



UID MARKING PILOT PROGRAM

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26 September 2006

TABLE OF CONTENTS

Paragraph	Page
1.0 PURPOSE	4
2.0 BACKGROUND	4
3.0 TEST PROCEDURE:	4
3.1 Hot	4
3.2 Cold	4
3.3 Icing	5
3.4 Salt Fog	5
3.5 Chemical Compatibility	5
3.6 Sand and dust	5
4.0 Results	11
5.0 Conclusion	12
6.0 Recommendation	12
Appendix A - List of Chemicals	13
Appendix B - M240 Machine Gun pictures	14
Appendix C - M9 Pistol pictures	25
Appendix D – Sand Test pictures	34

1. PURPOSE

The purpose of the UID pilot program is to evaluate various marking methods for application to small arm weapons. There are four populations of weapons that will need to be marked. They are as follows:

- 1) Current production
- 2) Fielded weapons
- 3) Weapons marking during overhaul
- 4) Future production

This test effort will evaluate methods for satisfying items #2 and #3

2. BACKGROUND

The Department of Defense (DoD) has implemented a policy that requires all items that are serialized managed items, items valued over \$5000.00 and items the PM needs to track, need to have a Unique Identifier (UID) applied to them. All fielded army weapons must be UID compliant by 31 December 2010 and all new or modified contracts must have a UID requirement. The requirement for the UID marking is contained in MIL-STD-130 Military Standard: Identification Marking of U.S. Military Property and DFARS 252.211-7003 Defense Federal Acquisition Regulation Supplement.

3. TEST PROCEDURE

For the first phase, thirty (30) M9 Pistol and thirty (30) M240 Machine Gun (MG) receivers were marked utilizing various methods of applying the UID to the weapon. Each of the test receivers employed several UID markings of different processes, some utilized as many as four (4) different marking methods. The weapon-marking matrices are shown in tables 1 and 2. The test samples for each weapon system were separated into two test groups. The first group was subjected to salt fog testing and sand and dust testing. The second group was subjected to hot testing, cold testing, icing and chemical compatibility testing. The environmental tests (hot, cold, and sand and dust tests) were conducted in accordance with Test Operating Procedure (TOP) 3-2-045, Automatic Weapons, Machineguns, Hand and Shoulder Weapons, to the maximum allowable extent. The salt fog test was conducted in accordance with ASTM B117, Standard for Operating Salt Spray (Fog) Apparatus and the chemical compatibility was conducted in accordance with TOP 3-2-609, Chemical Compatibility of Nonmetallic Materials Used in Small Arms Systems. All of the weapon UID markings were initially "scanned" to verify readability before the start of the testing. The UID markings were "scanned" at the conclusion of each phase of the testing. The results are provided in tables 4 and 5 with the data highlighted for any method that was not 100% readable. Based on the results of the initial tests, it was determined that an applied label provided the most promise. The UID Integrated Product Team (IPT) included an examination of the effects of clear coatings applied over the labels for improved resilience. The second phase of the UID test utilized additional test samples and coupons, the steel samples employed a phosphate coating (finish 5.3.1.3 of MIL-STD-171, Finishing of Metal and Wood Surfaces) and the aluminum samples had a hard anodized coating (finish 7.5.1 of MIL-STD-171, Finishing of Metal and Wood Surfaces). These samples were subjected to the same tests as the test weapons except for the sand dust portion. The matrices of coating and marking type are provided in tables 4 and 5.

3.1 Hot Test - Test samples were conditioned in a test chamber at 155 deg F for 24 hours. The temperature was increased to 220 deg F for 1 hour and then it was returned to 155 deg F for 4 hours. This cycle was repeated six times. At the conclusion of the six cycles, the markings were examined for damage and readability.

3.2 Cold Test - Test samples were conditioned in a test chamber at -55 deg F for 24 hours. The temperature was increased to 220 deg F for 1 hour then it was returned to -55 deg F for 4 hours. This cycle was repeated six times. At the conclusion of the six cycles, the markings were examined for damage and readability.

3.3 Icing – The test samples were conditioned in a test chamber and at 20 deg F for 24 hours. Water was sprayed onto the test samples every hour until an ice thickness of 1/8 inch was achieved. After achieving the required ice glaze thickness, the weapons were returned to ambient temperature and the markings were examined for any damage.

3.4 Salt Fog – The M9 pistol test samples and the aluminum coupons were placed in a test chamber and exposed to a 5% salt spray solution for 240 hours. The M240 MG receivers and the phosphate coated steel coupons were added to the M9 pistol receivers and the test continued for another 48 hours. All the markings on the M240 MG receivers and phosphate coated steel coupons were coated with MIL-L-63460 Cleaner, Lubricant and Preservative (CLP) prior to the test. The M240 MG receivers and phosphate coated steel coupons were removed and the M9 pistol test samples and aluminum coupons test continued for an additional 48 hours. The M9 pistol receivers and aluminum coupons were tested for a total of 336 hours and the M240 MG receivers and phosphate coated steel coupons were tested for 48 hours. At the conclusion of the salt fog exposure, the test samples were cleaned and the markings were examined for damage and readability.

3.5 Chemical Compatibility - The test samples were exposed to Army standard chemicals (see appendix A) for a period of 24 hours. At the conclusion of the chemical exposure, the test samples were cleaned and the markings were examined for damage and readability.

3.6 Sand and dust – The test samples were inserted into the sand and dust chamber. The samples were subjected to 3.5 lbs of blowing sand and dust. The sand “nozzle” was directed on the markings being tested (see appendix D). After the test, the markings were examined for damage and readability.

TABLE 1. M9 HANDGUN MARKING AND TEST MATRIX

Manufacturer's CAGE Code: 65490

Part Number: 9346412

Stock Number: 1005-01-247-0490

Salt fog Chemical/hot cold/icing/sand and dust

	SERIAL NUMBER	MARKING PROCESS			
		LASER COAT & DISCOLOR (CO2 LASER)	LASER ETCH & CLEARCOAT	DEEP LASER ENGRAVING	TESA TAPE
	188563	35-Anodized			15
	1161545A	28-Anodized			3
	1043836	32-Anodized			5
	1042743	30-Anodized			5
	1054961	33-Anodized			10
	1039665	29-Anodized	54- Aluma Hydell		4
	1365129	34-Anodized	55- Aluma Hydell		14
	1271026	31-Anodized	51- Aluma Hydell		6
	1026351	16- DataLase Paint w/ DataLase Clearcoat	53- Aluma Hydell		1
10	1162346A	17- DataLase Paint w/ DataLase Clearcoat	52- Aluma Hydell		2
11	1053069	18- DataLase Paint w/ DataLase Clearcoat	47- DataLase		8
12	1063378	20- DataLase Paint w/ DataLase Clearcoat	46- DataLase		11
13	1166060	21- DataLase Paint w/ DataLase Clearcoat	48- DataLase		12
14	1063166	19- DataLase Paint w/ DataLase Clearcoat	49- DataLase		9
15	1038436	22- DataLase Paint w/ DataLase Clearcoat	50- DataLase		13
16	1144412	23- DataLase Paint w/ Aluma Hyde II Clearcoat	44- Evershield		
17	1161535A	26- DataLase Paint w/ Aluma Hyde II Clearcoat	41- Evershield		
18	1046623	25- DataLase Paint w/ Aluma Hyde II Clearcoat	43- Evershield (unreadable after coat)		
19	1154403	27- DataLase Paint w/ Aluma Hyde II Clearcoat	42- Evershield		
20	1055007	24- DataLase Paint w/ Aluma Hyde II Clearcoat	45- Evershield		
21	1147329		38- Bare / No Coating	64	
22	1063546		37- Bare / No Coating	57	
23	1054981		40- Bare / No Coating	56	
24	1043361		36- Bare / No Coating	58	
25	1048603		39- Bare / No Coating	59	
26	1155074			62	66
27	1064054			60	67
28	1037671			63	68
29	1052138			65	69
30	1233046			61 (unreadable)	70

TABLE 2. M240 MACHINE GUN MARKING AND TEST MATRIX

Manufacturer's CAGE Code: 3S679

Part Number: 11826290

Stock Number: 1005-01-157-3081

*Sample

Salt fog Chemical/hot cold/icing/sand and dust

SAMPLE	SERIAL NUMBER	MARKING PROCESS						
		LASER DISCOLOR		LASER ETCH		DEEP LASER ENGRAVING		TESA TAPE
		BARE PHOSPHATE	DATALASE PAINT (Sherwood Material) WITH CLEAR COAT*	WITH OUT CLEAR COAT	WITH CLEAR COAT*	AFTER PHOSPHATE AND BEFORE CHROMIC DIP - NO CLEAR COAT	AFTER PHOSPHATE AND BEFORE CHROMIC DIP & CLEARCOAT*	
			15- Ahyde II		41- Ahyde II		78- Ahyde II	
			2- Ahyde II		40- Ahyde II			
			14- Ahyde II		47- Ahyde II			
			10- Ahyde II		46- Ahyde II		75- Ahyde II	
			13- Ahyde II		45- Ahyde II			
			12- Datalase		35- Datalase		63- Datalase	
			11- Datalase		34- Datalase		62- Datalase	
			9- Datalase		33- Datalase		77- Datalase	
			8- Datalase		32- Datalase		64- Datalase	
			7- Datalase		31- Datalase		76- Datalase	
			6- Krylon		42- Evershield		55- Krylon	
			5- Krylon		39- Evershield		56- Krylon	
			1- Krylon		38- Evershield		60- Krylon	
			3- Krylon		36- Evershield		57- Krylon	
			4- Krylon		37- Evershield		58- Krylon	
		16		28		53		79
		17		27		71		80
		18		26		67		81
		19		29		70		82
		20		30		61		83
		21				66		84
		22				69		85
23	U14.300	23				68		86
24	U15.726	24- removed during process				52- sent through phosphate processes twice		87
		25			48- Ahyde II		74- Ahyde II	88
					51- Evershield		54- Ahyde II	89
					50- Evershield		59- Ahyde II	90
					49- Ahyde II	73		91
				44		65		92
30	U11,171			43		72		93

TABLE 3. TEST SAMPLES FOR SECOND PHASE

Sample #	Description
1	Evershield Clear Coat – Tesa Tape
2	Evershield Clear Coat– Tesa Tape
5	Two Part Epoxy– Tesa Tape
6	Two Part Epoxy– Tesa Tape
7	Two Part Epoxy– Tesa Tape
8	Evershield Clear Coat– Tesa Tape
10	Evershield Clear Coat– Tesa Tape
12	Two Part Epoxy– Tesa Tape
17	2 Guard Clear Coat– Tesa Tape
18	2 Guard Clear Coat– Tesa Tape
19	2 Guard Clear Coat– Tesa Tape
20	2 Guard Clear Coat– Tesa Tape
21	Metalphoto Aluminum – Camo – No top coat.
22	Metalphoto Aluminum – Poly coat side one
23	Metalphoto Aluminum on Steel – Camo
24	Metalphoto Aluminum – Poly
25	Metalphoto Aluminum on Steel – Poly coat

Notes:

The Tesa Tape samples include six (6) coupons with twelve Tesa Tape labels applied to them, one on each side. The labels are clear coated with several different coatings including Evershield Aircraft Coatings, two part clear 5 minute epoxy and 2 Guard Clear coating. It appears that the clear coats will make it difficult for a soldier to remove the label from his/her weapon.

