

Hidden Identification on Parts: Magnetic Machine-Readable Matrix Symbols

These symbols could be read even when covered with paint.

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Have you ever seen a piece of space flight hardware? When you do you will notice some letters and numbers etched or inscribed on it. All NASA parts have an identity, usually expressed in terms of part number, serial number, etc. In most cases this identity is permanently marked directly on the part for tracking throughout its lifecycle. The recently approved NASA Technical Standard 6002A and Handbook 6003A (found at <http://standards.nasa.gov>) added the matrix symbol to the identification scheme as shown in Figure A. This put a checkerboard bar code on the part so an optical scanner could read it. The intent was to make tracking parts as easy as checking out at the grocery store. And the system works great as long as the matrix symbol is visible.

But what if the matrix symbol identification gets covered with paint or a similar coating? NASA has developed a method for reading the matrix symbol through up to 15 mils of paint (5 or 6 layers). This method of part identification involves coating selected patches on the objects with magnetic materials in matrix symbol patterns and reading the patterns by use of magneto-optical imaging equipment. The handheld magnetic scanner, shown in Figure B, developed under partnership between PRI of Torrance, California, and NASA, is easy to use and is commercially available through a NASA licensee. And it decodes the matrix symbol just like any other scanner. The magnetic marks can be read under conditions that would render optical methods useless. For example, the magnetic scanner can read magnetic marks in the dark or under bright ambient light that might interfere with optical reading of visible marks, symbols that are obscured by discoloration or contamination, in addition to symbols that are covered by paint, primers, or laminates, among others. Furthermore, inasmuch as magnetic marks can be hidden from unaided view, they are less likely to be deliberately damaged or destroyed. They can even be hidden on purpose for security reasons.

Magnetic material can be applied in the form of viscous ink or paste and can even be mixed with spray paint. The magnetic material should be one of high retentivity and high coercivity. The matrix symbol pattern can be defined by use of a stencil, or else recesses to hold the magnetic material in the matrix symbol pattern can be formed by laser engraving, machine engraving, micro-abrasive blasting, laser etching, or any other suitable marking method. If the magnetic material as applied is not magnetized strongly enough to enable reliable detection over time, it can be magnetized again by use of a permanent magnet or electromagnet.

Bar codes were seldom seen before 1975 but are now common in every commercial outlet. They are on tags and labels of virtually every product. Likewise, direct part marking is now being popularized for tracking things that cannot be labeled.

Magnetic parts marking has wide-ranging applicability in a number of fields. Chief among these are the airline industry as well as the electronics and health care industries. The technology could solve many problems within the Department of Defense (DOD), which recently issued the revised MIL STD 130 (L) parts marking standard to include matrix symbols for direct part marking. So many items used in the DOD and military are painted, sometimes with several layers of paint, to prevent corrosion. A permanent mark can now be applied to a part for tracking throughout its lifecycle and simply painted over in the usual paint process.

NASA has already received numerous inquiries from the automotive industry, where the aesthetic considerations of painting over parts markings are as important as any functional considerations. Any markings on surfaces exposed to the customer's view can be so thin and so flat that, once painted over, they will be visually undetectable to the customer or anyone else. Magnetic marks under paint will be one way for automotive suppliers to comply with the Automotive Industry Action Group's (AIAG) recently issued B-17 2D Direct Parts Marking Guideline while maintaining the integrity of coatings for corrosion protection on automotive parts.

Of course, magnetic markings are not limited to traditional parts marking. For the home, the technology could be used for identification as a security measure for high-value items. Plasma TVs, stereos, and other luxury items so prevalent in today's society could be coded with the owner's identity in a way completely invisible to the eye.

The idea for magneto-optic marking was conceived by NASA's Marshall Space Flight Center (MSFC) in the mid-90s. NASA efforts to develop a "commercially off the shelf" capability have been led by Fred Schramm, a technical manager within MSFC's Technology Transfer Department.

NASA's development partner for the magnetic scanner has been PRI Research & Development Corporation (PRI). According to Schramm, PRI's Dr. William Shih, Gerald Fitzpatrick, and Craig Knisely worked with NASA to adapt PRI's Magneto-Optic Imager (MOI) technology—which is used extensively for the non-destructive inspection of commercial and military aircraft for cracks and corrosion—to this application. Unneeded functionality of PRI's MOI product was removed, driving down both the size and cost of the magnetic scanner. Other components from RVSI's HE-30 product were incorporated. The handheld magnetic scanner unit is now the approximate size and weight of a portable hair dryer.

NASA has signed a nonexclusive license with Robotic Vision Systems, Inc. (RVSI) of Nashua, NH, to commercialize the handheld scanner. MSFC and RVSI first formed an alliance in 1997 to develop commercial applications for NASA's marking processes. Those who are interested in purchasing the handheld magnetic scanner may contact RVSI's Don Roxby at 256-830-8123.

Companies that are interested in licensing the magneto-optic technology may do so by contacting NASA's Sammy Nabors, MSFC's Commercialization Technology Lead, at sammy.nabors@nasa.gov or 256-544-5226.

Does paint cover the identification on your part? Do you find it a challenge? Magnetic parts marking is one way that NASA is dealing with that challenge. Is the technology right for you?

Figure A Caption:
Space Shuttle component with matrix symbol identification markings.

Figure B Caption:
This **Hand-Held Scanner** would contain all the equipment (except a source of electric power) needed to read and decode magnetic matrix symbols.

Figure A

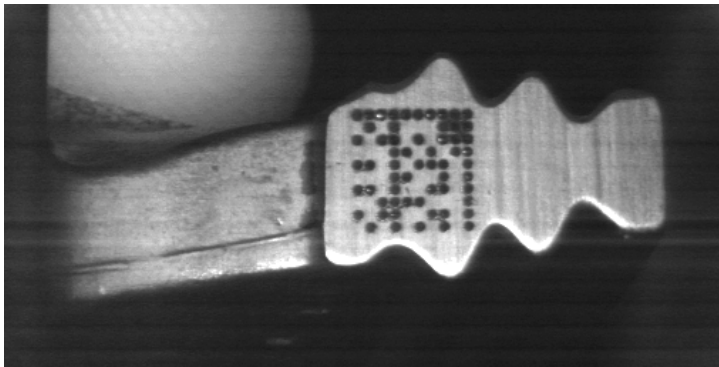


Figure B

