SMALL ARMS MARKING PROGRAM

RVSI CiMatrix

Purpose of Weapon Marking Program

- Facilitate the automation of weapons tracking

  - Eliminate manual data entry

  - Improve data accuracy

  - Speed data entry

  - Link weapon to use history in computer

Weapon Identification Requirements

- Weapon identification number must be machine-readable
- Marking must be done in the arms room
- The marking shall remain decodable throughout the functional life of the weapon (approximately 25 years)
- The marking shall withstand all environmental conditions that the weapon will be exposed to under normal and war time conditions
- The presence of the marking or the method of marking shall not have a detrimental affect on functional, performance, reliability, or durability of the weapon
- Symbol markings applied to weapons shall be placed in close proximity to existing human-readable markings

Historical Events
(Listed In Chronological Order)

RVSI CiMatrix

1984 to 1989 - Robbins AFB, Warner-Robbins, Georgia

- Established that markings could be applied to small arms using laser-marking technology
- Determined that laser marking applied to anodized aluminum coating had no adverse affects on substrate material properties
- MIL-STD-130 revised to include laser marking of anodized aluminum.

1990 - National Aeronautics and Space Administration (NASA), Marshall Space Flight Center (MSFC), Alabama

- Established Compressed Symbology Testing (CST) Laboratory to develop 2-D technology
  - Conducted software reliability tests
  - Tested 40 different marking methods
  - Successfully applies 2-D symbols to over 70 different materials
  - Conducted metallurgical tests to assess affects of markings on substrates. Direct laser marking proven safe for use on all metals except non-anodized aluminum and titanium

1993 - Ohio University, Center for Automated Identification Education and Research, Athens, Ohio

- Conducted software tests to determine the integrity of selected 2-D symbols for the U.S. Army PM-AMMOLOG Project Office, the DOE at Oak Ridge Laboratories, and ARDEC at Picatinny Arsenal.
- Tests confirm that Data Matrix and PDF417 are more reliable than Code 39
  - 1 error per 1,700,000 versus 1 error per 10,000,000

1993 - Rockwell International Corporation, Huntsville, Alabama

- Conducted comparison tests between Vericode, Aztec Code and Data Matrix software packages
  - Data Matrix determined to be winner.
- MIL-STD-130J revised to permit the implementation of two-dimensional (2-D) symbols onto government programs

1994 - Automated Identification Manufacturers (AIM) Association

- Releases symbology standard for Data Matrix symbol

1995 - American National Standards Institute (ANSI)

- Standardizes symbologies across all industries
  - Data Matrix to be used to identify individual parts
  - PDF417 to be used for shipping and receiving applications
  - MaxiCode to be used for freight transportation, sortation, and tracking.

1997 - CiMatrix Symbology Research Center (SRC), Huntsville, Alabama

- Advanced readers successfully tested
  - Marked weapons read well under all light conditions
  - M16 Rifles read while racked
- Identifying 13 clear coats that might withstand small arms use environment

1998 - University of Tennessee Space Institute, Tullahoma, Tennessee

- Conducted preliminary tests on 13 clear coats and selected 3 candidates for subsequent U.S. Army tests.
  - 40 hour salt spray test
  - Abrasion resistance
  - Chemical resistance (Break Free®CLP and Mil.CommTW25B)

U.S. Army Salt Spray Tests Using Actual M16 Components									
Sample No.	Laser Type	Clear Coat	Salt Spray Test Results (Percentage of Corrosion)						Remarks
			4 Hrs	24 Hrs	48 Hrs	72 Hrs	168 Hrs	336 Hrs	
1.	Nd:Yag	DYMAX 984	0	0	0	0	0	0	Passed
2.	Nd:Yag	DYMAX 984	0	0	0	0	0	0	Passed
3.	Nd:Yag	DYMAX 984	0	0	0	0	0	0	Passed
4.	Nd:Yag	DYMAX 984	0	0	0	0	0	0	Passed
5.	Nd:Yag	DYMAX 984	0	0	0	0	0	0	Passed
6.	Nd:Yag	Control Spec.	2-5	60	100				Failed
7.	Nd:Yag	Control Spec.	0	1	100				Failed
8.	Nd:Yag	Control Spec.	0	0	30	30	30		Failed
9.	Nd:Yag	Control Spec.	2-5	50	100	100	100	100	Failed
10.	Nd:Yag	Control Spec.	2-5	60	90	95	100	100	Failed
11.	Nd:Yag	RDC-Poly	0	1	3				Failed
12.	Nd:Yag	RDC-Poly	0	2	15	15			Failed
13.	Nd:Yag	RDC-Poly	0	5	25	30	50		Failed
14.	Nd:Yag	RDC-Poly	0	5	20	50	60		Failed
15.	Nd:Yag	RDC-Poly	0	2	10	40	50	60	Failed
16.	Nd:Yag	AquaSur D45	0	20	50				Failed
17.	Nd:Yag	AquaSur D45	0	10	30	60			Failed
18.	Nd:Yag	AquaSur D45	0	40	50	70	95		Failed
19.	Nd:Yag	AquaSur D45	0	40	60	90	100	100	Failed
20.	Nd:Yag	AquaSur D45	0	30	50	80	100	100	Failed