The Tesa Tape labels are on phosphate steel coupons provided by General Dynamics which are representative of the phosphate coatings applied to the MK19 grenade launchers and M240 machine gun.

The two-part epoxy is Devcon’s five minute epoxy. It requires thorough mixing and must be spread onto the area to be coated. It comes in an applicator to ensure that the correct amount of both parts is always distributed proportionally. It is difficult to obtain a smooth surface over the marked area because the epoxy is very thick and must be applied by hand, it cannot be sprayed onto the part. This coating cures to a very thick and durable finish.

The Evershield clear coat is a two-part coating and must be mixed using a 3:1 ratio. Evershield can be sprayed onto the surface to be coated. Only a thin coat needs to be applied and Evershield claims that the product has the durability to survive most harsh environments.

2 Guard is easy to work with but contains strong fumes and must be used in a well ventilated environment. 2 Guard can be sprayed or brushed onto the part to be coated.

The metalphoto aluminum tags have a data matrix applied to both a camouflage and aluminum colored tags. Test samples have either no top coat or are covered with polyurethane.

In addition to the labels described, Metalcraft labels were added to the test. The Metalcraft labels are currently being used by FN and were supplied by them. Due to the low number of test samples, the same coupons will be subjected to all the tests.

TABLE 4. NUMBER OF MARKS READ VERSUS THE NUMBER OF MARKS TESTED FOR EACH TEST

Method	Coating	Initially		After hot		After Cold		After icing		After chemical	
		M9	M240	M9	M240	M9	M240	M9	M240	M9	M240
Laser coat and discolor	Krylon	NA	2/2	NA	2/2	NA	2/2	NA	2/2	NA	2/2
	Bare Phosphate	NA	1/4	NA	0/4	NA	1/4	NA	1/4	NA	1/4
	Anodized	3/4	NA	4/4	NA	3/4	NA	4/4	NA	3/4	NA
	DataLase Clearcoat	3/3	2/2	3/3	2/2	3/3	2/2	3/3	2/2	3/3	2/2
Laser etch & clear coat	Aluma Hyde II	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2
	Aluma Hyde II	2/2	1/3	2/2	1/3	2/2	2/3	2/2	1/3	2/2	1/3
	DataLase Clearcoat	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2
	Evershield	2/2	2/4	2/2	2/4	2/2	4/4	2/2	3/4	2/2	2/4
Deep laser engraving	No coating	2/2	2/3	2/2	2/3	2/2	2/3	2/2	1/3	2/2	1/3
	No Coating	3/4	6/6	3/4	5/6	3/4	2/6	1/4	4/6	X	4/6
	Ahyde II	NA	1/2	NA	0/2	NA	0/2	NA	0/2	NA	0/2
	Datalase	NA	2/2	NA	2/2	NA	2/2	NA	1/2	NA	1/2
Tesa Tape	Krylon	NA	2/2	NA	2/2	NA	2/2	NA	1/2	NA	1/2
		9/9	8/8	9/9	8/8	8/9	8/8	8/9	7/8	8/9	8/8

Notes:

- 1) These are the green highlighted test samples
- 2) The table shows the number of samples that were read versus the total number of test samples (i.e. 3/4 shows 4 samples were tested and 3 remained readable)
- 3) NA indicates no samples for that method-M9's are anodized and M240's are phosphated so there are no samples of M9's phosphated or no M240's that are anodized.
- 4) The highlighted data are marks that were not readable 100%.

TABLE 5. NUMBER OF MARKS READ VERSES THE NUMBER OF MARKS TESTED FOR EACH TEST

Method	Coating	Initially		After Salt Fog		Hot/cold wpns After sand and dust	
		M9	M240	M9	M240	M9	M240
Laser coat and discolor	Krylon	NA	3/3	NA	0/3	NA	2/2
	Bare Phosphate	NA	0/4	NA	0/4	NA	1/1
	Anodized	4/4	NA	3/4	NA	NA	NA
	DataLase Clearcoat	3/3	3/3	0/4	0/3	NA	2/2
	Aluma Hyde II	3/3	3/3	0/3	0/3	NA	2/2
Laser etch & clear coat	Aluma Hyde II	3/3	4/4	0/3	2/4	NA	1/1
	DataLase Clearcoat	3/3	3/3	0/3	0/3	NA	2/2
	Evershield	3/3	3/3	0/3	2/3	NA	2/2
	No coating	3/3	3/3	0/3	1/3	NA	1/1
	No Coating	3/3	3/3	0/3	0/3	NA	2/2
Deep laser engraving	Ahyde II	NA	3/3	NA	0/3	NA	0/1
	DataLase	NA	3/3	NA	0/3	NA	1/1
	Krylon	NA	3/3	NA	0/3	NA	1/1
Tesa Tape		8/8	4/4	8/8	4/4	NA	2/2

Notes:

- 1) These are the blue highlighted test samples, except the sand and dust test.
- 2) The table shows the number of samples that were read verses the total number of test samples (3/4 shows 4 samples were tested and 3 remained readable)
- 3) NA indicates no samples for that method-M9's are anodized and M240's are phosphated so there are no samples of M9's phosphated or no M240's that are anodized.
- 4) Sand and dust testing was conducted with the weapons from the hot/cold/icing tests, this was due to that most of the marking were damaged during the salt fog testing.
- 5) The highlighted data are marks that were not readable 100%, the dark yellow were the most effected.

4. RESULTS:

The M9 receivers were marked with nine different methods and the M240 receivers were marked with thirteen different methods.

Phase one results:

M9 Pistol - None of the nine types of markings could be read 100% of the time. One of the nine methods is the TESA tape. One of the labels came loose and ripped while it was being handled. It was speculated that it might not have been applied properly. The portion of the label that came loose was on a curved surface. The opposite side of the label was also ripped, but it did not separate. The serial number was printed under the UID making the label higher in the curved area than necessary (see below). Most of the other TESA labels were mounted lower on the pistol and did not have this problem.

M9



M240



M240 Machine Gun – None of the thirteen types of markings could be read 100% of the time. The only method that survived all the testing was the TESA tape, only one was damaged during the icing test. The damage may have been caused during the handling since there was no other evidence of damage on any of the other seven test samples. The label was still readable even though there was visible damage (see above).

Three of the four marking methods (laser coat and discolor, laser etch, and deep laser engraving) had some unreadable marks without any coating and some were unreadable with most of the coatings. Some of the markings needed to be scanned several times before they could be read due to the design of the reader. The reader “learns” the setting that needs to be used while reading the markings. The reader cannot “distinguish” that it is reading different types of markings and it must be reset each time. Some other markings could not be read after the hot test, but could be read after the cold test. This was attributed to the reader and not the quality of the markings.

Phase two results:

The samples (see table 5) were subjected to salt fog testing for a period of 48 hours. None of the test samples showed signs of corrosion and all were 100% readable. The samples were also exposed to hot and cold cycling with no degradation and all being 100% readable.

The chemical compatibility test samples were subjected to 24-hour exposure to various Army chemicals (listed in Appendix A). Due to the number of chemicals (11) and the duration of exposure (24 hours), this portion of testing lasted two weeks. None of the standard weapon cleaning or lubricants (Cleaner, Lubricant and Preservative (CLP), MIL-L-6340; Lubricating Oil, General Purpose, Preservative (Water Displacing, Low Temperature), VV-L-800; Lubricant, Semi-fluid, Automatic Weapons (LSA), MIL-L-46000; Lubricating Oil, Weapons, Low Temperature (LAW), MIL-L-14107; Lubricating Oil and Preservative, MIL-L-3150; or Cleaning Compound, Solvent (Rifle Bore Cleaner), MIL-C-372) had any adverse effects on the coatings or the labels. All test samples remained readable.

The test samples with the 2-part epoxy were difficult to read due to the “shine” on the coating. The reader needed to be held at an angle, but it was not always easy to find the correct angle. The 2 Guard Clear Coats and the Poly coating have a good thickness and readability. The 2 Guard Clear Coat has application issues as previously described. The Camo had some difficulty in readability, the contrast is low due to the color but the visibility is more subdued. The reader needed to be set at a greater distance than with the others to get consistent readings, but once the proper offset is achieved, the readings are repeatable. The difficulties in reading the various markings had to do with the “establishing the necessary positioning requirements associated with the reader.

5. CONCLUSION:

The salt fog test had the most significant impact on the markings and their readability. All the markings on the M240 MG were coated with CLP at the start of the salt fog test. Since the coating is not as porous as the phosphate, the CLP was “washed off” of it by the salt fog leaving it with no protection.

The laser discolor on the M240 MG was difficult to perceive visibly prior to the testing. The laser etch had very good readability initially when Datalase clearcoat was used, but did not last during the salt fog testing. Initially the deep laser engraving was difficult to read on some of the receivers.

Both of the metal labels performed very well in the testing either alone or with coatings. The coatings also performed well in the testing and were not affected by any of the Army standard lubricants or cleaners.

6. RECOMMENDATIONS:

The use of laser discolor is not recommended as many of the markings were not readable initially. Some of the markings were difficult to find. Similarly, deep laser engraving is not recommended as the markings were difficult to read and because of corrosion issues. The laser etching method gives a more durable marking while also providing ease of reading, but none of the coatings used with the laser etching were able to survive the salt fog portion of the testing.

The recommended marking method is the metal or vinyl labels with a clear coat applied. This method is recommended for the weapons that are going through the depot rebuilding process in addition to the ones that are currently fielded. The metal labels were easy to read throughout the tests.

Both metal labels that were tested can be used along with the Evershield clear coat. The Evershield has demonstrated the best overall characteristics of the three clear coats tested.

It is recommended that additional testing be performed on other clear coats. Clear coatings could be used over the metal labels to add additional protection to the label and utilized for field level touch up if any damage to the coating occurred.

It is recommended that periodic re-evaluations are conducted on the developing technologies supporting alternative methods of UID application and improved clear coatings.

