

AD-A040 245

ARMY MISSILE RESEARCH AND DEVELOPMENT COMMAND REDSTO--ETC F/G 17/5
INDEX OF 3.2-MM AND 10.6-MICROMETERS IMAGE DATA TAPES.(U)
FEB 77 B D GUENTHER

UNCLASSIFIED

DRDMI-TR-77-2

NL

1 OF 2
AD
AO40245



ADA 040245

1-4
②
D.S.
TECHNICAL REPORT TR-77-2

INDEX OF 3.2-mm AND 10.6- μ m IMAGE DATA TAPES

Physical Sciences Directorate
Technology Laboratory

1 February 1977

Approved for public release; distribution



AD No. —
DDC FILE COPY

US Army Missile Research and Development Command
Redstone Arsenal, Alabama 35899

DISPOSITION INSTRUCTIONS

**DESTROY THIS REPORT WHEN IT IS NO LONGER NEEDED. DO NOT
RETURN IT TO THE ORIGINATOR.**

DISCLAIMER

**THE FINDINGS IN THIS REPORT ARE NOT TO BE CONSTRUED AS AN
OFFICIAL DEPARTMENT OF THE ARMY POSITION UNLESS SO DESIGNATED
BY OTHER AUTHORIZED DOCUMENTS.**

TRADE NAMES

**USE OF TRADE NAMES OR MANUFACTURERS IN THIS REPORT DOES
NOT CONSTITUTE AN OFFICIAL INDORSEMENT OR APPROVAL OF
THE USE OF SUCH COMMERCIAL HARDWARE OR SOFTWARE.**

14 DRDMI-TR-77-2 *June*

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TR-77-2	2. GOVT ACCESSION NO. <u>micrometers</u>	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) INDEX OF 3.2-mm AND 10.6- mm IMAGE DATA TAPES.	5. PERFORMING ORG. REPORT NUMBER TR-77-2	6. AUTHOR(s) B. D./Guenther
7. AUTHOR(s) B. D./Guenther	8. CONTRACT OR GRANT NUMBER(s)	9. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 1L161102AH49 ANCMS 611102.H490011
9. PERFORMING ORGANIZATION NAME AND ADDRESS Commander US Army Missile Research and Development Command Attn: DRDMI-TR Redstone Arsenal, Alabama 35809	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 1L161102AH49 ANCMS 611102.H490011	11. CONTROLLING OFFICE NAME AND ADDRESS Commander US Army Missile Research and Development Command Attn: DRDMI-TI Redstone Arsenal, Alabama 35809
11. CONTROLLING OFFICE NAME AND ADDRESS Commander US Army Missile Research and Development Command Attn: DRDMI-TI Redstone Arsenal, Alabama 35809	12. REPORT DATE 1 Feb 1977	13. NUMBER OF PAGES 119
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	14. SECURITY CLASS. (of this report) UNCLASSIFIED	15. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		ACCESSION FOR DTIC White Section <input checked="" type="checkbox"/> DDC Buff Section <input type="checkbox"/> UNANNOUNCED <input type="checkbox"/>
18. SUPPLEMENTARY NOTES		JUSTIFICATION BY DISTRIBUTION AVAILABILITY CODES
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Image data Magnetic tape Submillimeter wavelengths		DIS. AVAIL. AND, IF SPECIAL A
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) <u>micrometers</u> This report describes image data of military vehicles at wavelengths of 3.2 mm and 10.6 (μm) available on magnetic tape from the Physical Sciences Directorate. This report is to provide an index of the available images for prospective users. Additional study of the images and methods of processing them will be carried out at Hughes Research Laboratories and the US Army Missile Research and Development Command.		

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

410211 BPM

1 February 1977

TECHNICAL REPORT TR-77-2

INDEX OF 3.2-mm AND 10.6- μ m IMAGE DATA TAPES

B. D. Guenther

DA Project No. 1L161102AH49
AMCMS Code No. 611102.H490011

Approved for public release; distribution unlimited

Physical Sciences Directorate
Technology Laboratory
US Army Missile Research and Development Command
Redstone Arsenal, Alabama 35809

CONTENTS

	Page
I. INTRODUCTION.	5
II. BACKGROUND.	5
III. DESCRIPTION OF THE IMAGE SCAN SYSTEM.	7
IV. DATA PROCESSING	18
V. DATA DISPLAY.	18
VI. TARGETS	23
Appendix A. INDEX OF DATA TAPE	31
Appendix B. COMPUTER PROGRAMS.	109

CONTENTS

ACKNOWLEDGEMENTS

The original suggestion to simulate submillimeter images by operating at 940 GHz and scaling the range was made by Dr. J. Allen, Office of the Director of Defense Research and Engineering. The selection of target matrix was aided by Dr. V. Corcoran, IDA consultant to the Director of Defense Research and Engineering. Mr. Robert McMillan of Rome Air Development Center gave valuable assistance by smoothing the contractual support. Colonel T. M. Robinson, NGB, USPFO for California, arranged availability of target vehicles. Lieutenant Colonel Reigel, Commander 3d Battery, 185th Armored Battalion, California National Guard, provided support and allowed the use of facilities and equipment under his command. Dr. N. George, Dr. J. S. Bennett, and Dr. C. R. Christenson have been involved in fruitful discussions of imaging with coherent systems. The assistance provided by Dr. George in obtaining visual displays of some of the data is greatly appreciated. The author's collaborators in the US Army Missile Research and Development Command submillimeter program, Dr. R. L. Hartman and Dr. W. L. Gamble, were involved in this effort from its inception and have provided invaluable advice and support. Most of all, thanks goes to Dr. J. M. Baird and Mr. John F. Heney of Hughes Research Laboratory who were truly dedicated to the support of this mission.

I. INTRODUCTION

This report describes image data of military vehicles at wavelengths of 3.2 mm and 10.6 μm available on magnetic tape from the Physical Sciences Directorate, US Army Missile Research and Development Command (MIRADCOM), Redstone Arsenal, Alabama.

The images were obtained through the use of the Hughes Research Laboratories mobile image scanning equipment. All the data described here were taken 7 June 1976 through 11 June 1976 at a California National Guard Armory in San Diego, California. Thanks are due to Lt. Col Curtis E. Reigel, Commander, 3rd Battalion, 185th Armor, for providing support and allowing the use of the facilities and equipment under his command.

This report is to provide an index of the available images for prospective users. Additional study of the images and methods of processing them will be carried out both at Hughes Research Laboratories and MIRADCOM.

II. BACKGROUND

A basic research program was established in December 1975 at MIRADCOM to evaluate the submillimeter wavelength region of the electromagnetic spectrum for possible Army applications. The goal of this program is to determine if an all-weather capability will be provided by utilization of these wavelengths. Initial emphasis was created by an ASAP summer study in 1974 by Dr. Paul W. Kruse which suggested that submillimeter waves could provide sufficient resolution and inclement weather penetration to allow the Army to acquire, recognize, and direct conventional weapons fire onto hostile targets such as tanks and other military vehicles [1-4]. The 1976 ASAP summer study reviewed the MIRADCOM effort [5].

The primary reasons for selecting this wavelength region are as follows:

- a) Millimeter and centimeter wavelengths are not seriously degraded by inclement weather but they cannot provide sufficient resolution for target identification without exceeding the restrictions placed on antenna size by operational systems.
- b) Optical and infrared wavelengths can provide the required resolution for target identification but propagation of these wavelengths in inclement weather is poor.

c) Submillimeter wavelengths can be used with system compatible antenna sizes to provide a narrow beam that will minimize the problem of clutter returns and provide sufficient resolution for accurate target location, size discrimination, and shape recognition capability. Clear air attenuation is expected to be high but inclement weather effects should not seriously degrade the beam.

The characteristics of submillimeter waves suggest potential application in the following:

- a) Terminal homing.
- b) Target designation.
- c) Active seekers.
- d) Beam riders.
- e) Prelaunch guidance.
- f) Surveillance.
- g) Target acquisition.
- h) Secure communications.
- i) Reducing system vulnerability to antiradiation missiles (ARM) and electronic countermeasures (ECM).

Before any application can be undertaken, a data base in the submillimeter region must be established. Propagation in conjunction with meteorological observations and data on target reflectivities and scene contrast needed for image capability predictions are the most important inputs needed for the data base.

A more specific list of the critical data inadequacies in the area of propagation can be given [6]. There are no experimental data on scattering. Measurements of absorption in clear air are limited and do not include detailed meteorological measurements. Observed fluctuations in attenuation are not explained. The theories on clear air absorption do not work well in the atmospheric windows. The data base for extinction in rain, snow, and fog is very limited. A bibliography to provide an introduction to the field of submillimeter propagation is available [7].

A program is currently under way at MIRADCOM to obtain a statistically meaningful data base for submillimeter propagation in the atmospheric windows at approximately 750, 850, and 1.3 mm [8].

It was decided that the most productive technique for evaluating the imaging capability at these wavelengths was not to build an imaging submillimeter radar but rather to use an existing 3.2-mm radar at ranges which simulate the resolution one would obtain with a submillimeter wave radar.

In addition to obtaining the simulated submillimeter data, high resolution images were obtained both at 3.2 mm and at 10.6 μm . These data are now available in digital format. The high resolution data allow digital image processing to be used to study the effects of image degradation and image enhancement.

The intensity of the returned signal is calibrated with respect to the return from a polished gold sphere. It is hoped that these calibrated data will be useful to system designers. Calibrated target signature data of this type are not available in the submillimeter wavelength region; neither are data available on optical properties of materials in this region. A program is beginning at MIRADCOM to fill this gap. The 3.2-mm and 10.6- μm data will aid in interpretation and uation of the submillimeter target signature and optical constant parameters.

III. DESCRIPTION OF THE IMAGE SCAN SYSTEM

There is a detailed description [9] of the image scanning equipment and the methods used to calibrate the equipment. A summary of that description will be given here.

A. The 3.2-mm Equipment

The 3.2-mm system used a Hughes LOW-1 backward wave oscillator (BWO) to provide at least 1 W of power to the 45-cm transmitting antenna. A separate receiving antenna with an identical aperture feeds the heterodyne receiver. At 14.6 m, the system resolution spot size (at the 3-dB points) is oval in shape with a height of 10 cm and a width of 8.2 cm. The calibration of the receiver is shown in Figure 1.