RVSI CiMatrix

1998 - U.S. Army Armament Research and Development Center (AMSTA-AR-ESW-S), Rock Island, Illinois

- Conducted additional tests on three clear coats identified by the UT and certified one for use during the Fort Lewis Pilot Project.
- Selected coating (DYMAX-984) conforms to Military Specification MIL-I-46058-C,

1998 - Symbology Research Center (SRC), Huntsville, Alabama

- Search conducted to identify low cost mobile laser for use in Fort Lewis Pilot Project
- Weapons components successfully marked using four different portable lasers
- Laser Marking Technologies LE-100S selected for use during Fort Lewis Pilot Project

Preliminary Evaluation Test Matrix - Test Coupons						
			Tests			
No. of Samples	Laser Type	Clear Coat	Abrasion	Chemical	Salt spray (40 hours)	Results
10	Nd:Yag	VHT-HT	Passed	Failed	Passed	Eliminated
10	Nd:Yag	VHT-MB	Passed	Passed	Passed	Down Select for Additional Tests
10	Nd:Yag	RDC-Poly	Passed	Passed	Passed	Down Select for Additional Tests
10	Nd:Yag	KPG-Matte	Passed	Failed	Passed	Eliminated
10	Nd:Yag	TL-CMS	Passed	Failed	Passed	Eliminated
10	Nd:Yag	TL-CPC	Passed	Failed	Passed	Eliminated
10	Nd:Yag	TL-SCLR	Passed	Passed	Passed	Eliminated due to Long drying
10	Nd:Yag	NW-SSP	Passed	Failed	Passed	Eliminated
10	Nd:Yag	DYMAX 984	Passed	Passed	Passed	Down select for Additional tests
10	Nd:Yag	DYMAX 984-LVF	Passed	Passed	Failed	Eliminated
4	Nd:Yag	WIT-TIFID Silicon	Passed	Passed	Passed	Still under development
3	Nd:Yag	WIT-TIFID Silver Tantalum	Passed	Passed	Passed	Still under development
10	Nd:Yag	DRK-220-98B	Passed	Passed	Passed	Still under development

RVSI CiMatrix

Selected Weapon Marking And Reading Methods

RVSI CiMatrix

The Laser Marker

Laser Marking Technologies Model LE-100S (Michael Rauch)

- Diode Pumped Solid State Nd:YVO4
- 1064 nm
- 5.5 Watt (output is 17 Watt)
- CW & Q-Switched
- Thermo-Electric Cooler
- 110 volts, 15 Amps
- Power Unit Weights 43 Lbs.
- Priced at 45K
- Marks all typical Nd:YAG application materials
- Very low maintenance

LE-100S Desktop Laser Marking System

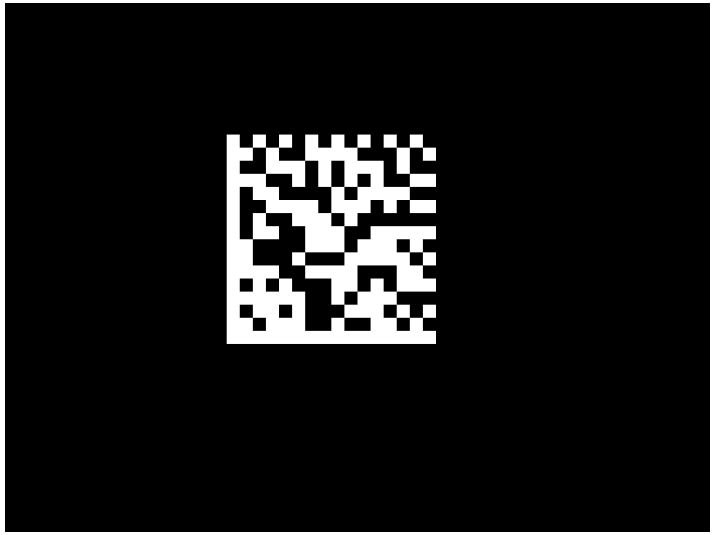
RVSI CiMatrix

Why Data Matrix?

- 2-D symbologies offer many advantages over linear/stacked bar codes and other technologies
  - Error correction capabilities
  - Greater data capacity
  - Increased area efficiency
  - Readers decode all major symbols; decode off of rough and reflective surfaces; and can photograph people, products, and signatures

The Symbol Format to be used

Data Matrix



- Error Checking & Correction Level 200
- 17 Characters of Data
  (Weapon Serial Number & Cage Code)
- 16x16 Matrix Size
- White on Black Marking
- 9mm Square Symbol on Semiautomatic 9mm M9 Pistol
- 10mm Square Symbol on M16 5.56mm Rifle

RVSI CiMatrix

Marking Location for M16, 5.56MM Rifle

RVSI CiMatrix

Marking Location for 9MM M9 Pistol

Hand-Held Reader

- Reads Data Matrix symbol and all major linear and stacked bar codes
- Auto-discriminates between symbols
- Decodes of off non-paper substrates
- Captures photographs of persons, products or signatures

RVSI CiMatrix

Conclusion

All technical problems limiting small arms marking and reading have been overcome.

- Symbol fully tested and approved for use on DOD Programs
- Laser markings safe for use and approved by Military Standard
- Readers successfully tested in weapons marking applications
- Portable laser markers available to support weapon marking programs

RVSI CiMatrix