**APPENDIX A
LIST OF CHEMICALS**

NO.	CHEMICAL	SPECIFICATION
1	Water, distilled	N / A (baseline)
2	Lubricant, Cleaner and Preservative (CLP)	MIL-L-63460D
3	Simulated Sea Water or 5% Sodium Chloride	ASTM D-1141
4	Lubricating Oil, General Purpose, Preservative (Water Displacing, Low Temperature)	VV-L-800
5	Insect Repellant	O-I-503E
6	Lubricant, Semi-fluid, Automatic Weapons (LSA)	MIL-L-46000B
7	Lubricating Oil and Preservative	MIL-L-3150
8	Degreasing Solvent Naphtha (Stoddard, dry cleaning or D-Limonene solvent)	P-D-680
9	Lubricant, Arctic, Weapons (LAW)	MIL-L-14107C
10	Cleaning Compound, Solvent (Rifle Bore Cleaner)	MIL-C-372C
11	Decontaminating Agent (STB)	MIL-D-50030

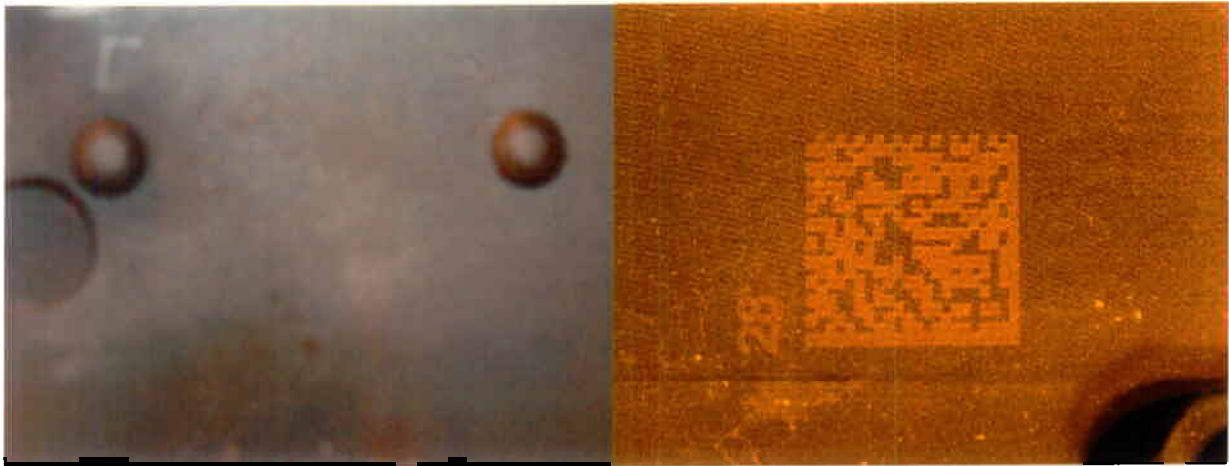
APPENDIX B
M240 MACHINE GUN PICTURES

M240 UID marking after testing

