XXXXXX

In reply refer to:
SRC Letter # –XXXXX Job # -XXXXXX

To: XXXXXXX
Office: XXXXXXX
Ph #: XXXXXXX

The SRC has overseen the successful placement of Data Matrix symbols on the XXXXXXXX that were supplied to us. The requirements of the identification solution were to produce quality Data Matrix symbols that could be capably read for up to six (6) months and the human readable marks must be readable for over ten (10) years. The identification solution found uses a Rofin-Baasel Nd:YAG laser to generate human-readable and machine-readable 2D codes onto the milled surface of the parts.

After marking the machined parts an anti-oxidizing agent was applied to the parts to preserve the mark and to prevent the parts from rusting.

Due to the curved shape of the part, the required mark was a rectangular 12x36 data matrix with dimensions of 14.5 mm X 4.833 mm. All of the marks were readable using fixed station reading equipment and red LED lighting.

The following images are screenshots of the data matrices generated by the SRC using the ND:YAG laser supplied by XXXXXXXX with RVSI's Data Matrix Verifier software captured with our DMx Auto ID+ camera system. The verification software is used to 'grade' the quality of a mark based on AIM standards for bar codes (not necessarily 2D symbologies, which are generally on substrates other than paper). The following verification information demonstrates the high quality Data Matrix Code that was created on the machined surface of the steel parts.

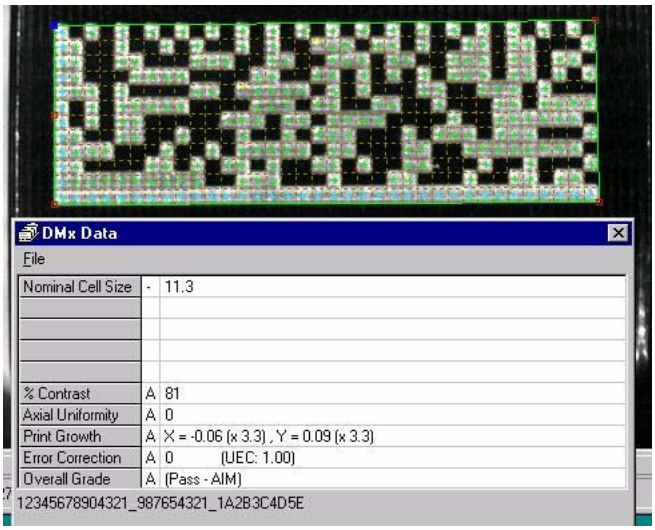

Figure 1. XXXXXXX1-bottom

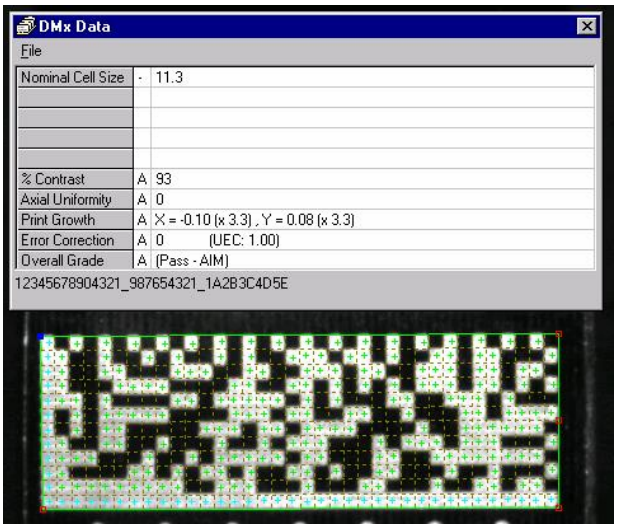

Figure 2. XXXXXX 1-top

The above image is a screenshot of the data matrix symbols on XXXX number 1. The XXXXXX are numbered on the inside of each ring using a permanent black marker. The line at the bottom of the gray box is the Data that was decoded from the symbol.