The system response was calibrated against the backscatter from a polished 50-mm (2-in.) diameter gold-plated chrome steel sphere. The sphere was assumed to have the theoretical radar cross section of -26.9 dB/m^2 . The data are digitized into 12 bits and stored on magnetic tape for later processing. To convert this integer value to voltage, the relationship $10 V = 4096$ is used. An effective radar cross section (RCS) referenced to the gold sphere can be calculated by using the following expression:

$$\text{RCS}(\text{dB/m}^2) = 6.91 \left(\frac{I}{409.6} - V_s \right) - 26.9 \quad (1)$$

where I = the integer value on the data tape and V_s = the voltage reading from the 50-mm gold sphere. The sphere voltage was taken at the end of every scan when the transmitter and receiver were parallel

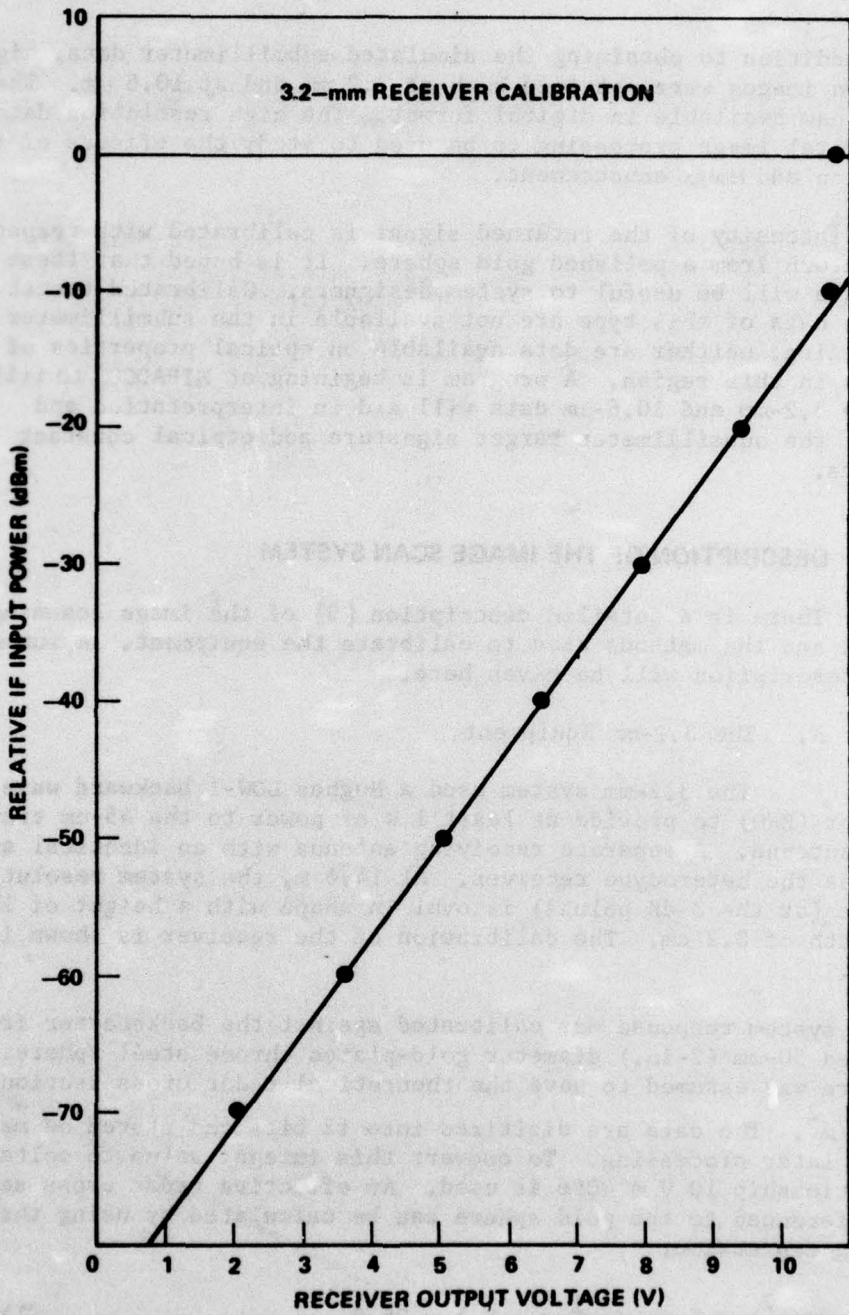


Figure 1. IF amplifier and detector calibration data.

polarized. When the transmitter and receiver were cross polarized, the following expression was used to calculate the backscattered intensity:

$$\text{Intensity (dB)} = 6.91 \left(\frac{I}{409.6} - 10 \right) \quad (2)$$

The accepted definition of radar cross section is the area intercepting that amount of power which, when scattered equally in all directions, produces an echo equal to that from the target [10]. Thus, a specular sphere with a geometrically projected area of a square meter (a radius of $1/\sqrt{\pi}$) has an RCS of a square meter. This definition implies that the target is smaller than the illuminating beam. Therefore, the RCS calculated using Equation (1) should be used as a calibrated reflectance, not as an RCS usable in the radar range equations.

B. The 10.6- μm System

A 1-W CO_2 laser lasing on the P20 line provides the transmitting signal for the 10.6- μm imaging system. The natural divergence of the laser output beam results in a 4-cm, horizontally polarized, illuminated spot on a target at 14.6 m. A 2-mm diameter liquid nitrogen cooled HgCdTe detector positioned in the back focal plane of a 20-cm diameter F/4 telescope acts as the receiver. The receiver was polarization insensitive. Synchronous video detection at 1 K Hz with an integration time of 0.01 sec is used to eliminate the effects of background radiation.

The 10.6- μm images differ from those obtained at 3.2 mm in several important respects:

- 1) The resolution of the 10.6- μm transmitter is approximately twice that of the 3.2-mm transmitter (4 cm versus 10 cm).
- 2) The receiver in the 10.6- μm system performs speckle averaging resulting in the 3.2-mm data having a larger component of speckle noise. This speckle noise further reduces the effective resolution of the 3.2-mm system [11, 12].
- 3) Heterodyne detection was used at 3.2 mm but video detection was used at 10.6 μm .
- 4) The 3.2-mm receiver is sensitive to only one polarization while the 10.6- μm receiver is polarization insensitive.

The calibration curve for the 10.6- μm system is shown in Figure 2. The data are stored digitally in the same format as the 3.2-mm image data. When the reflected signal is referenced to the same gold sphere as was used in the 3.2-mm calibration, the following equation gives the effective cross section:

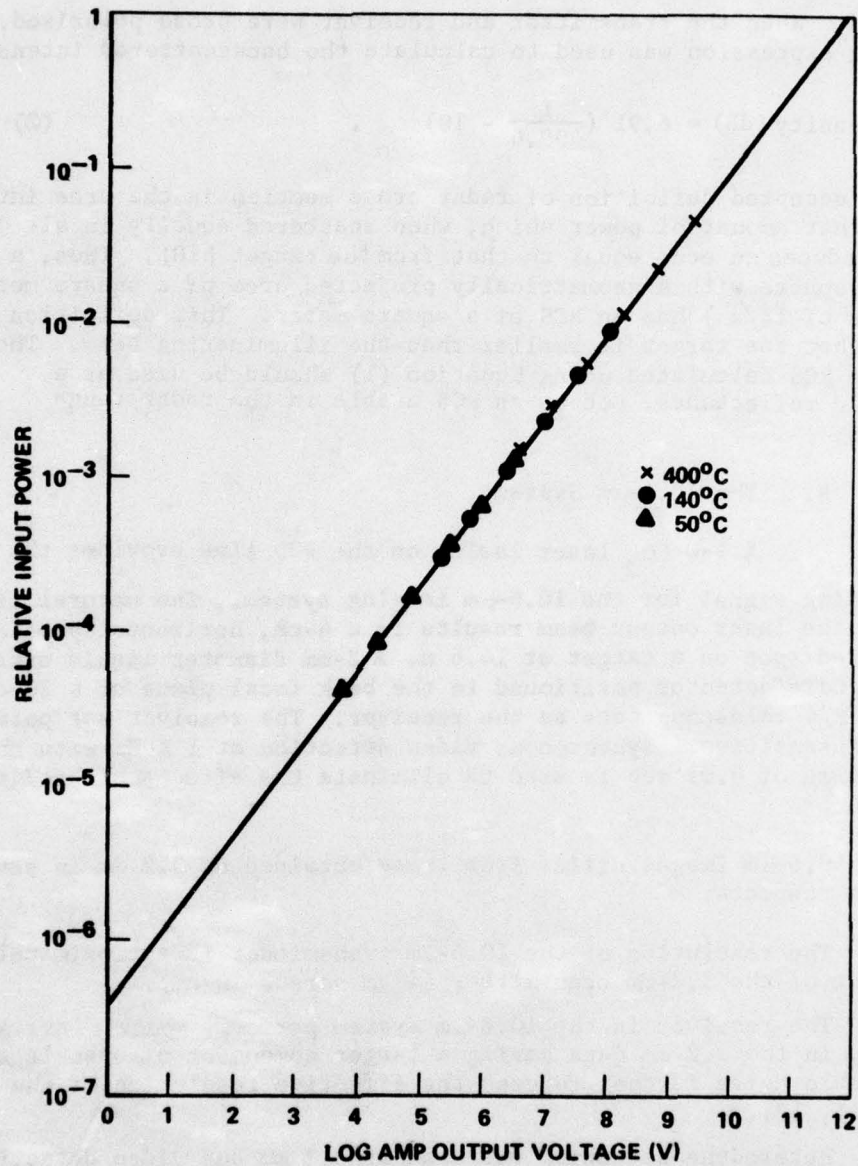


Figure 2. Plot of calibrated data for 10.6- μm receiver.

$$\text{RCS (dB/m}^2\text{)} = 5.346\left(\frac{I}{409.6} - V_s\right) - 26.93 \quad (3)$$

The return from the gold sphere, V_s , was recorded at the end of each run. The same warning should be kept in mind when using Equation (3) that was given with Equation (1).

When the exterior light level remained constant, very good visible records were obtained (Figure 3a).

C. Visible System

A passive visible system with resolution of ~ 3 mrad was used to provide a boresight reference record for the 3.2-mm data. However, the lack of an automatic gain control (AGC) on this data channel and the fact that the light levels often changed rapidly during a scan produced streaking in most of the visible sensor images (Figure 3b). Nevertheless, the visible images can still be used to obtain the spatial origin of the reflectivity data in the 3.2-mm and 10.6- μm records.