**Laser Discolor
Bare**

After Salt Fog

After hot/cold/icing



After hot/cold/icing

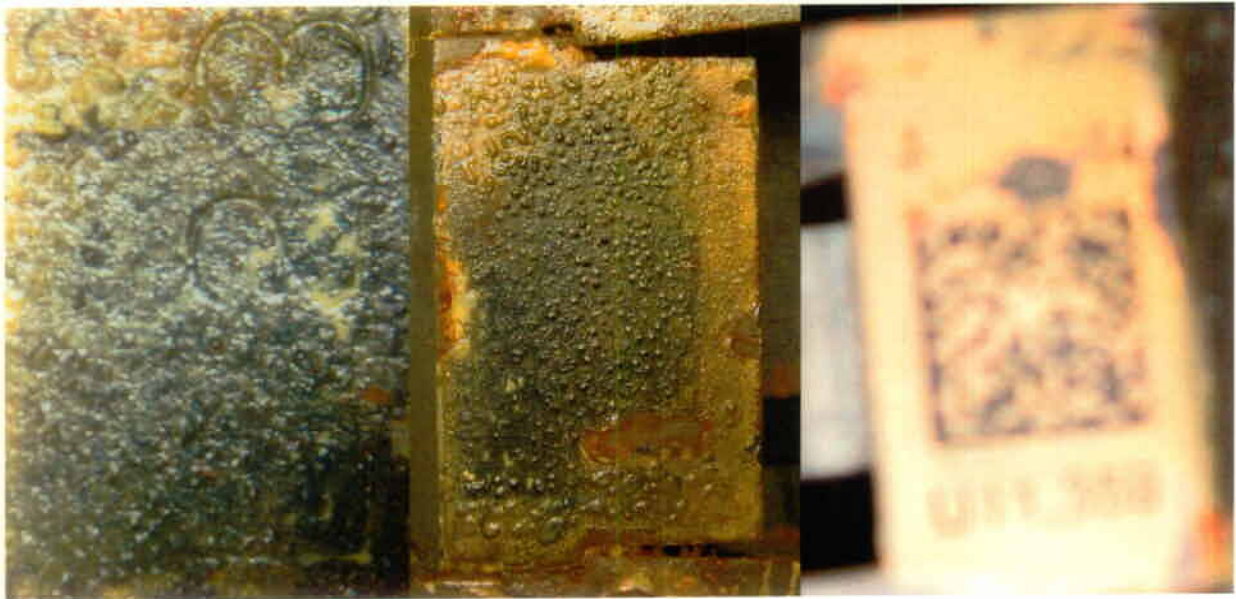


**Laser Discolor
Ahyde II**

After Salt Fog

After Salt Fog

After hot/cold/icing

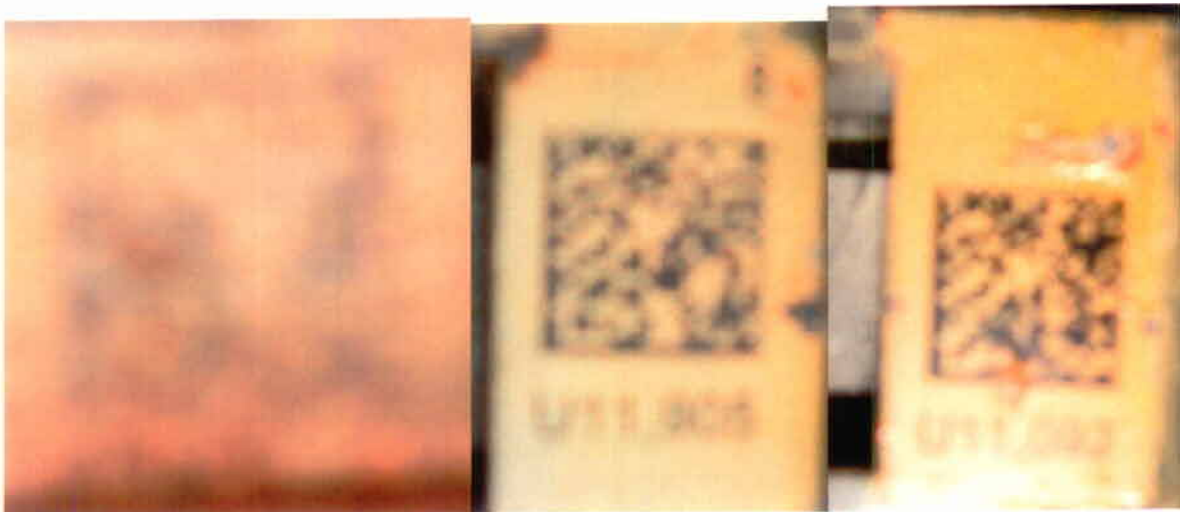


**Laser Discolor
Datalase**

After Salt Fog

After hot/cold/icing

After hot/cold/icing



**Laser Discolor
Krylon**

After Salt Fog

After hot/cold/icing

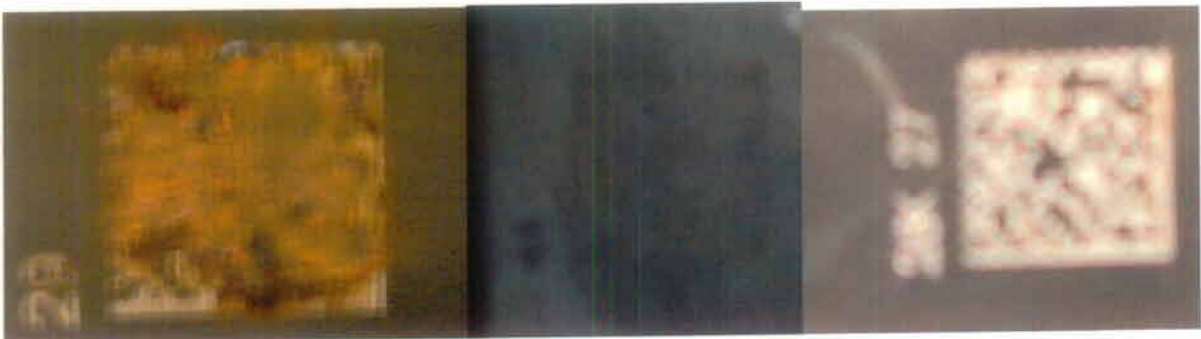


**Laser Etch
Bare**

After Salt Fog

After hot/cold/icing

After hot/cold/icing

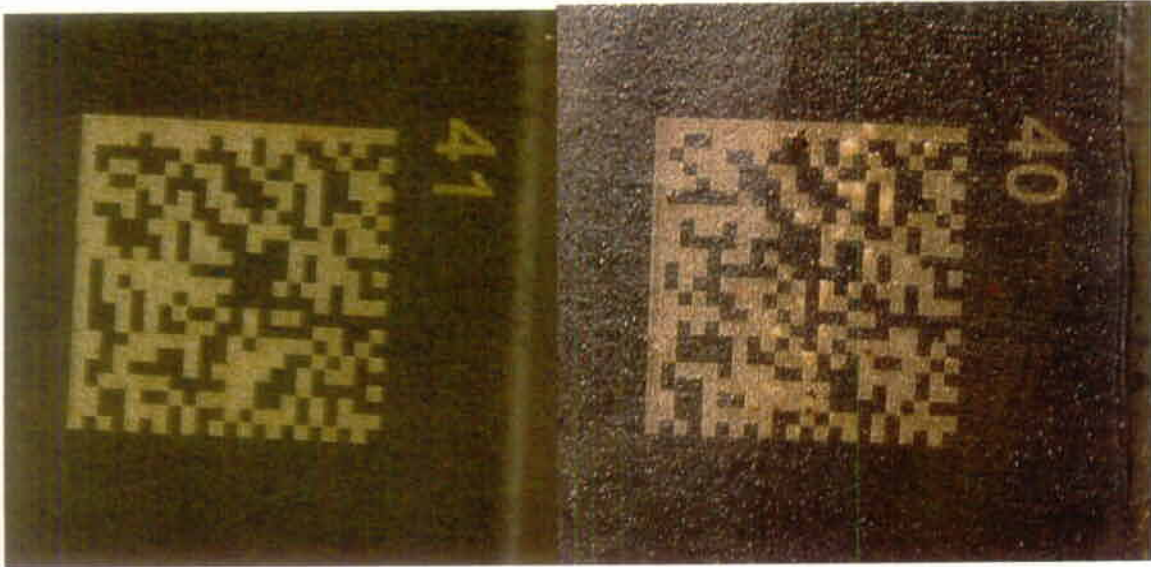


Laser Etch

Ahyde II

After Salt Fog

After Salt Fog

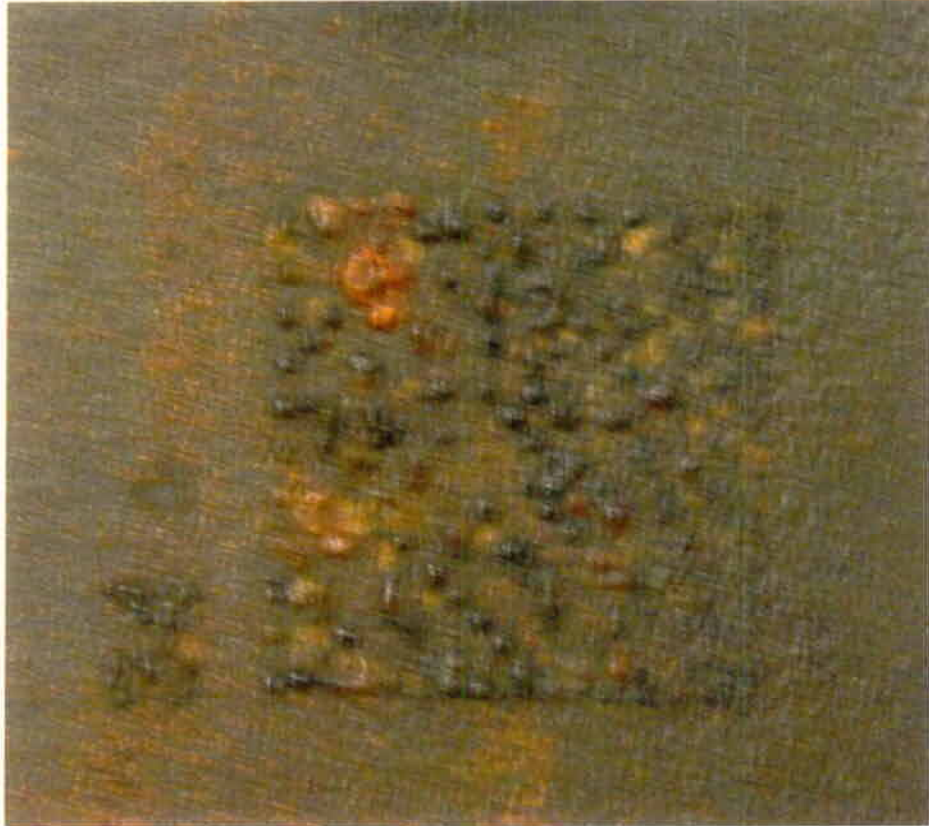


After Hot/cold/icing

After Hot/cold/icing

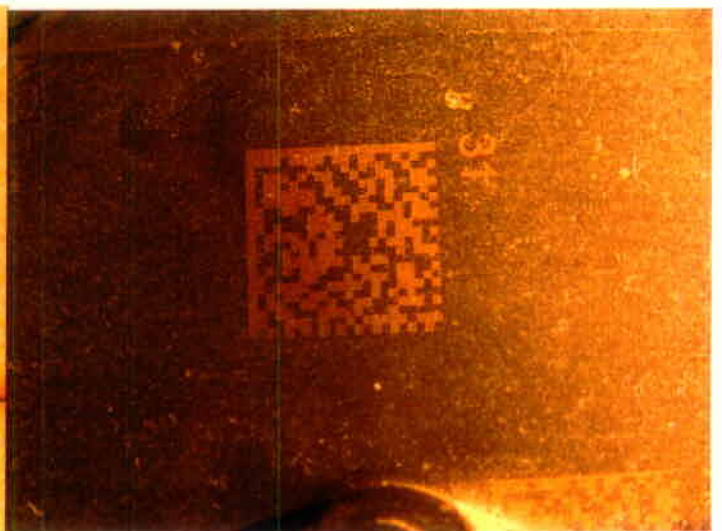
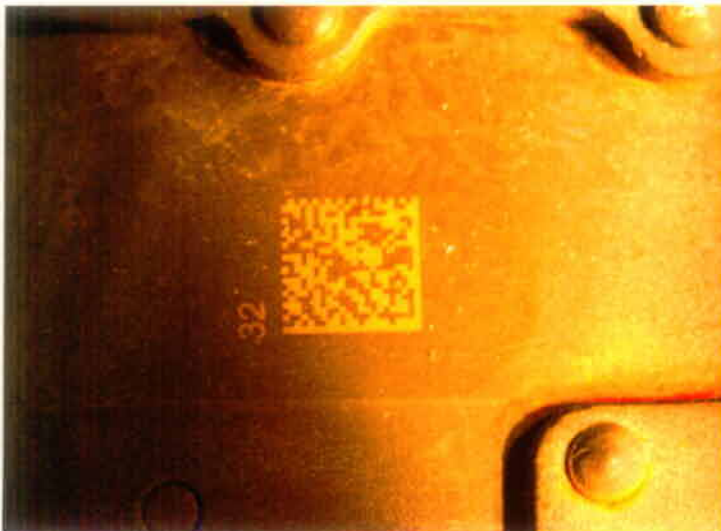