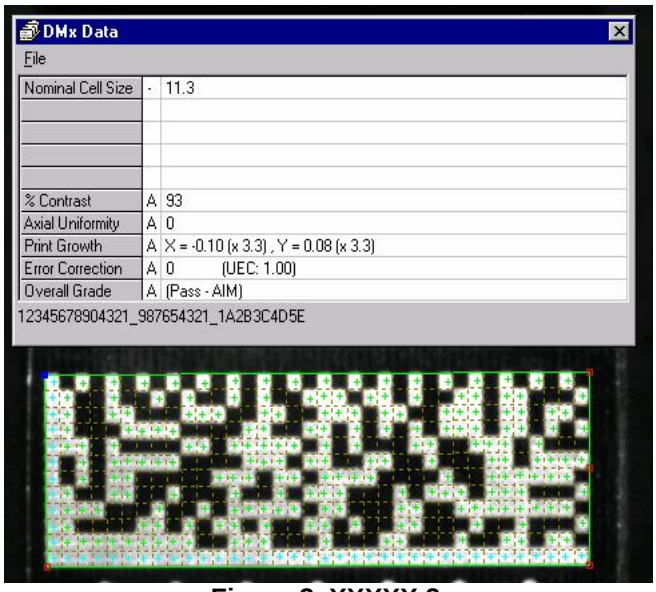

Figure 3. XXXXX 2

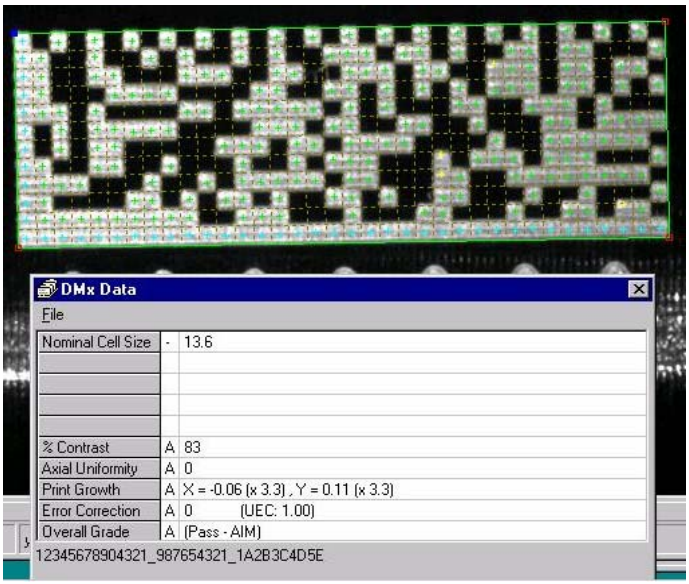

Figure4. XXXXX 3

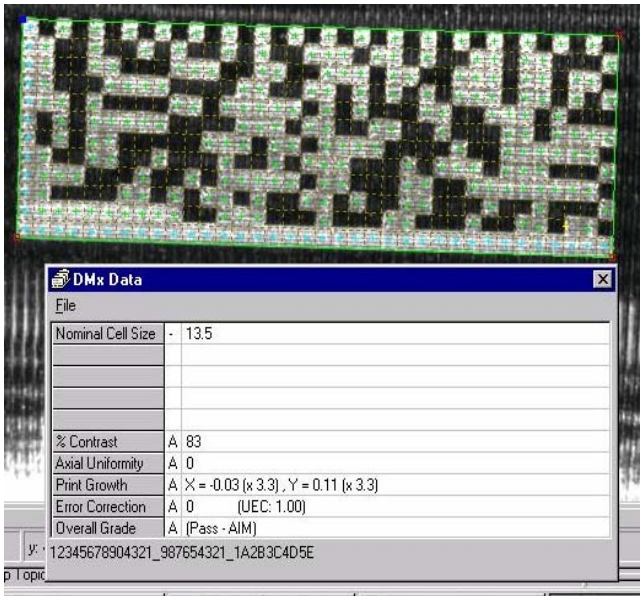

Figure 5. XXXXXX 4

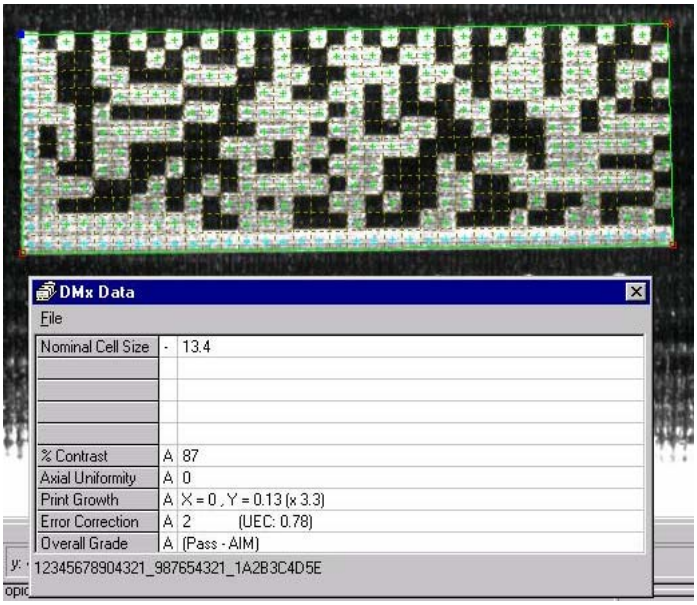

Figure 6. XXXXXX 5

The following images are screen shots of the RVSI Data Matrix Verifier using RVSI's Direct Part Marking verification standard. This software tool is used to 'grade' the quality of a mark and unlike the standard "AIM Verification" available from other reader companies (which is designed to read paper labels), it provides feedback related to the direct marking of parts on any material to aid the mark quality verification process.

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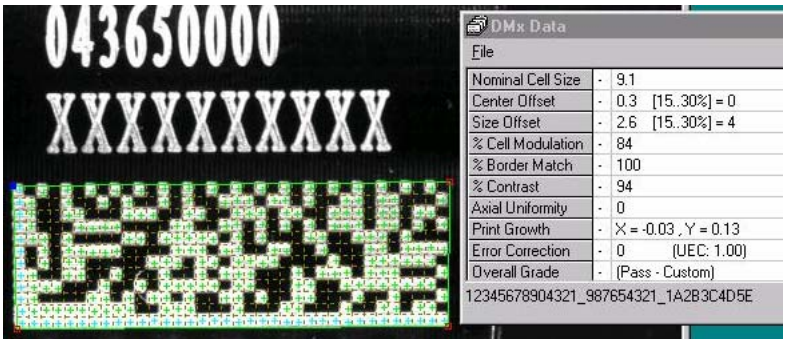

Figure 7. XXXXXX 3 with RVSI's custom verification software

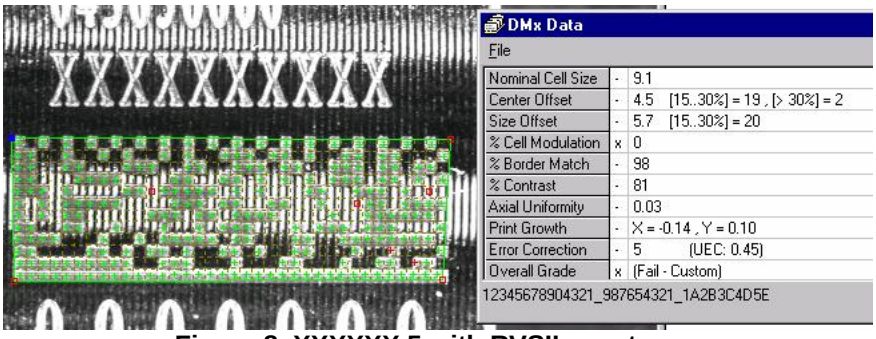

Figure 8. XXXXXX 5 with RVSI's custom verification software

The line at the bottom of the gray box is the Data that was decoded from the symbol.

Please call me at 256.830.8123 ext 16 to contact me directly should you have any questions or need additional clarification.

See attachment for Marking Data Sheets
Laser document: SRC-L-329A, SRC-L-329B

Sincerely,

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Correspondence File
Computer File: F:/CiMatrix/Letters/XXXXXX

Direct Part Mark Verification for Data Matrix Codes

The AIM symbology specification calls out the Data Matrix verification methodology as the measure of: Symbol Contrast; Print Growth; Axial Non-uniformity; and, Unused Error Correction. A final grade of the mark quality will be the lowest grade given in the previously cited categories. The AIM method follows what was done for Bar Code Verification many years ago and has validity where Matrix Codes are applied to labels (essentially we are measuring the label printer quality).

With directly marked parts, this AIM method misses several key measures and will almost always report a final score based on the Symbol Contrast score, which with most direct marks will be very low and meaningless as it is not something we can control (peening a metallic surface seldom adds any contrast). If a company relies exclusively on AIM parameters they will likely fail completely readable marks and accept some marks that will later prove to be unreadable.

