturing process. DMAIC is a methodology used for process improvements using Six Sigma. DMAIC is an acronym that stands for the five phases of this process: Define, Measure, Analyze, Improve and Control.

INTRODUCTION

The laser marking process is aimed to create a permanent identification and/or descriptive information on the surface of metallic implants to provide full traceability for the products being manufactured at Medtronic Spinal Humacao. The process, as its names implies utilize a laser equipment to produce the required traceability such as the part number identifier, the lot number, size, material and Medtronic Raising Men (where applicable).
Cobalt Chrome (CoCrMo) and Titanium (Ti) products go through laser marking process using multiple Laser Marking systems, such as Laser Telesis, which uses fiber laser technology and Electrox Cobra which uses lamp diode pump technologies. In addition, products identification tags are also marked using Rofin Marking System. All marks are 100% visually inspected during routine manufacturing activities as required per prints specifications which guarantees that marking information, location, and legibility requirements are met.

PROBLEM STATEMENT

Current marking and inspection system are performed separately in different equipment under different processing stages. This requires more equipment, location space, processing time, different operators and multiple transactions in the manufacturing system. In addition, actual laser marking equipment requires several adjustments for the processing of different products and generate high processing scrap for the instability they present. There is a high number of units scrapped daily in these equipment's for incomplete laser, laser illegible and laser mark out of position. The goal of this project is to reduce this scrap and have an integrated system that performs both Marking and Inspection. In order of achieve this goal, the of DMAIC project methodology will be used.

Figure 1: Current Laser Mark & Inspection Process

OBJECTIVES

This project aims to achieve implement an integrated laser marking and inspection system. This system will allow more precise marking location and contribute towards laser scrap reduction. In addition, it will reduce equipment, reduce manufacturing usage space, reduce operators and processing time.

METHODOLOGY

The DMAIC methodology was used as part of this research project to improve and optimize the Laser Marking and Inspection manufacturing process. DMAIC is a methodology used for process improvements using Six Sigma. DMAIC is an acronym that stands for the five phases of this process: Define, Measure, Analyze, Improve and Control.

DEFINE PHASE

For the Define Phase of this project, a project charter was used to define all the deliverables, focus and goals of the project.

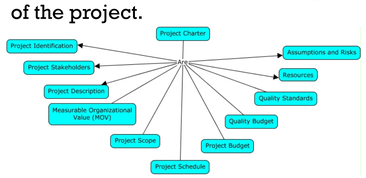

Figure 2: Project Charter

MEASURE PHASE

In the Measure phase scrap unit's data was collected from December 2017 the start-up of the New Product Introduction up to May 2018, to be representative of the process, using the different laser marking defects reject codes, such as incomplete laser, laser illegible and laser mark out of position.

ANALYZE PHASE

Data collected during the Measure Phase, was analyzed to determine the mayor offender of the laser marking defects. In addition, the process output will be compared from the actual process to when the new implemented system is incorporated into the Manufacturing operations.

IMPROVE PHASE

The ILT Laser Marking System with OCR-OCV Vision Inspection will perform laser marking and laser marking inspection operation for multiple products among Humacao Spinal products. The system will be able to mark and inspect products for which processing will require a fixture design to accommodate the part and provide consistent and repeatable positioning during the process. The Laser Marking and Marking Inspection will be performed with OCR-OCV algorithms from their integrated machine vision solution within the same laser marking equipment. The integrated machine vision solution also provides the system the capability to perform axis adjustments or marking pattern orientation (rotation and displacement) to always mark the part at the specified location. To accommodate different products and different geometries the machine will have an X, Y and Z linear motion axes, will provide a docking for rotation capabilities to accommodate the variability of products currently manufactured at Humacao Spinal.

CONTROL PHASE

Since this project has been recently implanted on site, there is not much data results for the control phase. Although, the expected result from this project is to increase laser processing output by reducing scrap transaction and processing time, so far from the data obtained, the ILT System has demonstrated to be capable for its intended used and fulfill the business desired output. In addition, reduced equipment space, which could further on be used for increasing manufacturing processing capacity.

RESULTS

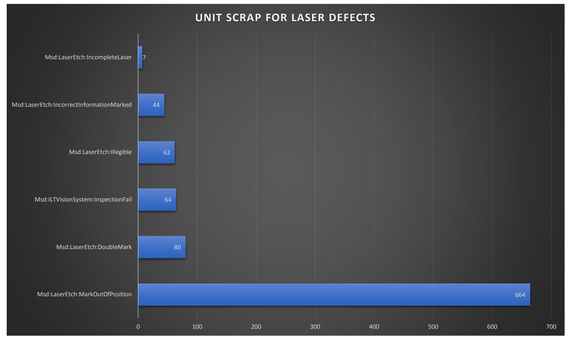

Figure 3: Top Offender Laser Scrap

Figure 4: ILT System

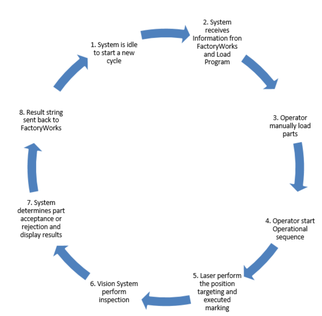

Figure 5: ILT Process Summary

CONCLUSION

Since this project has been recently implanted on site, there are not much data results for the improvement and control phases. Although, the expected result from this project is to increase laser processing output by reducing scrap transaction and processing time, so far from the data obtained, the ILT System has demonstrated to be capable for its intended used and fulfill the business desired output. In addition, reduced equipment space, which could further on be used for increasing manufacturing processing capacity.

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