After Salt Fog



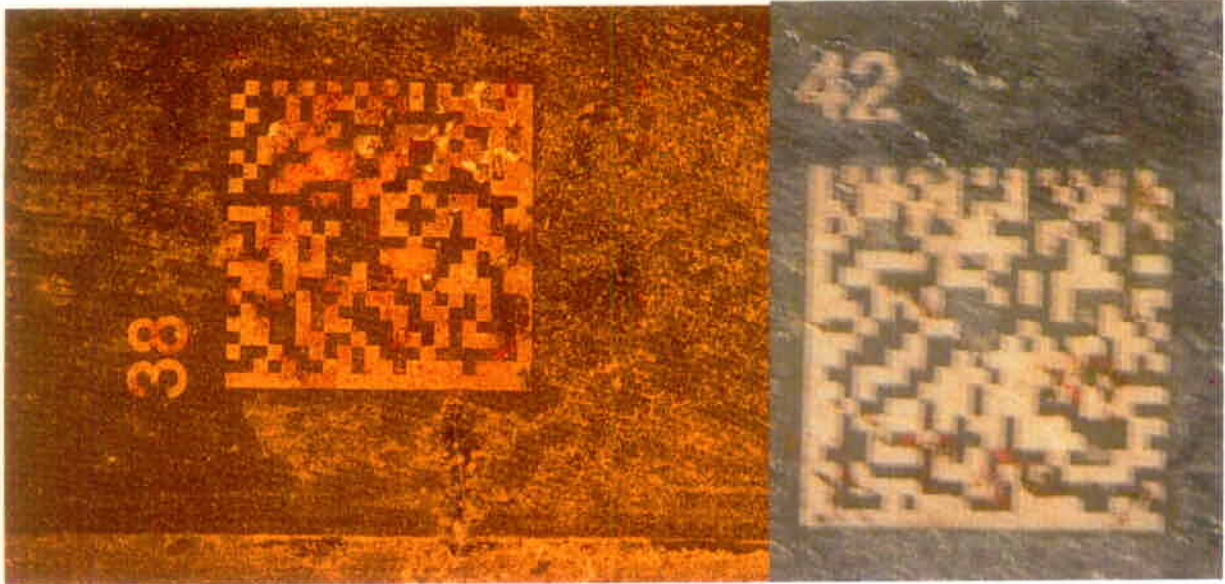
After hot/cold/icing

After hot/cold/icing

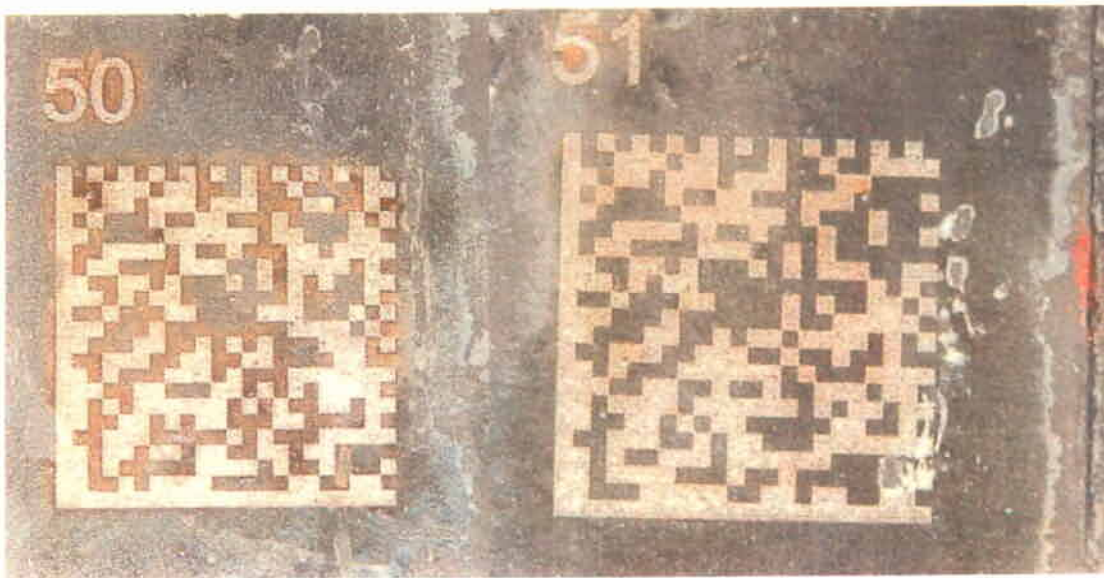


**Laser Etch
Evershield**

After Salt Fog

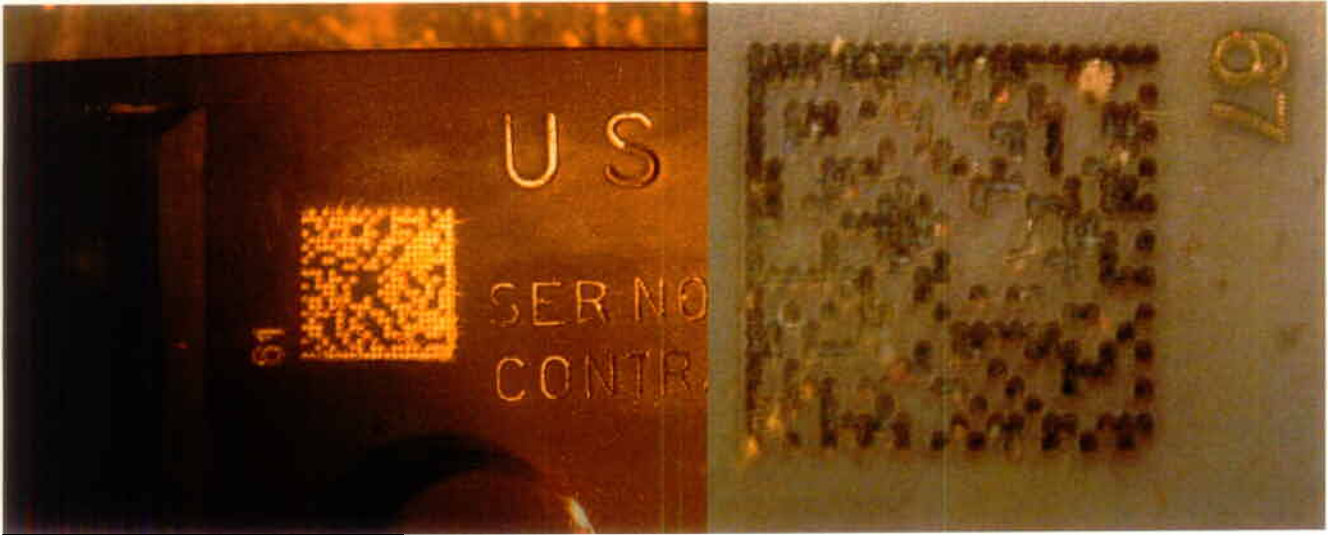


After hot/cold/icing

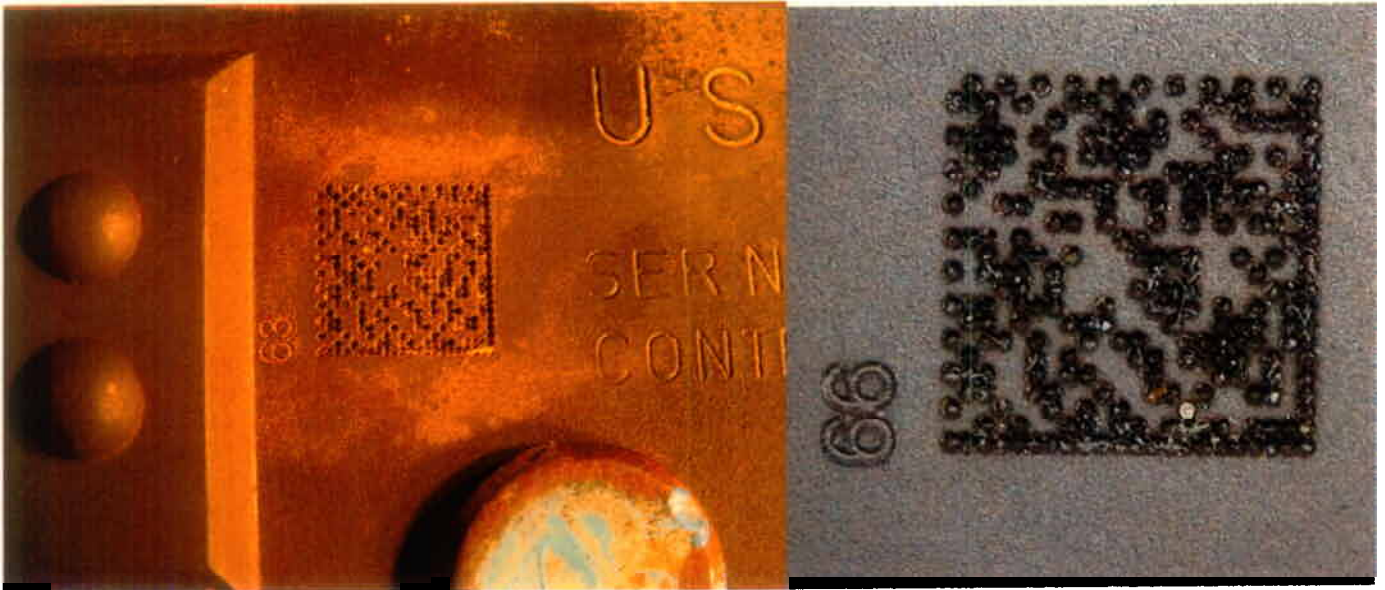


**Deep Laser Engraving
Bare**

After Salt Fog

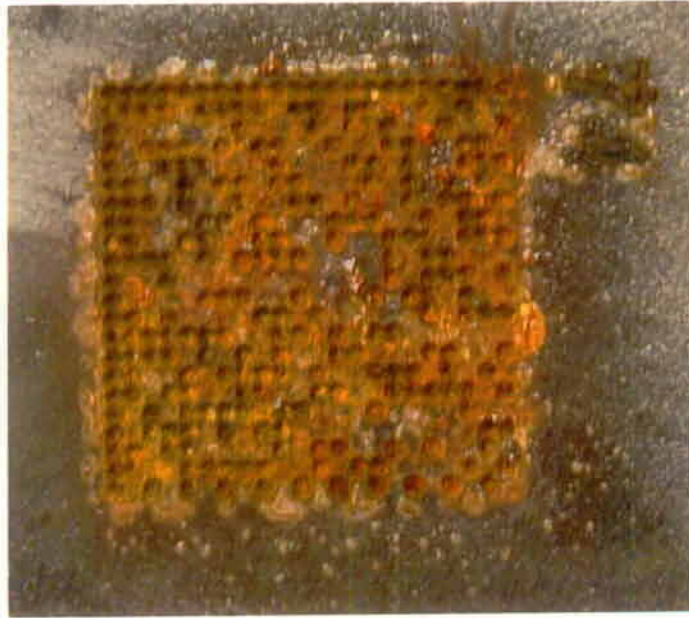


After hot/cold/icing

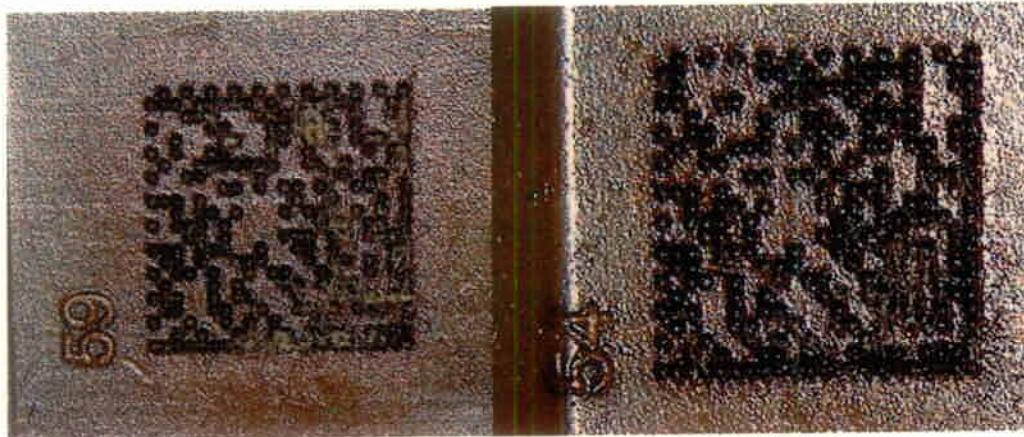


**Deep Laser Engraving
Ahyde II**