D. Accessory Equipment

An equipment van and azimuth and elevation (AZ/EL) scanning pedestal from a 584 radar system were used to house all of the equipment and provide the scanning capability needed to form images. Figure 4 shows the system in operation at San Diego, California.

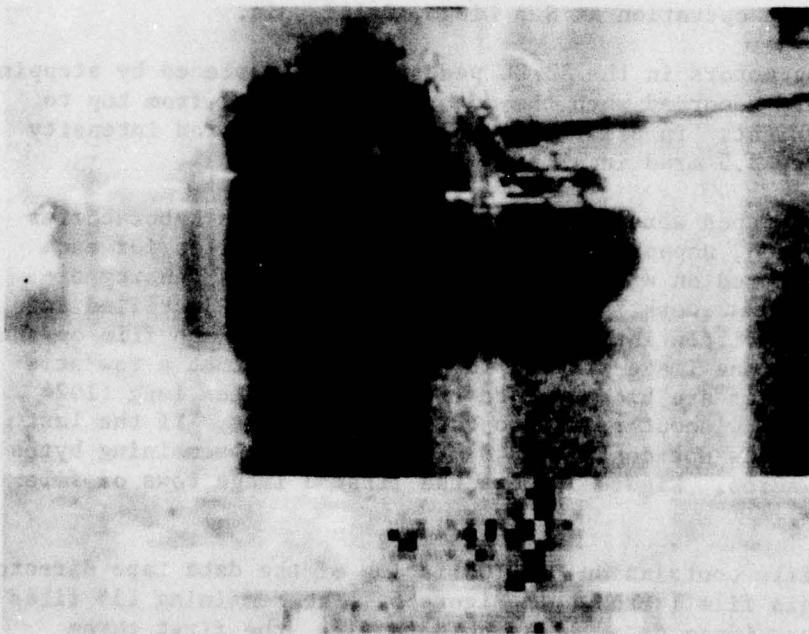
The scanning motors in the AZ/EL pedestal were replaced by stepping motors. Data were recorded when the motors were stepped from top to bottom, left to right. In all but two cases, the scattered intensity was recorded every 3.5 mrad in AZ and 3.4 mrad in EL.

The raw data tapes were returned to Hughes Research Laboratories where they were read, unpacked into separate computer files for each wavelength, and stored on a final 9-track data tape at a density of 800 BPI. The 12-bit work for each intensity is right-justified into a 16-bit work and written into two bytes on the tape. Each file on the data tape contains one image written in a TV raster format a row at a time. The data files are blocked into records 2048 bytes long (1024 intensity readings) without regard to the raster format. If the last record of a file does not contain 2048 bytes, then the remaining bytes are filled with zeros. Figure 5 shows the first 3 image rows of file No. 32.

The first file contains an EBCDIC listing of the data tape directory. A printout of this file is shown in Figure 6. The remaining 135 files contain the binary image data. In each data file, the first three intensities have been replaced by the number of columns, the number of rows, and a zero (first three numbers in the listing shown in Figure 5).

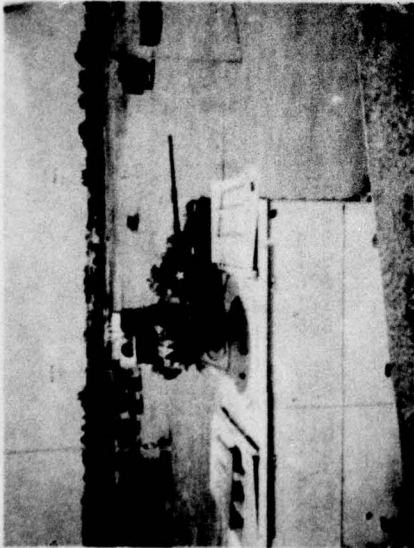


(a) FILE NO. 31



(b) FILE NO. 10

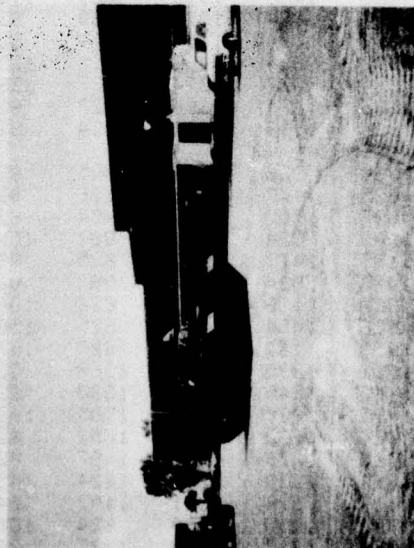
Figure 3. Visible image files.



VIEW FROM SCANNER TO TARGET



SIDE VIEW. NOTE CALIBRATION
SPHERE MOUNTED ON POLE BY TANK



VIEW FROM TARGET TO SCANNER



SCANNER CLOSE-UP

Figure 4. Experimental equipment and operational arrangement.

FILE NUMBER 32

IMAGE ROW NUMBER	1									
174	73	0	1470	826	1394	825	1121	1541	1136	
824	1544	824	1502	820	824	825	825	1575	1215	
825	823	1132	825	1283	1100	825	824	1034	1057	
1310	1047	824	1321	825	827	823	824	825	1203	
824	824	824	1249	1294	827	1562	1208	746	1094	
1311	824	1338	1033	822	823	826	1521	823	824	
1084	824	1490	825	827	1473	823	824	1210	824	
822	825	1342	827	1588	825	1606	1529	824	1545	
1543	826	824	1041	824	1563	1627				
1435	824	824	1108	824	1397	1642	824	1285	1128	
1429	824	1119	1524	825	829	1415	1060	865	1277	
1353	823	826	825	822	825	827	1303	1249	1257	
1400	824	1235	825	824	861	943	825	1375	1498	
825	1592	825	1173	1400	824	824	1200	824	1372	
823	1361	1460	1160	1142	824	1253	1349	1250	824	
824	824	1008	1081	1343	824	1425	823	824	1356	
1239	1199	825	1414	1109	823	1483	1633	1331	825	
1077	824	992	822	1174	824	824				
IMAGE ROW NUMBER	2									
824	1700	825	1436	1107	1412	1400	823	1081	1572	
824	1377	825	1411	1164	824	1170	1419	1376	827	
879	1277	1255	824	825	825	1469	1455	1603	1211	
1088	827	825	1121	1265	1253	1396	824	1454	870	
822	878	1144	1764	823	1294	1104	824	826	1108	
825	827	1329	1051	824	824	1400	1324	825	1008	
824	825	824	1134	824	1231	1016	824	824	824	
824	1384	995	1350	1606	823	825	1013	825	1444	
975	1609	726	825	1647	824	1293				
1235	1394	1354	1512	1372	823	821	1104	1394	825	
1213	1385	859	823	1006	1500	824	1466	1031	825	
824	826	1005	1419	824	1136	825	1448	1115	824	
1352	824	824	1019	1360	825	1152	822	1173	1174	
824	1018	824	1391	824	824	825	823	1045	1667	
1333	1190	824	1468	1215	1257	1053	977	972	825	
1363	824	827	824	927	1288	1031	824	1174	824	
1316	1186	824	1366	823	826	824	826	1568	1190	
824	824	1198	1021	824	826	824				
IMAGE ROW NUMBER	3									
1291	960	826	1560	825	825	1466	825	1052	824	
1328	825	1477	1323	1116	824	1361	826	1099	825	
825	823	1707	1332	1484	827	824	1147	1175	864	
823	1508	824	825	824	1552	824	824	822	1317	
1387	1185	1477	1397	825	824	825	825	824	822	
824	1073	824	824	993	825	823	826	1372	1404	
824	824	1139	826	826	1088	824	1371	1343	1560	
823	826	1454	927	825	1509	1060	825	827	1491	
824	828	1167	1468	827	1677	826				
824	1513	825	1241	1368	824	1383	823	824	1417	
824	1442	1345	824	1330	824	825	824	1328	824	
825	1495	1238	824	1585	1631	827	825	825	1488	
1395	826	1230	1160	1652	824	1259	823	825	824	
823	825	1278	825	1497	825	824	823	1041	823	
1406	1398	1373	826	1624	1452	879	826	1244	824	
1268	1429	824	1321	1193	1243	824	824	1517	823	
824	1302	825	1259	824	1613	821	824	824	1156	
1518	1041	1217	1440	1387	824	824				

Figure 5. Sample of image data in digital format.

BEST AVAILABLE COPY

HUGHES/MICOM MULTISPECTRAL SCAN DATA

THIS TAPE CONTAINS SCAN DATA TAKEN BY HUGHES RESEARCH LABORATORY SPONSORED BY ARMY MISSILE COMMAND. THE DATA WAS TAKEN DURING THE WEEK OF JUNE 7, 1976 IN SAN DIEGO. THE TARGETS ARE AN M48A5 TANK AND ASSORTED MILITARY TRUCKS AND JEEPS. THE WAVELENGTHS ARE 3.2 MM, 10.6 MICRON (WITH ACTIVE SYSTEMS), AND PASSIVE VISIBLE. (IN SOME CASES THE VISIBLE IMAGES ARE EMPTY DUE TO DARKNESS DURING SCANNING.)

FOR FURTHER INFORMATION CONTACT ..
B. D. GUENTHER (MICOM) (205) 876-3820
J. M. RAJND (HUGHES) (213) 456-6411

TAPE CHARACTERISTICS

-
- .. NO LABEL
- .. 800 RPI (LOW DENSITY)
- .. BLOCKING SIZE 2048
- .. ALL FILES ARE BINARY EXCEPT FOR THE FIRST FILE WHICH IS EBCDIC.
- .. INTENSITIES ARE 12 BITS AND ARE RIGHT JUSTIFIED IN 16 BITS (THE INTENSITIES PER 32 BIT WORD)**
- .. 9 TRACK TAPE
- .. 136 FILES

**
NOTE .. THE UPPER LEFT THREE INTENSITIES CONTAIN THE FOLLOWING:
(1,1) - NUMBER OF COLUMNS
(2,1) - NUMBER OF ROWS
(3,1) - ZERO FILLED

TAPE DIRECTORY

-
- .. THE FOLLOWING IS A DIRECTORY OF THE MICOM DATA TAPE WHERE
 - .. THE FILES ARE LISTED IN THE ORDER OF OCCURRENCE ON THE TAPE
 - .. EACH TAPE NUMBER REFERS TO THE ORIGINAL DATA TAPE RECORD
 - .. EACH SCAN NUMBER REPRESENTS ONE SCAN WITH THREE SENSORS
 - .. THE WAVELENGTH USED IS DESCRIBED
 - .. THE BITS PER INTENSITY IS 12 (RIGHT JUSTIFIED IN 16 BITS)
 - .. THE NUMBER OF ROWS (VERTICAL DIMENSION) PER PICTURE IS GIVEN
 - .. THE NUMBER OF COLUMNS (HORIZONTAL DIMENSION) PER PICTURE IS GIVEN

CAUTION: THE FIRST FILE IS EBCDIC THE 135 FOLLOWING ARE BINARY.