To compensate for this shortcoming RVSI developed and offers a custom verification grading method where all the AIM parameters can be chosen (or not, as in the case of Symbol Contrast) as well as many more measurements that are useful for identifying problems common to specific marking methods. This enhanced level of analysis provides what we call ***diagnostic verification****:* information that can be used to consistently improve the marks *as they are made*.

With Ink Jet, Dot Peen and Laser marks (the 3 most often used methods for marking Data Matrix on parts) the two most important aspects to measure are the "normalized" Center Offset and Size Offset values. These measures are made of all the ON cells (those actually marked. vs. the spaces left unmarked) within the borders of the code. The scores are "normalized" because with a Data Matrix code if all cells are shifted the same amount, or are smaller or larger by the same amount, we really don't have to fix anything—most readers will deal with that "scale" change and no marker maintenance is necessary. However, if we have a difference in cell position within the code we have an indication that service is needed (i.e. clogged ink jet nozzles, plugged air pressure filters, worn bushings). The same is true of Size Offset, typically all ON cells of a matrix would be the same size, and a variation in size could indicate, for example, pressure problems on a pin stamp marker and power management or mask problems on a laser.

The addition of these mark analysis parameters, available only on RVSI's verification products, provides effective diagnostics of marking problems. In fact, a number of the leading marking companies are incorporating this technology into their products to guarantee their customer remarkable reliability and consistency in creating good data matrix marks, highlighting service requirements, and identifying corrective actions required to ensure marking excellence. [Note also that RVSI has also developed the only verifier customized to the unique parameters employer by the Aerospace Industry's IAQG in its ATA 2000 Specification.]

RVSI has attacked the identification of parts for traceability and process control as a system problem that requires a system solution. The right marking methods must first be chosen (the SRC has validated over 50 methods of marking parts); the use of Verification after marking to confirm the mark quality is a must (provided the proper measurements are made); application engineering to accommodate the environmental conditions encountered at the read stations, both fixed and hand held, must be taken into consideration (and they should both use the same algorithmic approach to minimize integration); and finally the communication of the data must support the factory environment and traceability needs of the user.

We refer to this system approach as the MVRC^{sm} Methodology (Mark, Verify, Read, and Communicate). It is only available from RVSI.

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Why use RVSI verification?

- ONLY RVSI provides true "diagnostic" verification that is essential to diagnosis and correction of marking problems!
- ONLY RVSI provides a verification program that is IAQG (International Aerospace Quality Group) compliant:
  - Specifically addresses marking methods like dot peening
  - Requires new criteria to ensure:
    - Consistent readability
    - Moderate effect on marked material
    - Accuracy of cell placement
    - Mark depth consistency
- ONLY RVSI verification is specifically developed for, utilized by, and fully approved by Rolls Royce
- ONLY RVSI has proven experience-integrating verification into various types of marking machines to control the quality of the mark.
- ONLY RVSI has verification that can be used to improve the mark quality in a closed loop process:
  - ONLY RVSI provides verification that measures center off-set:
    - Verification of center off-set measures the accuracy of cell placement - how much the marking machine is varying between marks as a result of marking machine wear-down
  - ONLY RVSI provides verification that measures print growth on entire Data Matrix symbol:
    - As opposed to competitive verification systems that only verify the print growth on a few cells on the border of the Data Matrix, RVSI's verification system verifies the print growth on the entire Data Matrix symbol. This provides a significantly more accurate verification, as you are able to identify cell variations throughout the entire code that would be missed by all other verification systems. RVSI's verification solution measures the cells that hold the data, not just the finder pattern.
  - ONLY RVSI provides cell modulation:
    - Cell modulation is the variation in quality of the cells within the Data Matrix code. If the marking equipment is not marking consistently, (even if the quality differs between just one cell within the symbol), RVSI verification can identify it with ease. The verification of cell modulation enables you to catch problems within the symbol cells when they are diminishing in quality and provides a means of catching potential larger code problems (i.e. when the entire cell disappears) prior to the use of error correction.
    - This feature will soon be incorporated in a new ISO standard (ISO/IEC 15415). RVSI is the verification industry leader and will be compliant with this new standard.
  - ONLY RVSI provides cell size off-set:
    - Cell size offset is the measurement of consistency in size from one cell to another. This feature ensures the marking system creates consistent symbols and enables us to identify mark quality errors before they become costly.

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