After Salt Fog

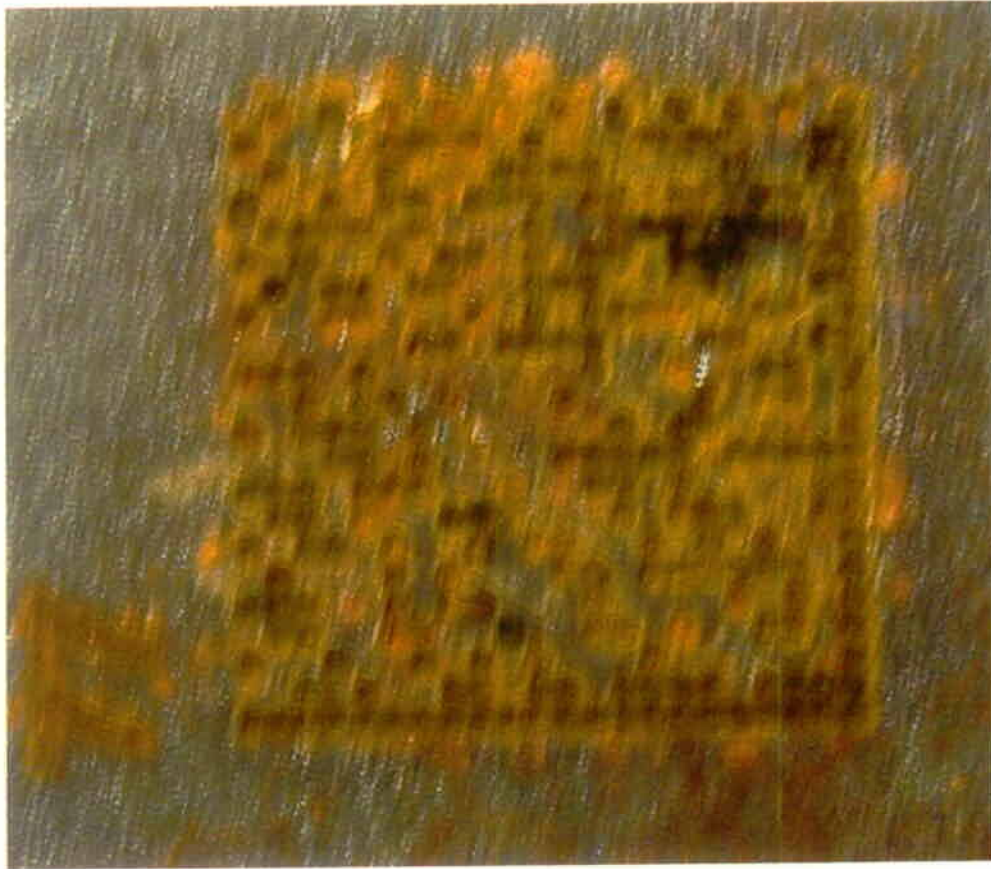


After hot/cold/icing

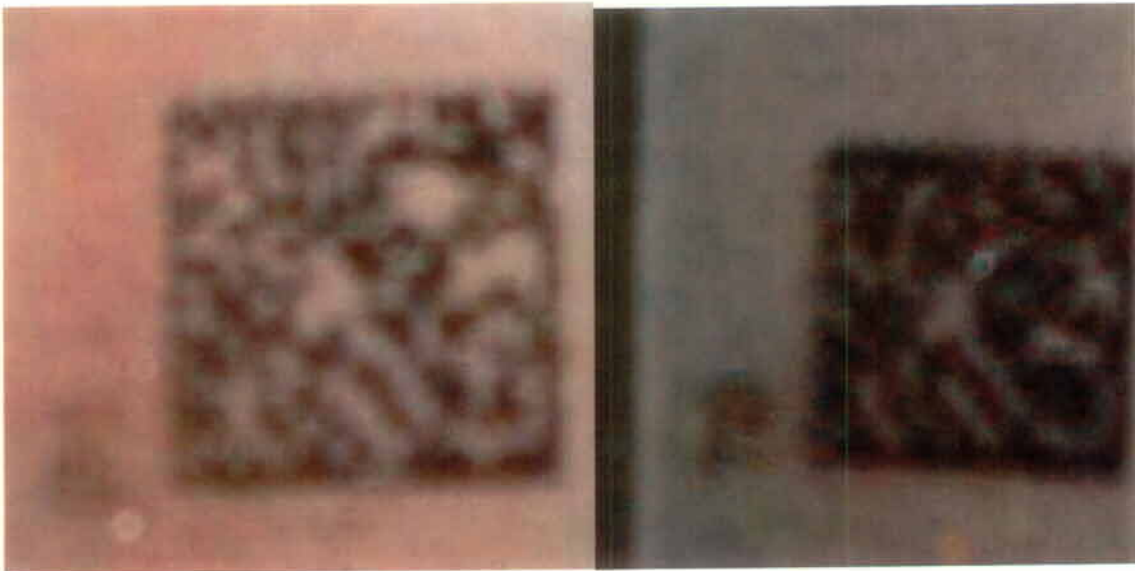


**Deep Laser Engraving
Datalase**

After Salt Fog

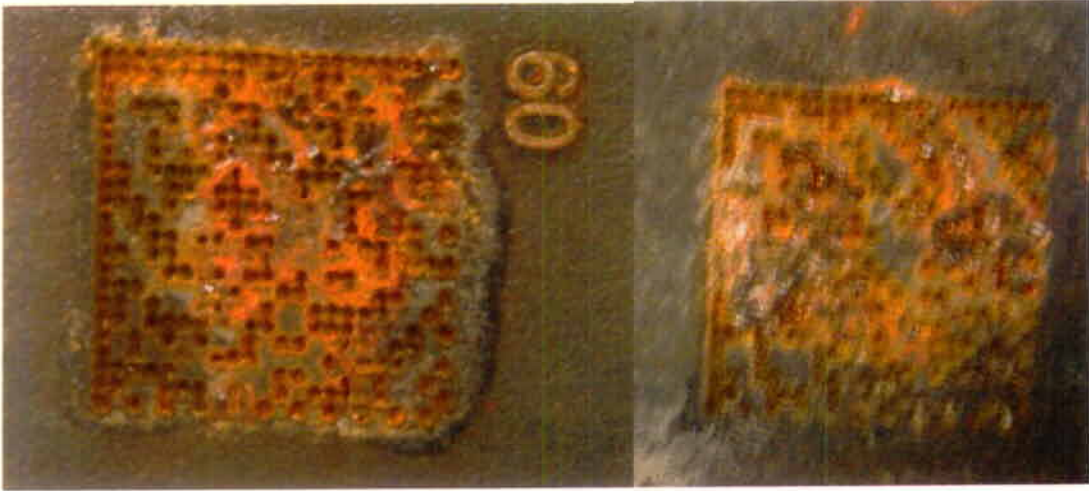


After hot/cold/icing

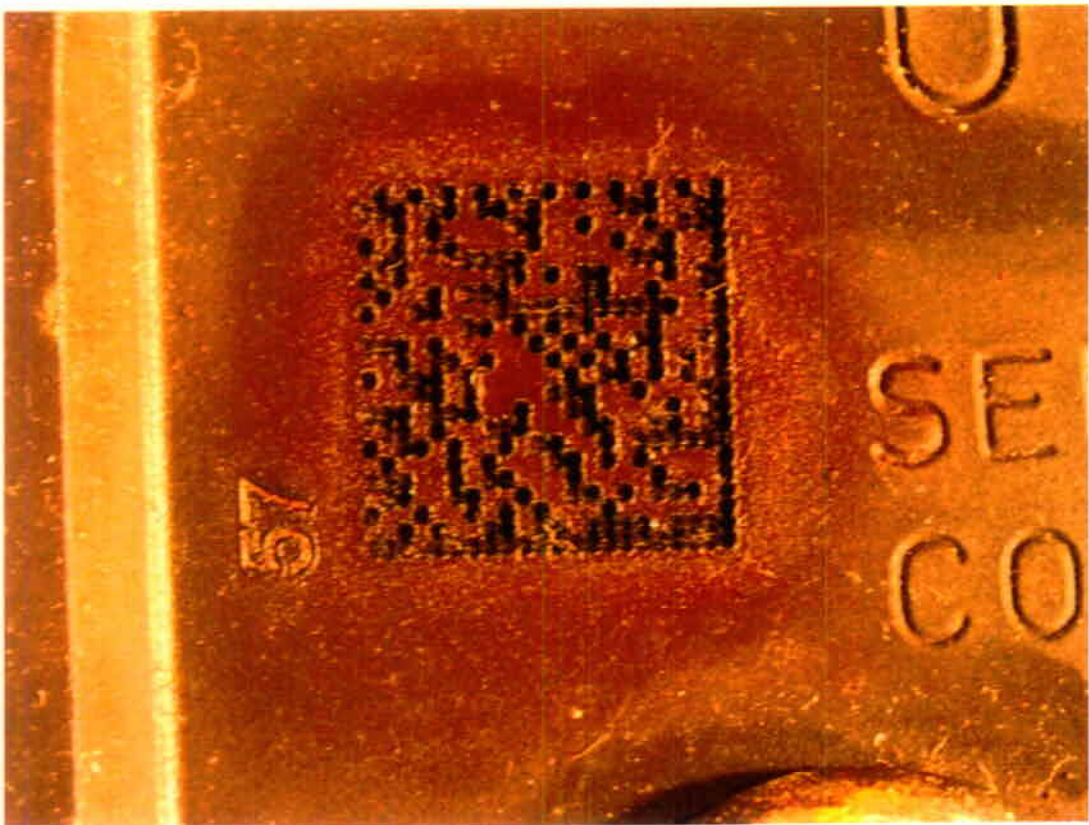


**Deep Laser Engraving
Krylon**

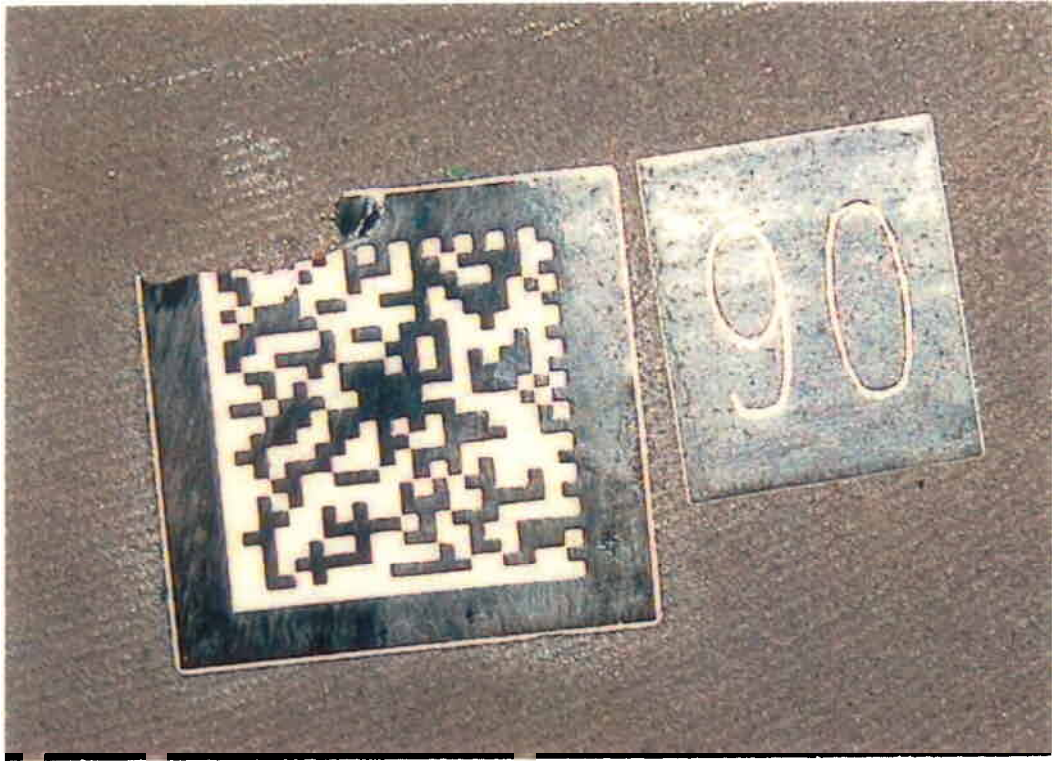
After Salt Fog



After hot/cold/icing



TESA Tape



APPENDIX C
M9 PISTOL PICTURES

M9 UID marking after testing