(a)

Figure 6. EBCDIC listing of the data tape directory.

FILE NO.	TAPE NO.	SCAN NO.	WAVELENGTH	BITS	SIZE (IN)	ROW
1	N/A	N/A	(TEXT HEAD)
2	27	01	3.2 MM	(16)	14	20)
3			10.6 MICRON	(16)	14	20)
4			VISIBLE	(16)	14	20)
5	27	02	3.2 MM	(16)	14	19)
6			10.6 MICRON	(16)	14	19)
7			VISIBLE	(16)	14	19)
8	27	03	3.2 MM	(16)	174	46)
9			10.6 MICRON	(16)	174	46)
10			VISIBLE	(16)	174	46)
11	27	04	3.2 MM	(16)	147	48)
12			10.6 MICRON	(16)	147	48)
13			VISIBLE	(16)	147	48)
14	27	05	3.2 MM	(16)	102	46)
15			10.6 MICRON	(16)	102	46)
16			VISIBLE	(16)	102	46)
17	27	06	3.2 MM	(16)	6	9A)
18			10.6 MICRON	(16)	6	9A)
19			VISIBLE	(16)	6	9A)
20	27	07	3.2 MM	(16)	49	4A)
21			10.6 MICRON	(16)	49	4A)
22			VISIBLE	(16)	49	4A)
23	27	08	3.2 MM	(16)	90	9A)
24			10.6 MICRON	(16)	90	9A)
25			VISIBLE	(16)	90	9A)
26	27	09	3.2 MM	(16)	117	72)
27			10.6 MICRON	(16)	117	72)
28			VISIBLE	(16)	117	72)
29	27	10	3.2 MM	(16)	102	73)
30			10.6 MICRON	(16)	102	73)
31			VISIBLE	(16)	102	73)
32	27	11	3.2 MM	(16)	174	73)
33			10.6 MICRON	(16)	174	73)
34			VISIBLE	(16)	174	73)
35	27	12	3.2 MM	(16)	213	64)
36			10.6 MICRON	(16)	213	64)
37			VISIBLE	(16)	213	64)
38	28	01	3.2 MM	(16)	87	52)
39			10.6 MICRON	(16)	87	52)
40			VISIBLE	(16)	87	52)
41	28	02	3.2 MM	(16)	24	67)
42			10.6 MICRON	(16)	24	67)
43			VISIBLE	(16)	24	67)
44	28	03	3.2 MM	(16)	201	65)
45			10.6 MICRON	(16)	201	65)
46			VISIBLE	(16)	201	65)
47	28	04	3.2 MM	(16)	144	76)
48			10.6 MICRON	(16)	144	76)
49			VISIBLE	(16)	144	76)
50	28	05	3.2 MM	(16)	156	9A)
51			10.6 MICRON	(16)	156	9A)
52			VISIBLE	(16)	156	9A)
53	28	07	3.2 MM	(16)	10A	64)
54			10.6 MICRON	(16)	10A	64)
55			VISIBLE	(16)	10A	64)
56	28	08	3.2 MM	(16)	216	90)
57			10.6 MICRON	(16)	216	90)
58			VISIBLE	(16)	216	90)
59	28	09	3.2 MM	(16)	18A	43)
60			10.6 MICRON	(16)	18A	43)
61			VISIBLE	(16)	18A	43)
62	28	10	3.2 MM	(16)	18A	41)
63			10.6 MICRON	(16)	18A	41)
64			VISIBLE	(16)	18A	41)
65	28	11	3.2 MM	(16)	90	44)

(b)

Figure 6. (Continued).

66			10.6 MICRON	(16	99	44)
67			VISIBLE	(16	99	44)
68	28	12	3.2 MM	(16	156	48)
69			10.6 MICRON	(16	156	48)
70			VISIBLE	(16	156	48)
71	28	13	3.2 MM	(16	111	44)
72			10.6 MICRON	(16	111	44)
73			VISIBLE	(16	111	44)
74	28	14	3.2 MM	(16	225	100)
75			10.6 MICRON	(16	225	100)
76			VISIBLE	(16	225	100)
77	29	01	3.2 MM	(16	123	69)
78			10.6 MICRON	(16	123	69)
79			VISIBLE	(16	123	69)
80	29	02	3.2 MM	(16	99	103)
81			10.6 MICRON	(16	99	103)
82			VISIBLE	(16	99	103)
83	29	03	3.2 MM	(16	104	79)
84			10.6 MICRON	(16	104	79)
85			VISIBLE	(16	104	79)
86	29	04	3.2 MM	(16	120	78)
87			10.6 MICRON	(16	120	78)
88			VISIBLE	(16	120	78)
89	29	05	3.2 MM	(16	201	97)
90			10.6 MICRON	(16	201	97)
91			VISIBLE	(16	201	97)
92	29	06	3.2 MM	(16	183	76)
93			10.6 MICRON	(16	183	76)
94			VISIBLE	(16	183	76)
95	29	07	3.2 MM	(16	183	76)
96			10.6 MICRON	(16	183	76)
97			VISIBLE	(16	183	76)
98	29	08	3.2 MM	(16	174	100)
99			10.6 MICRON	(16	174	100)
100			VISIBLE	(16	174	100)
101	29	09	3.2 MM	(16	75	100)
102			10.6 MICRON	(16	75	100)
103			VISIBLE	(16	75	100)
104	29	11	3.2 MM	(16	102	95)
105			10.6 MICRON	(16	102	95)
106			VISIBLE	(16	102	95)
107	29	12	3.2 MM	(16	78	45)
108			10.6 MICRON	(16	78	45)
109			VISIBLE	(16	78	45)
110	29	13	3.2 MM	(16	138	56)
111			10.6 MICRON	(16	138	56)
112			VISIBLE	(16	138	56)
113	29	14	3.2 MM	(16	129	62)
114			10.6 MICRON	(16	129	62)
115			VISIBLE	(16	129	62)
116	29	15	3.2 MM	(16	63	36)
117			10.6 MICRON	(16	63	36)
118			VISIBLE	(16	63	36)
119	29	16	3.2 MM	(16	81	36)
120			10.6 MICRON	(16	81	36)
121			VISIBLE	(16	81	36)
122	29	17	3.2 MM	(16	142	42)
123			10.6 MICRON	(16	132	42)
124			VISIBLE	(16	132	42)
125	29	18	3.2 MM	(16	81	49)
126			10.6 MICRON	(16	81	49)
127			VISIBLE	(16	81	49)
128	29	19	3.2 MM	(16	84	48)
129			10.6 MICRON	(16	84	48)
130			VISIBLE	(16	84	48)
131	29	20	3.2 MM	(16	75	48)
132			10.6 MICRON	(16	75	48)
133			VISIBLE	(16	75	48)
134	29	21	3.2 MM	(16	75	48)
135			10.6 MICRON	(16	75	48)
136			VISIBLE	(16	75	48)

SCAN 06 OF TAPE 28 AND SCAN 10 OF TAPE 29
DID NOT CONTAIN ANY DATA.

(c)

Figure 6. (Concluded).

BEST AVAILABLE COPY

IV. DATA PROCESSING

The digital records have 4096 gray levels available; no image display can provide such a large dynamic range. It is therefore necessary to process the digital data before creating a visual record. One of the most straightforward methods of converting the digital data to useable gray scale values is to perform a linear mapping of the form:

$$I(\text{display}) = 256 \left(\frac{I_o - I_{\min}}{I_{\max} - I_{\min}} \right) . \quad (4)$$

This simple mapping function is shown graphically in Figure 7. It converts the 12-bit digital data to 8-bit gray scale data and was used to create all of the images shown in this report.

Mapping of one image intensity into a new image intensity, independent of position, is called point processing. Point processing is one of a number of digital image processing techniques which can be used to provide the viewer with information or insight about the image [13]. The sole purpose of the point processing function shown in Figure 7 was to provide a visual record of the data file. Follow-on work will examine the usefulness of more complicated digital image enhancement techniques.

V. DATA DISPLAY

During a scan, a composite image was produced in the radar van by exposing a polaroid film to an oscilloscope trace whose x and y deflections are associated with the AZ/EL scan and whose z-axis modulation is associated with signals from the three sensors. An example of such a composite image is shown in Figure 8. The images from the top to bottom are associated with the 10.6- μm , visible, and 3.2-mm sensors, respectively. These composite displays provide the operator with evidence that a successful scan has been completed but very little information about the quality of the images is provided by this crude display.

Once the data have been obtained and a final data tape created, digital image processing can be used to provide images for any display. Figure 9a shows the easiest display to implement. The digital image data were mapped onto the integers from 0 to 2 and a line printer was used to generate the image. Another simple method for generating visual images utilizing equipment available in most laboratories is shown in Figure 9b. A Versatec Matrix Model 1200A is used to print, in binary format, an image with eight grey levels.