**Laser Coat and Discolor
Anodized**

After hot/cold/icing

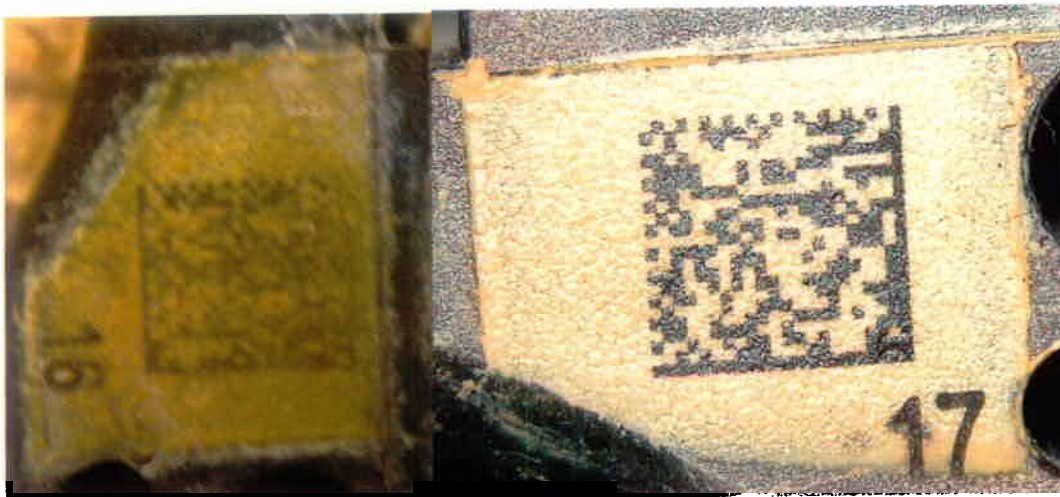
After Salt Fog



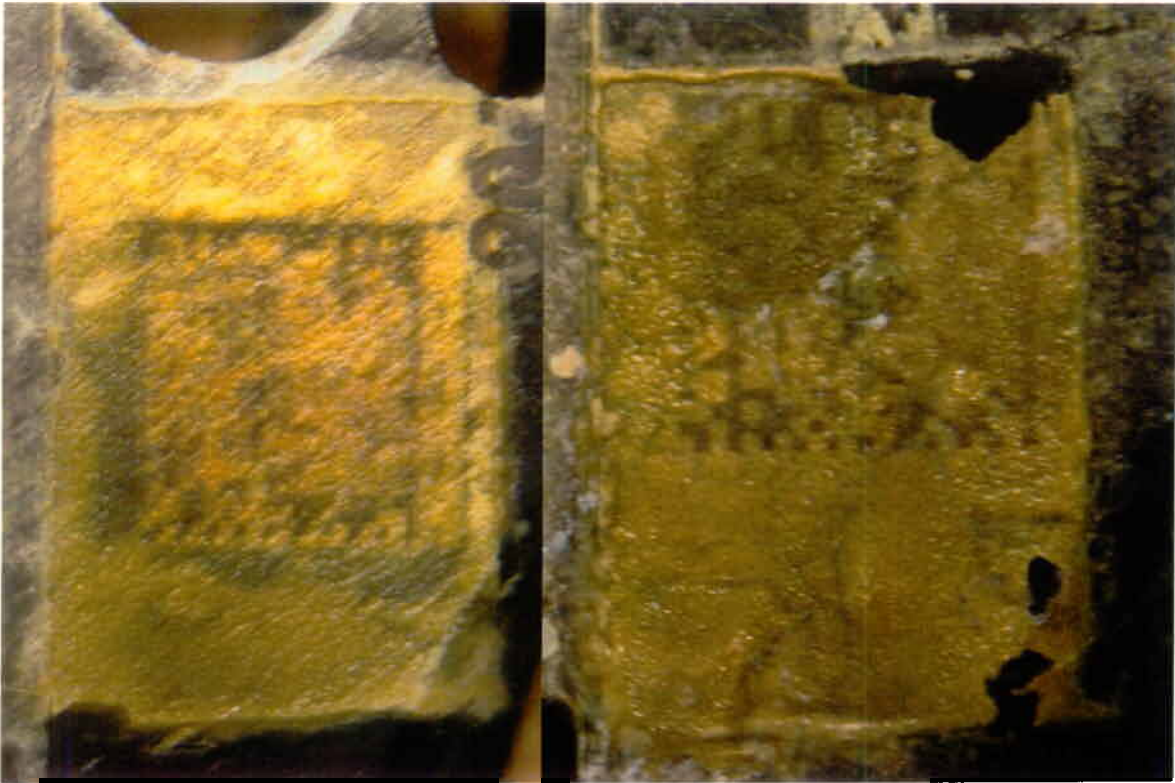
**Laser Coat and Discolor
Datalase**

After Salt Fog

After hot/cold/icing



After Salt Fog

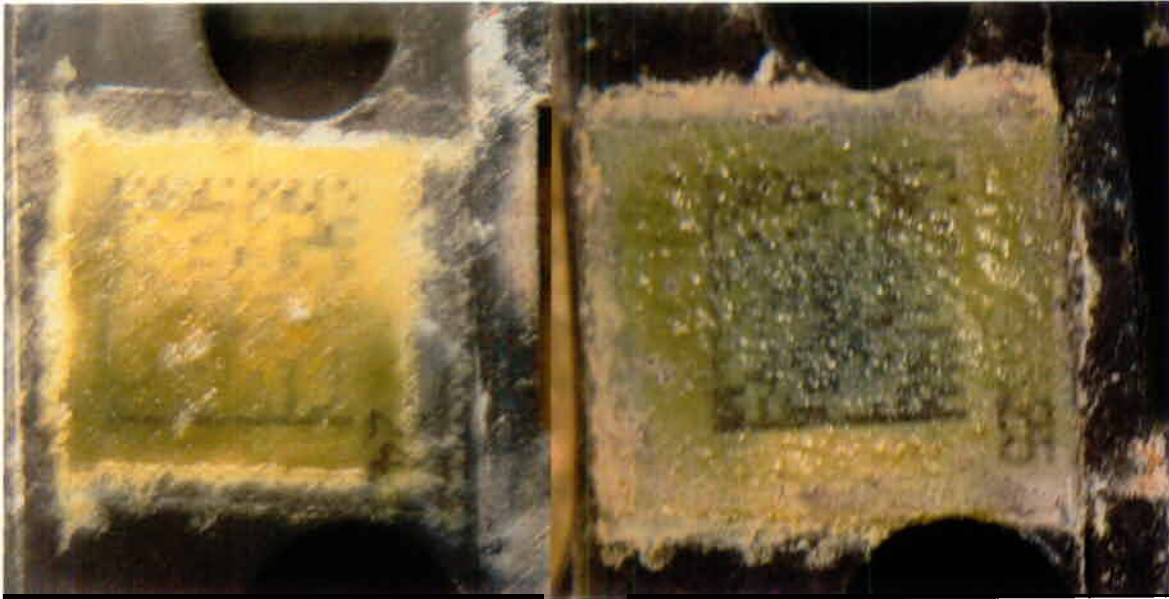


After hot/cold/icing

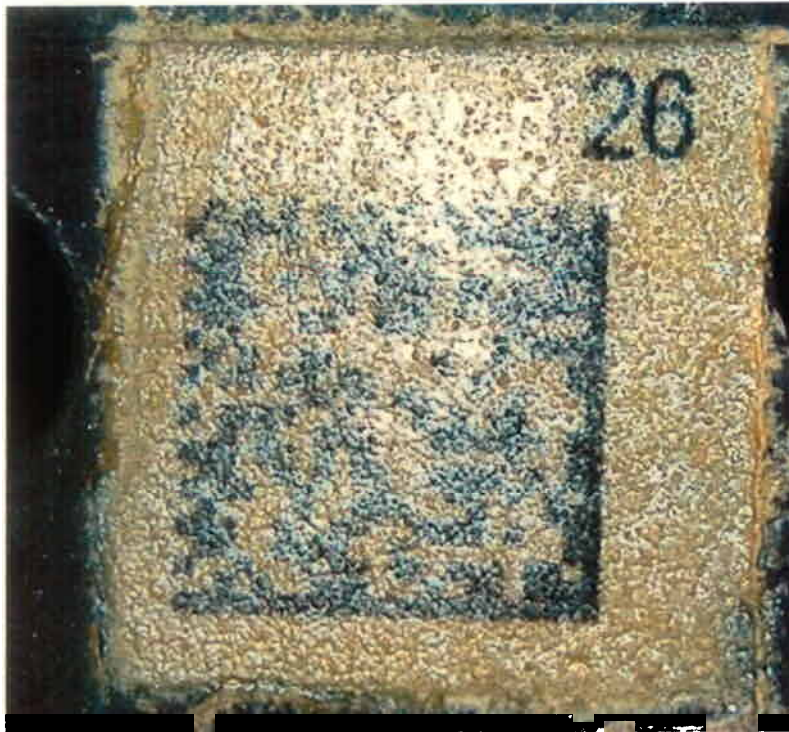


Laser Coat and Discolor
Aluma Hyde

After Salt Fog

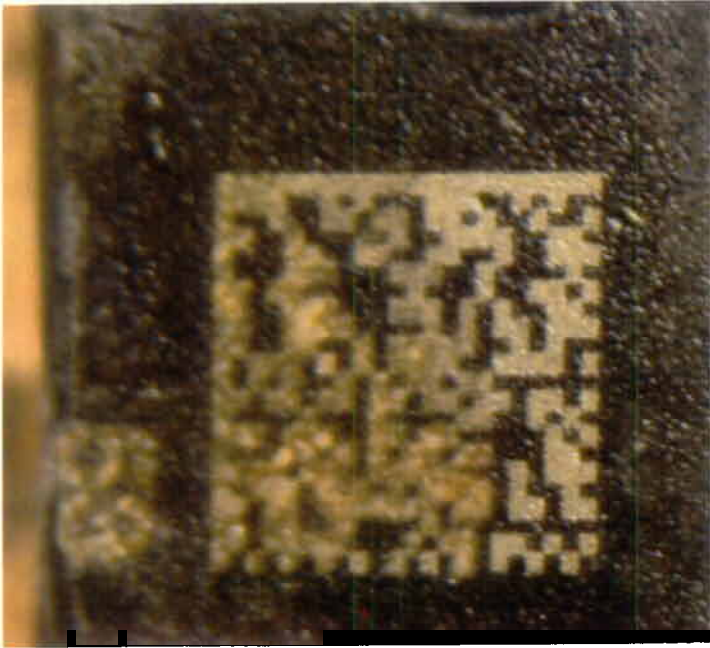
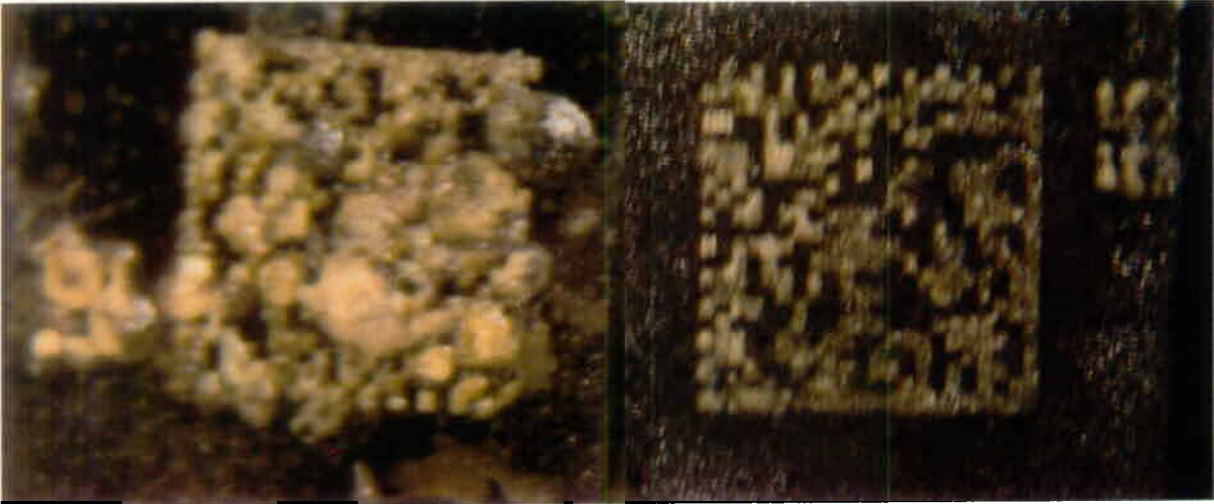