There are several types of display devices available which can provide high quality images from digital data. Figure 10 shows images produced by two such devices. On the left of Figure 10 is a composite

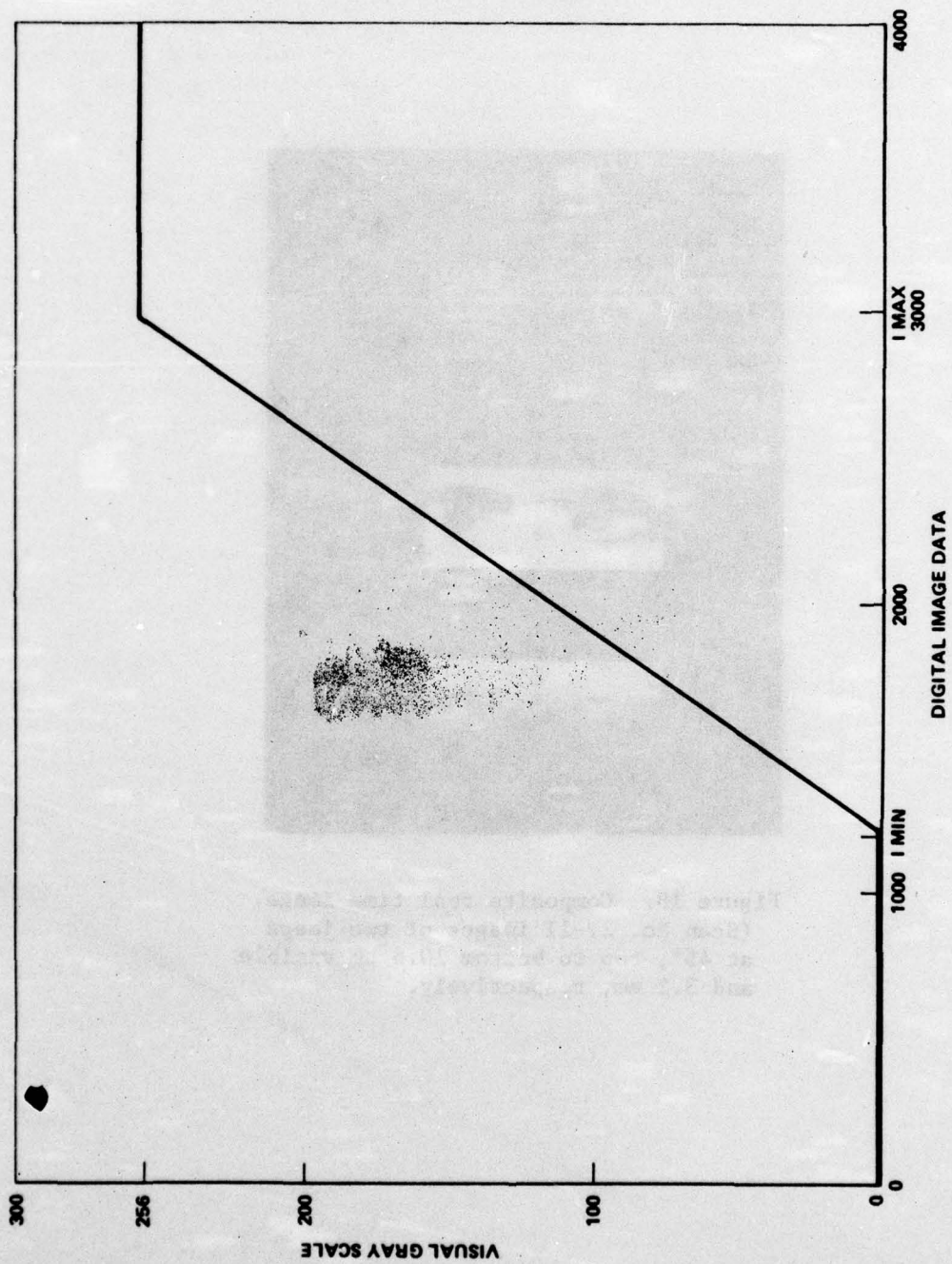


Figure 7. Linear mapping used for point processing.



Figure 18. Composite real time image.
(Scan No. 27-11 images of two jeeps
at 45°, top to bottom 10.6 μ m visible
and 3.2 mm, respectively.)

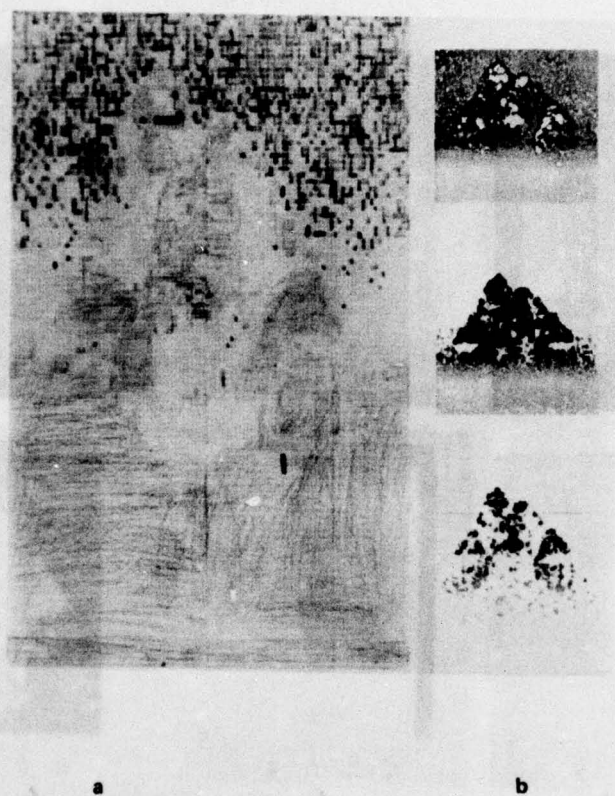


Figure 9. Image file No. 14 produces on line printer (a). The numbers 0 and 2 have been shaded with a colored pencil to enhance the contrast. Three printouts (b) of image file No. 14 using a versatec plotter and three different point processing functions.

EFFECTS OF DISPLAY

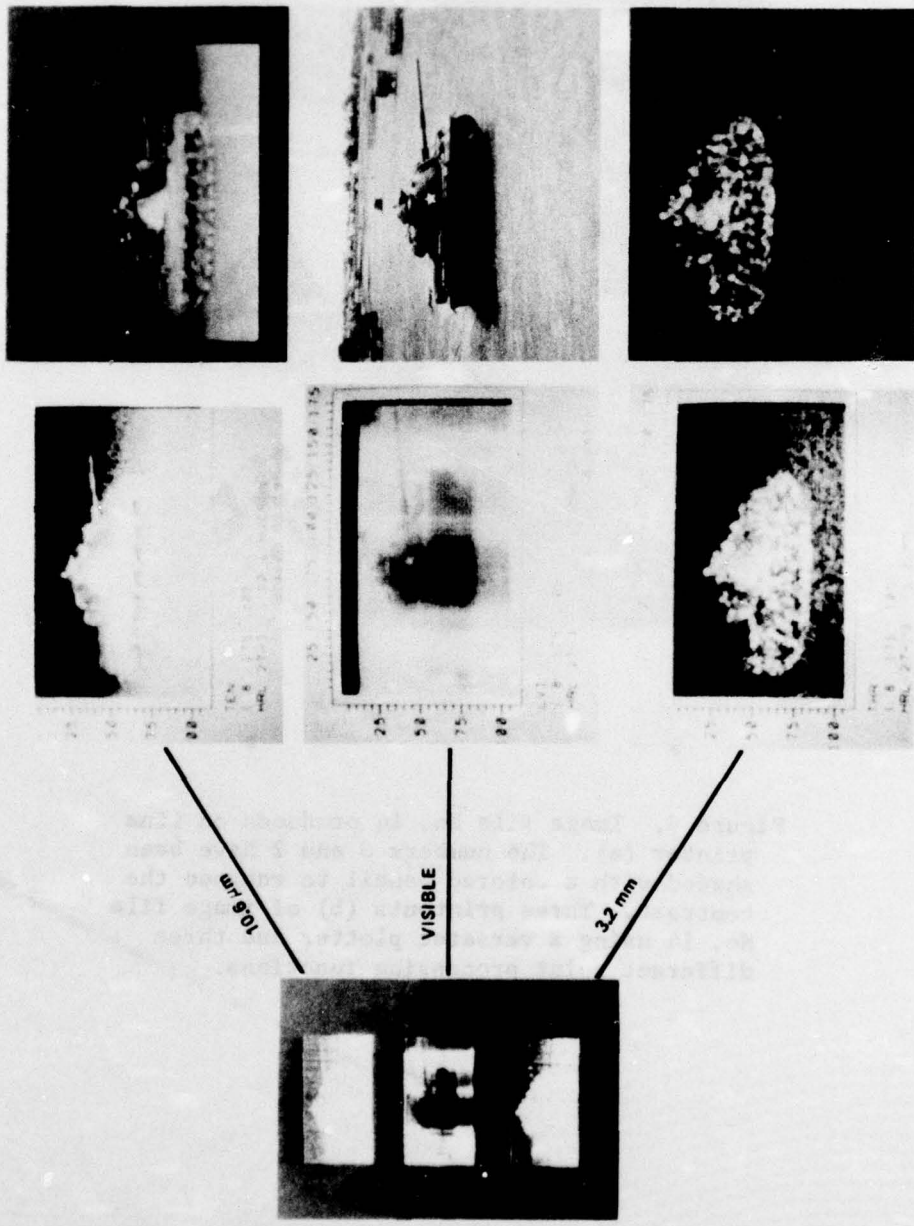


Figure 10. Comparison of image display devices.

image produced during a scan in real time. The center column of images contains photographs of a Conographics Model C9 gray level cathode ray tube (CRT) computer terminal which is capable of displaying up to 256 gray levels in a 1024 by 1024 pixel image. The photographs are a poor representation of the actual images because the film does not have the dynamic range of the display; nor is the film response matched to the display.

The highest quality hard copy images were produced by a flying spot scanner with matched photographic equipment. These images are shown in the right-hand column of Figure 11. The visible image is a normal photograph included for reference.

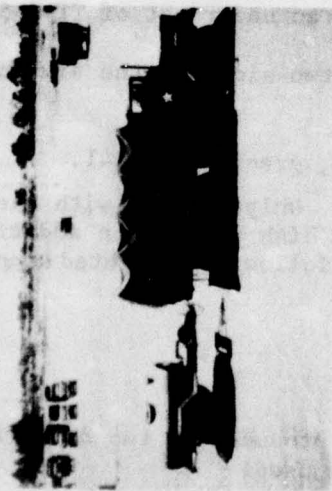
VI. TARGETS

The targets used to generate the images on the data tape are shown in Figure 10. The mess truck and trailer are a mobile kitchen and supply trailer constructed from plywood on a standard Army truck bed. The paint samples used in this experiment were made according to MIL specification of 1.5-ft aluminum squares. The top coats used were:

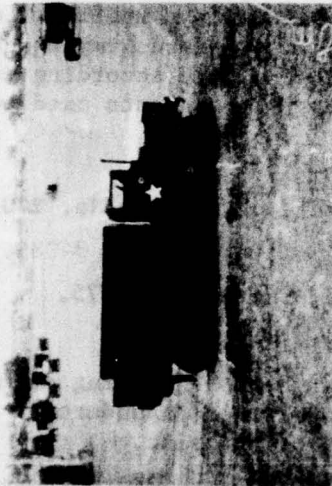
- a) TT-E-489 gloss enamel, black No. 17038.
- b) MIL-E-52227 semigloss enamel, olive drab No. 24037.
- c) TT-E-527 lusterless enamel, olive drab No. 34087.
- d) TT-E-516 lusterless enamel, white No. 37875.
- e) TT-E-489 gloss enamel, black No. 17038.
- f) MIL-E-46136 semigloss solar heat reflecting enamel, Type II, olive drab No. 24087 over an undercoat of MIL-E-46127 gray solar heat reflecting paint.
- g) MIL-E-46096 lusterless solar heat reflecting enamel, olive drab No. 34087 over an undercoat of TT-E-516.

Different primers were used on the two sides of the aluminum plates, as follows:

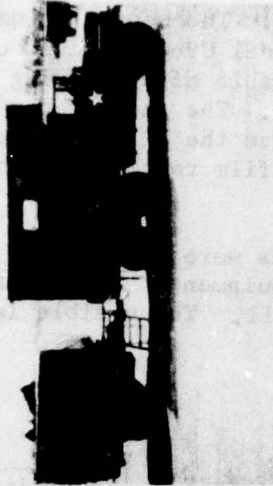
- a) TT-P-1757 zinc chromate primer, green No. 34141.
- b) MIL-P-52192 epoxy primer, red. Only samples with the first undercoat were measured due to high winds. In addition to the painted samples, scans over the following unpainted samples were made:
 - 1) Plywood behind canvas.
 - 2) Aluminum behind canvas.
 - 3) Galvanized steel samples produced by two different types of surface treatment were used.



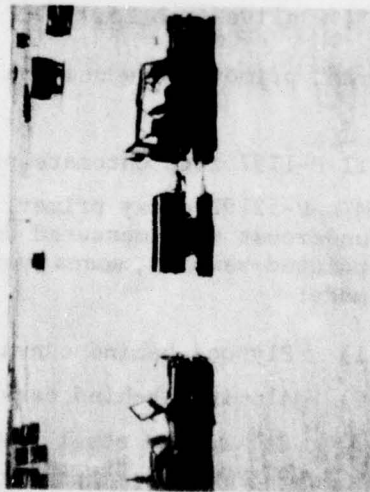
CANVAS TRUCK WITH WATER TANK



OPEN TRUCK



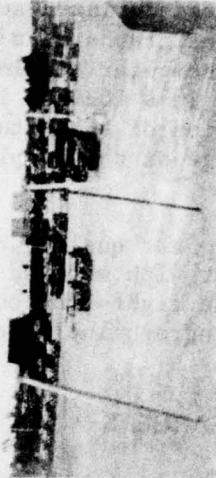
MESS TRUCK AND TRAILER
(PLYWOOD SIDES)



JEEPS AND TRAILER



M-48 TANK



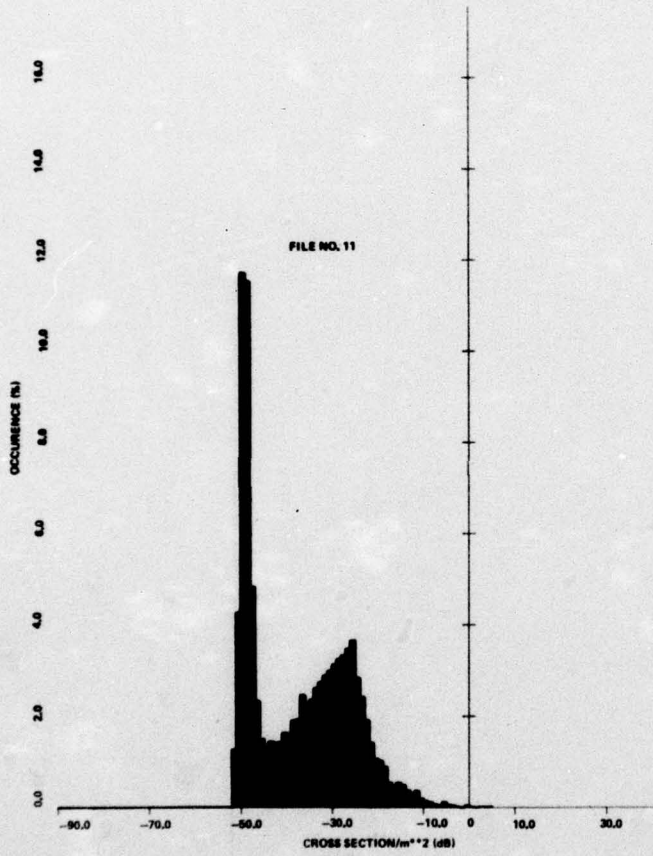
PAINT AND METAL SAMPLES

Figure 11. Targets.

- 4) 304 stainless steel.
- 5) 410 stainless steel.
- 6) Unpainted aluminum.

Appendix A provides detailed information about the contents of the 3.2-mm and 10.6- μ m files recorded on the data tape. A photograph of the target is included with the other information. The histograms of reflectivity values provided with each file present graphically the information content of the image contained in a given dynamic range. They also provide the information needed to perform certain types of processing.

The histograms, when used in conjunction with a program such as BIWT (Appendix B), provide information about the spatial origin of given reflectivity values. Figure 12 demonstrates the implementation of this "intensity dissection" of an image. Figure 12a is from file No. 11 and is a 3.2-mm image of a tank taken with the transmit and receive antennas parallel polarized. Figure 12b is from file No. 98 and is identical to Figure 12a except that the transmit and receive antennas are cross polarized. Figure 12c is the 10.6- μ m image of the same target and is from file No. 12.



FILE # 11
 MAX RCS = .000 ABOVE MAX RCS = .000
 MIN RCS = -10.00
 RCS = -10.00 REMOVED

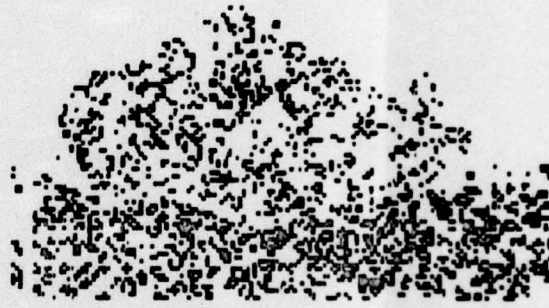
FILE # 11
 MAX RCS = -10.00 ABOVE MAX RCS = -10.00
 MIN RCS = -20.00
 RCS = -20.00 REMOVED