After hot/cold/icing

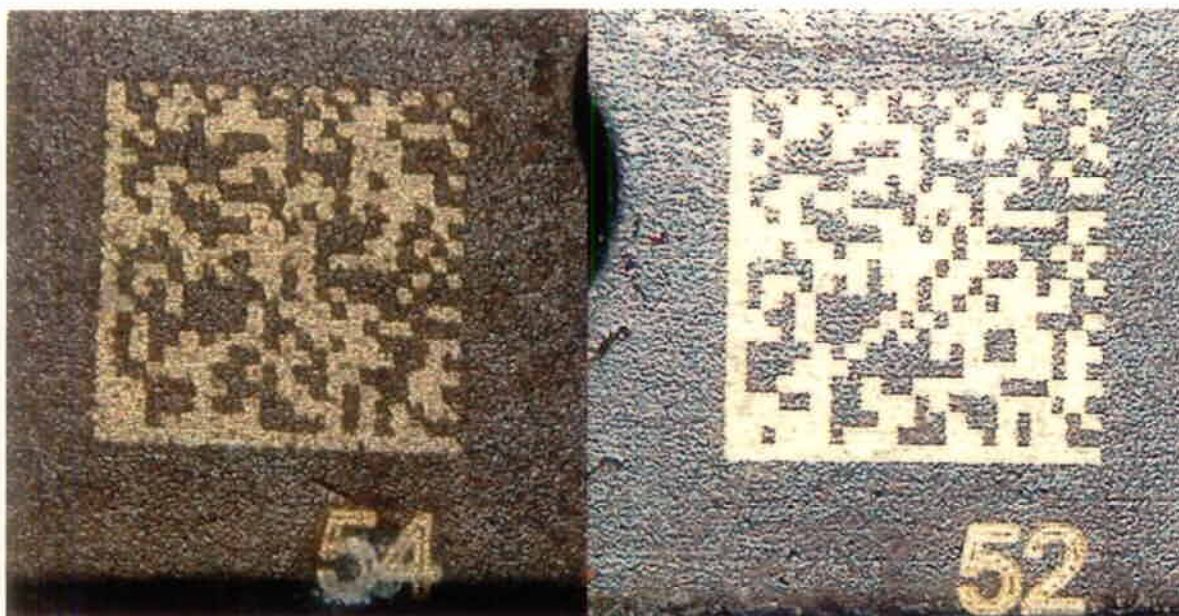


**Laser etch & clear coat
Aluma Hyde II**

After Salt Fog



After hot/cold/icing

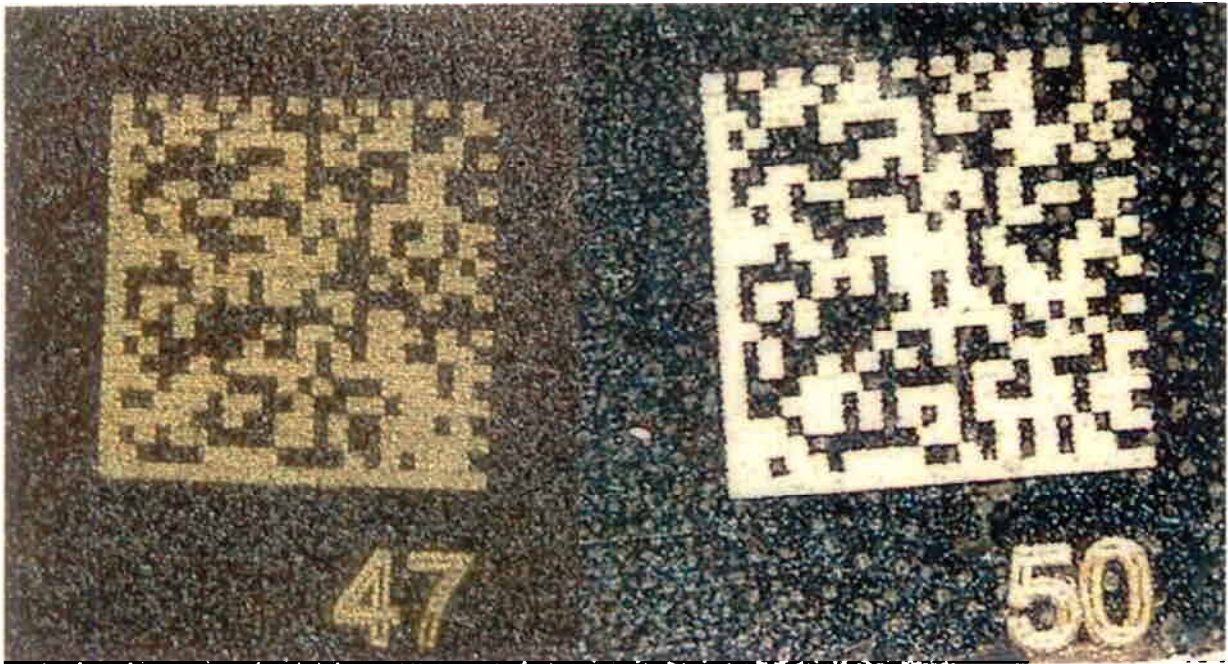


**Laser etch & clear coat
Datalase**

After Salt Fog



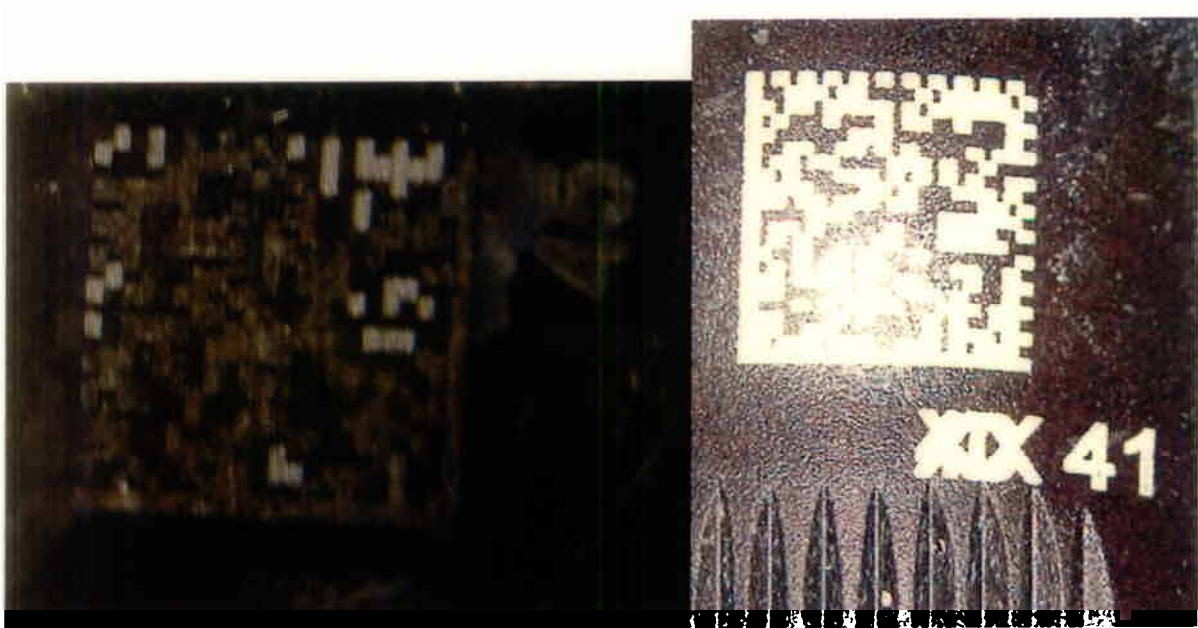
After hot/cold/icing



**Laser etch & clear coat
Evershield**

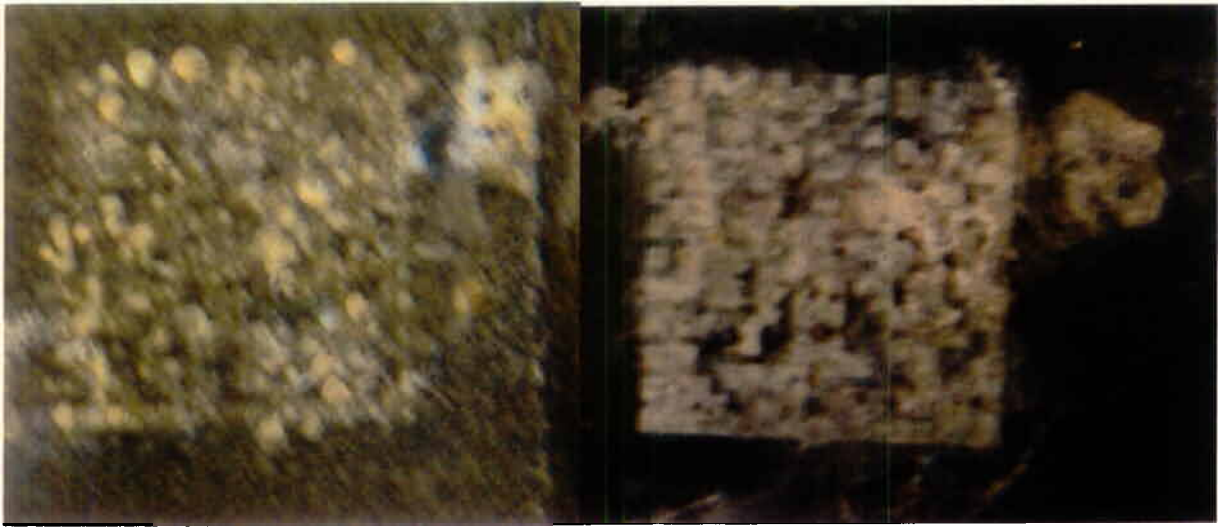
After Salt Fog

After hot/cold/icing

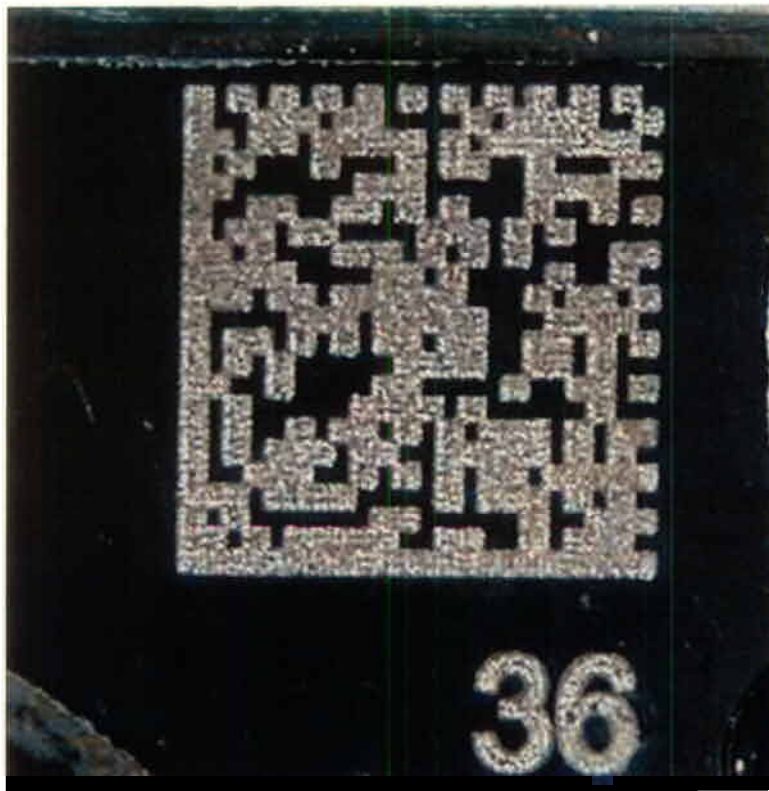


**Laser etch & clear coat
Bare**

After Salt Fog



After hot/cold/icing



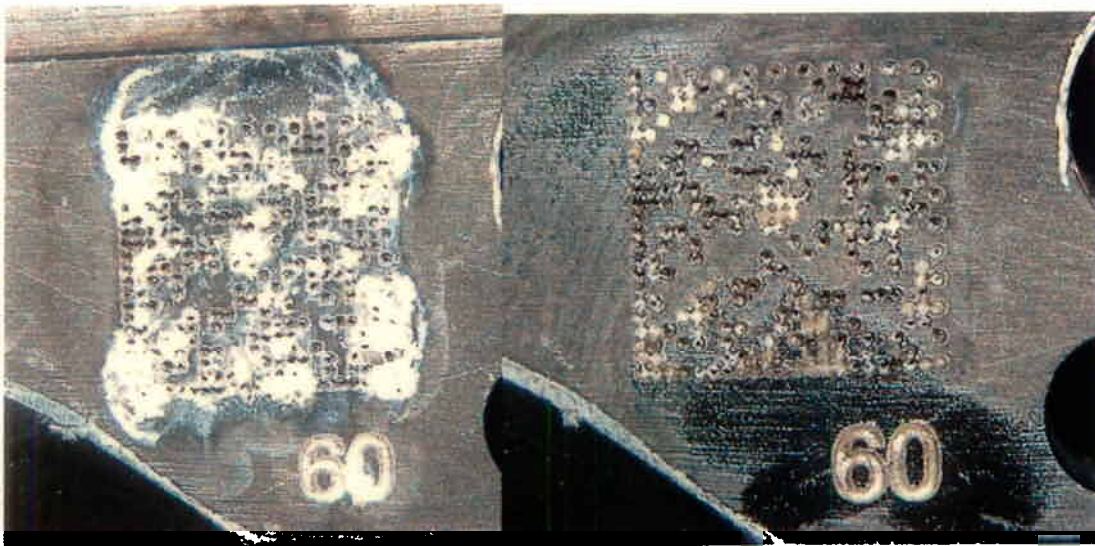
Deep laser

After Salt Fog



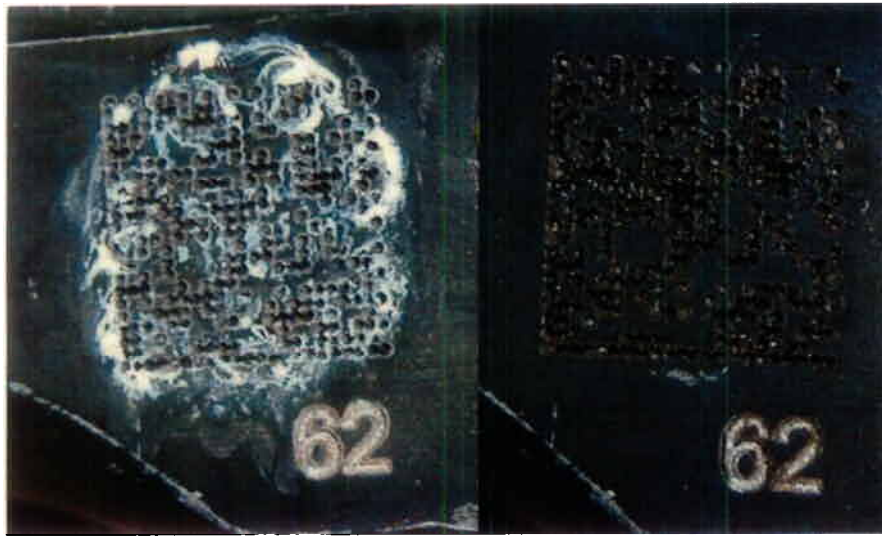
After icing before cleaning

After cleaning



After icing before cleaning

After cleaning



Tesa Tape



APPENDIX D
SAND TEST PICTURES



Sand chamber



Mark after sand testing before cleaning