-10 ≤ I

FILE # 11
 MAX RCS = -20.00 ABOVE MAX RCS = -20.00
 MIN RCS = -30.00
 RCS = -30.00 REMOVED

-20 ≤ I ≤ -10

FILE # 11
 MAX RCS = -30.00 ABOVE MAX RCS = -30.00
 MIN RCS = -40.00
 RCS = -40.00 REMOVED

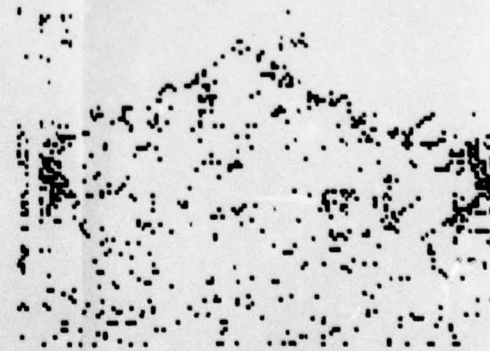


-30 ≤ I ≤ -25



-35 ≤ I ≤ -30

FILE # 11
 MAX RCS = -40.00 ABOVE MAX RCS = -40.00
 MIN RCS = -50.00
 RCS = -50.00 REMOVED



-45 ≤ I ≤ -40

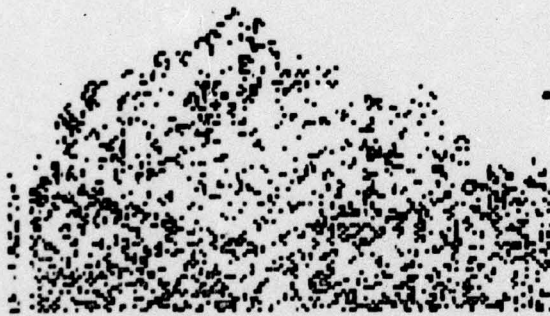
Figure 12a. Intensity dissection of

FILE * 11
MAX RCB * -10.00 ABOVE MAX RCB * -20.00
MIN RCB * -20.00
RCB * -20.00 REMOVED



-20 ≤ I ≤ -10

FILE * 11
MAX RCB * -20.00 ABOVE MAX RCB * -30.00
MIN RCB * -30.00
RCB * -30.00 REMOVED



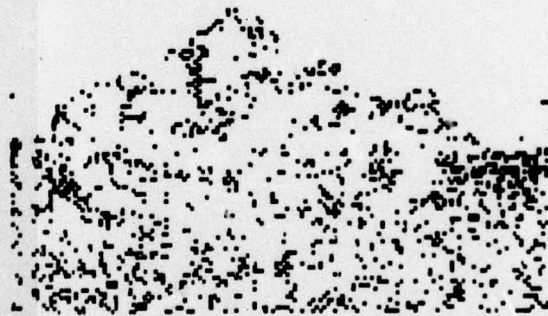
-35 ≤ I ≤ -30

FILE * 11
MAX RCB * -20.00 ABOVE MAX RCB * -30.00
MIN RCB * -30.00
RCB * -30.00 REMOVED



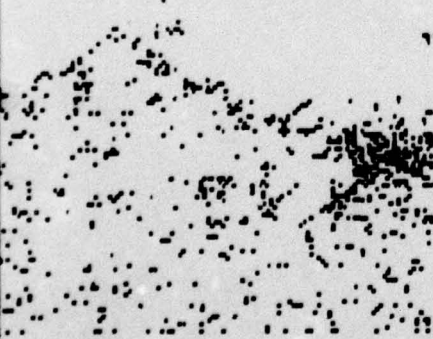
-25 ≤ I ≤ -20

FILE * 11
MAX RCB * -30.00 ABOVE MAX RCB * -40.00
MIN RCB * -40.00
RCB * -40.00 REMOVED



-40 ≤ I ≤ -35

FILE * 11
MAX RCB * -40.00 ABOVE MAX RCB * -50.00
MIN RCB * -50.00
RCB * -50.00 REMOVED



I ≤ -40

FILE * 11
MAX RCB * -50.00 ABOVE MAX RCB * -60.00
MIN RCB * -60.00
RCB * -60.00 REMOVED



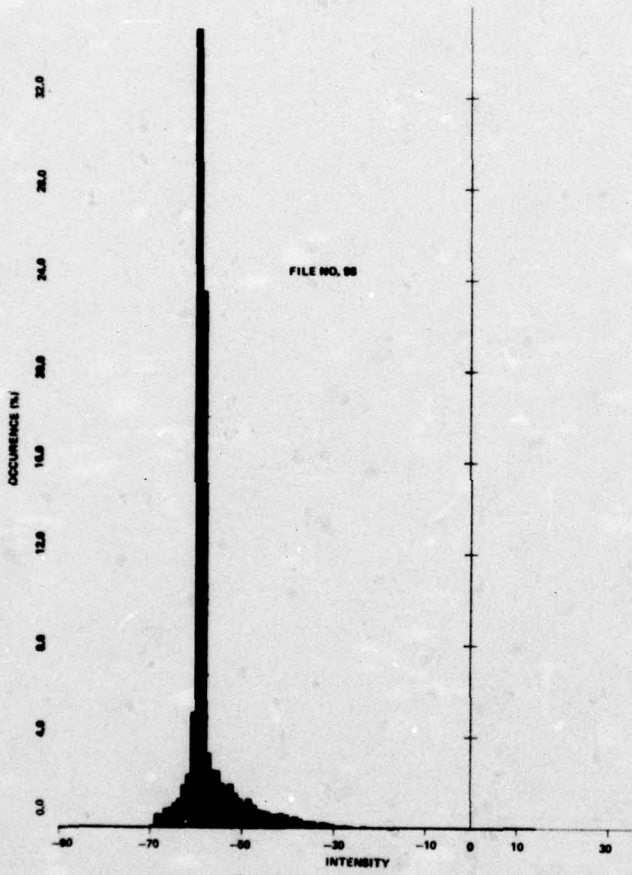
I ≤ -45

Intensity dissection of image.

2

FILE # 98
MAX RCB = -50.00 ABOVE MAX RCB = -50.00
MIN RCB = -50.00
RCB = -50.00 REMOVED

FILE # 98
MAX RCB = -50.00
MIN RCB = -50.00
RCB = -50.00



$-35 \leq I$

FILE # 98
MAX RCB = -50.00 ABOVE MAX RCB = -50.00
MIN RCB = -50.00
RCB = -50.00 REMOVED

$-40 \leq I$

FILE # 98
MAX RCB = -50.00
MIN RCB = -50.00
RCB = -50.00

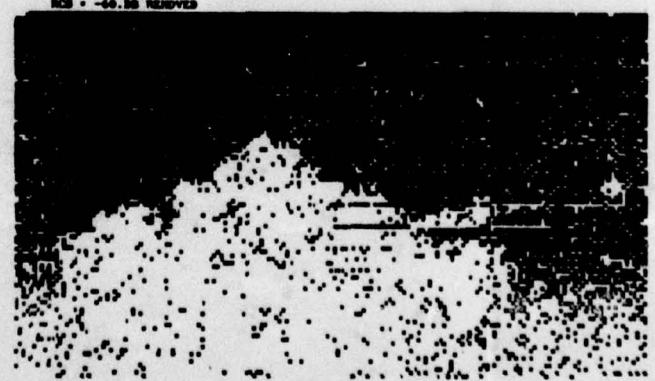


$-50 \leq I \leq -45$

FILE # 98
MAX RCB = -50.00 ABOVE MAX RCB = -50.00
MIN RCB = -50.00
RCB = -50.00 REMOVED

$-55 \leq I \leq -50$

FILE # 98
MAX RCB = -50.00
MIN RCB = -50.00
RCB = -50.00



$-60 \leq I \leq -58$

$-62 \leq I \leq -60$

Figure 12b. Intensity dissec

FILE * * 90
MAX RCB * -90.00 ABOVE MAX RCB * -90.00
MIN RCB * -90.00
RCB * -90.00 REMOVED



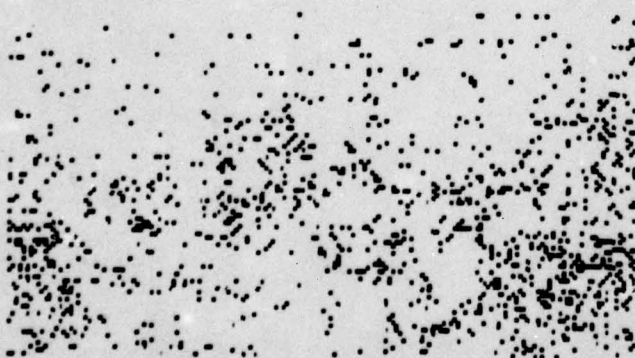
-40 ≤ I ≤ -35

FILE * * 90
MAX RCB * -90.00 ABOVE MAX RCB * -90.00
MIN RCB * -90.00
RCB * -90.00 REMOVED



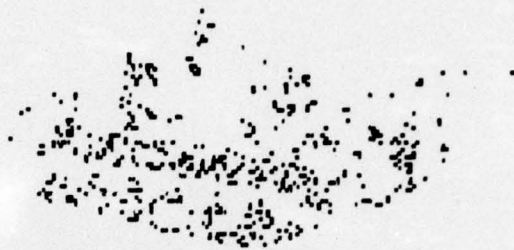
-55 ≤ I ≤ -50

FILE * * 90
MAX RCB * -90.00 ABOVE MAX RCB * -90.00
MIN RCB * -90.00
RCB * -90.00 REMOVED



-62 ≤ I ≤ -60

FILE * * 90
MAX RCB * -90.00 ABOVE MAX RCB * -90.00
MIN RCB * -90.00
RCB * -90.00 REMOVED



-45 ≤ I ≤ -40

FILE * * 90
MAX RCB * -90.00 ABOVE MAX RCB * -90.00
MIN RCB * -90.00
RCB * -90.00 REMOVED



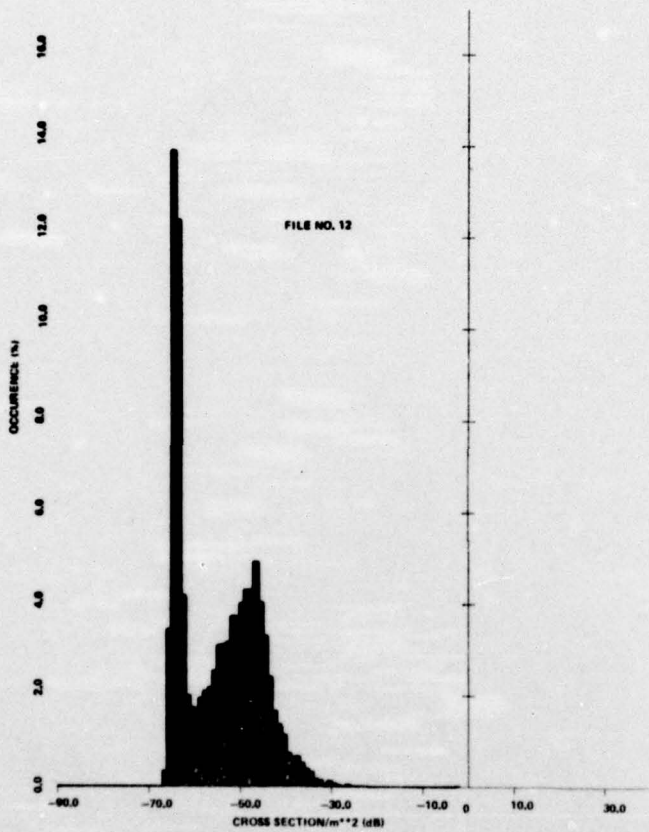
-58 ≤ I ≤ -55

FILE * * 90
MAX RCB * -90.00 ABOVE MAX RCB * -90.00
MIN RCB * -90.00
RCB * -90.00 REMOVED



I ≤ -62

12b. Intensity dissection of image.



FILE * * 12
 MAX RCB * -99.00 ABOVE MAX RCB * -99.00
 MIN RCB * -99.00
 RCB * -99.00 REMOVED



-33 ≤ I

FILE * * 12
 MAX RCB * -99.00 ABOVE MAX RCB * -99.00
 MIN RCB * -99.00
 RCB * -99.00 REMOVED



-40 ≤ I ≤ -35

FILE * * 12
 MAX RCB * -99.00 ABOVE MAX RCB * -99.00
 MIN RCB * -99.00
 RCB * -99.00 REMOVED



-50 ≤ I ≤ -45

Figure 12c. Intensity dessection of image.

FILE # 12
MAX NCR - 00.00 ABOVE MAX NCR - 00.00
MIN NCR - 00.00
NCR - 00.00 REMOVED

FILE # 12
MAX NCR - 00.00 ABOVE MAX NCR - 00.00
MIN NCR - 00.00
NCR - 00.00 REMOVED

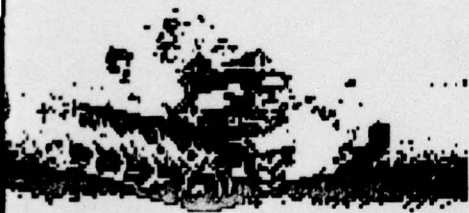


-33 ≤ I

-35 ≤ I ≤ -33

FILE # 12
MAX NCR - 00.00 ABOVE MAX NCR - 00.00
MIN NCR - 00.00
NCR - 00.00 REMOVED

FILE # 12
MAX NCR - 00.00 ABOVE MAX NCR - 00.00
MIN NCR - 00.00
NCR - 00.00 REMOVED



-40 ≤ I ≤ -35

-45 ≤ I ≤ -40

FILE # 12
MAX NCR - 00.00 ABOVE MAX NCR - 00.00
MIN NCR - 00.00
NCR - 00.00 REMOVED

FILE # 12
MAX NCR - 00.00 ABOVE MAX NCR - 00.00
MIN NCR - 00.00
NCR - 00.00 REMOVED



-50 ≤ I ≤ -45

I ≤ -50

Intensity dessection of image.

REFERENCES

1. Kruse, P. W., A System Enabling the Army to See Through Inclement Weather, Army Scientific Advisory Panel Report, June 1974.
2. Kruse, P. W. and Garber, V., "Technology for Battlefield Target Recognition in Inclement Weather," Proc. IRIS (23), (In the process of publication).
3. Hartman, R. L., and Kruse, P. W., "Submillimeter System for Imaging Through Inclement Weather," Second International Conference and Winter School on Submillimeter Waves and Their Applications, San Juan, Puerto Rico, December 6-10, 1976.
4. Hartman, R. L., Gambal, W. L., Guenther, B. D., and Kruse, P. W., "Submillimeter System for Imaging Through Inclement Weather," ODDR&E Optical/Submillimeter Atmospheric Propagation Workshop, December 6-10, 1976.
5. Army Scientific Advisory Panel Summer Study '76, Volume 3, September 1976.
6. Gamble, W. L. and Guenther, B. D., "Submillimeter Wave Propagation-A Survey," ODDR&E Optical/Submillimeter Atmospheric Propagation Workshop, December 6-10, 1976.
7. Guenther, B. D., Submillimeter Wave Research: A Propagation Bibliography, US Army Missile Research, Development & Engineering Laboratory, Redstone Arsenal, Alabama, November 1976, Report No. RR-77-3.
8. Gamble, W. L. and Guenther, B. D., "Submillimeter Laser Wave Propagation," Second International Conference and Winter School on Submillimeter Waves and Their Applications, San Juan, Puerto Rico December 6-10, 1976.
9. Baird, J. M., "Millimeter and Infrared Image Scans of Military Vehicles," Hughes Research Laboratories, August 1976, Contract No. F-30602-73-C-0191.
10. Skolnik, M. I. Introduction to Radar Systems, New York: McGraw-Hill Book Company, 1960, p. 40.
11. Kozma, A. and Christensen, C. R., "The Effects of Speckle on Resolution," J. Opt. Soc. Am., Volume 66, 1976, pp. 1257-1260.

12. George, N., Christensen, C. R., Bennett, J. S., and Guenther, B. D., "Speckle Noise in Displays," J. Opt. Soc. AM., Volume 66, pp. 1282-1290.
13. Andrews, H. C., "Monochrome Digital Image Enhancement," Applied Optics, Volume 15, 1976, pp. 495-503.

Appendix A. INDEX OF DATA TAPE

In the data index which follows, information will be provided to aid the user in selecting image data for evaluation:

- 1) A photograph of the target and its location with respect to the scanner.
- 2) A composite image obtained during the scan.
- 3) Calibration voltages and additional comments.
- 4) Histograms of the 3.2-mm and 10.6- μ m data files and images produced using the digital data.

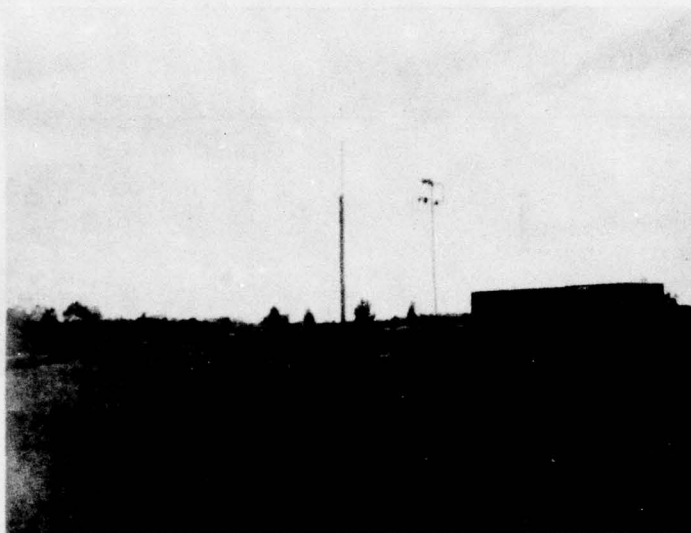
A summary of scans by target type is provided in Table A-1.

Target Type	Scan No.	3.2-mm Data File	10.6- μ m Data File	Notes
Target 1	1	101	101	
	2	102	102	
	3	103	103	
	4	104	104	
	5	105	105	
Target 2	6	201	201	
	7	202	202	
	8	203	203	
	9	204	204	
	10	205	205	
Target 3	11	301	301	
	12	302	302	
	13	303	303	
	14	304	304	
	15	305	305	
Target 4	16	401	401	
	17	402	402	
	18	403	403	
	19	404	404	
	20	405	405	

TABLE A-1. LIST OF THE TARGETS SCANS TAKEN

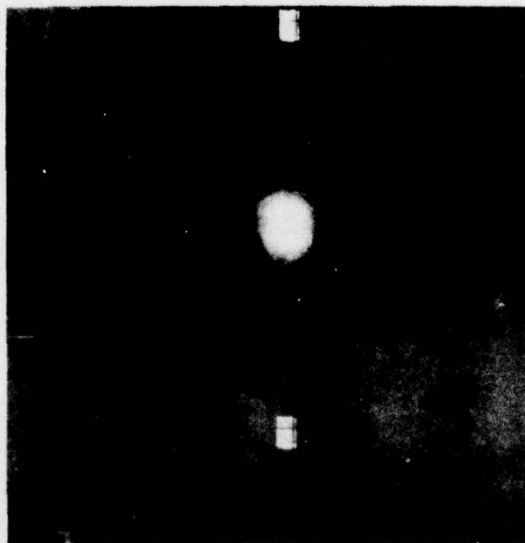
Target	Angle of View	3.2-mm Polarization*	Range (ft)	Tape and Scan No.	Notes
2-in. Ball	—	HH	51.5	27-1 and 2	
M48A5 Tank	Side 45° Head Back Head Side 45° Back Side Side Side Side	HH HH HH HH VH VH VH VH VH HH HH HH	50 50 50 50 50 50 50 50 100 100 200 400	27-3 27-4 27-5 27-6 and 8 29-2 29-7 29-8 29-11 29-13 29-14 29-21 29-15 to 19	Scanned after dark Light rain
2-1/2 Ton Truck with Canvas Top	Front Back 45° Side Side Head Back Side Side Side Side	HH HH HH VH VH VH VH HH HH HH	50 50 50 50 50 50 100 100 200 400	28-5 28-4 28-3 29-5 29-9 29-12 29-13 29-14 29-21 29-15 to 19,20	Two vehicles in one scan Includes water trailer Includes water trailer Includes water trailer, after dark Dark overcast
Jeeps with and without Rubberized Canvas	Head Back 45° Side Side 45° Front Back Side Side Side	HH HH HH HH VH VH VH VH HH HH HH	50 50 50 50 50 50 50 100 100 400	27-9 27-10 27-11 27-12 29-1 29-3 29-4 29-13 29-14 29-15 to 19	Includes trailer One jeep with trailer One jeep with trailer, after dark Two jeeps with trailer, after dark
Jeep with Enclosed Cab	Side	HH	50	28-1	
2-1/2 Ton Truck with Wooden Side Rails	Side Side	HH VH	50 50	28-12 29-6	Rain After dark
2-1/2 Ton Field Kitchen with Trailer	Side	HH	50	28-14	Wooden enclosure on truck
Target panels (1.5 ft square)	Normal Normal Normal 20°	HH HH HH HH	50 50 50 50	28-7 28-8 28-10 28-11 28-13	Six bare metal panels, night Six bare metal panels, rain, double density data Seven painted panels, rain, double density data Seven painted panels, rain, normal density data Seven painted panels
NOTE: The following files are either partial scans or scans that are suspect due to temporary equipment problems.					
Tank 2-1/2 Ton Truck Unknown Target Tank Test Panels	Back Side Back Normal	HH HH VH HH	50 50 50 50	27-7 28-2 28-6 29-10 28-9	Not supplied on data tape Not supplied on data tape Rain
* HH = Horizontal-Horizontal (parallel polarization) HV = Horizontal-Vertical (cross polarization)					

SCAN NO. 27-01 AND 27-02



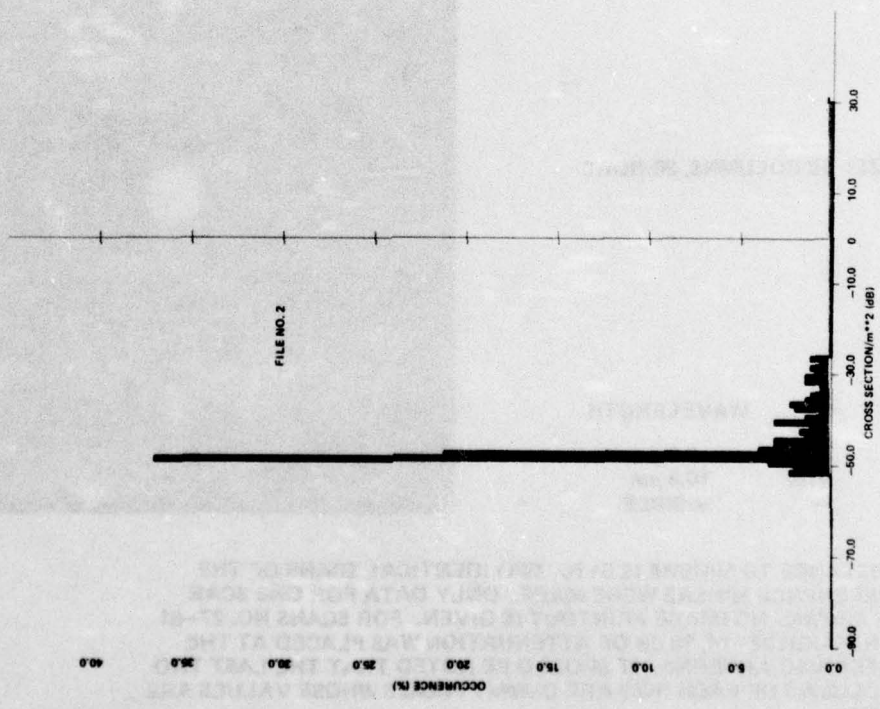
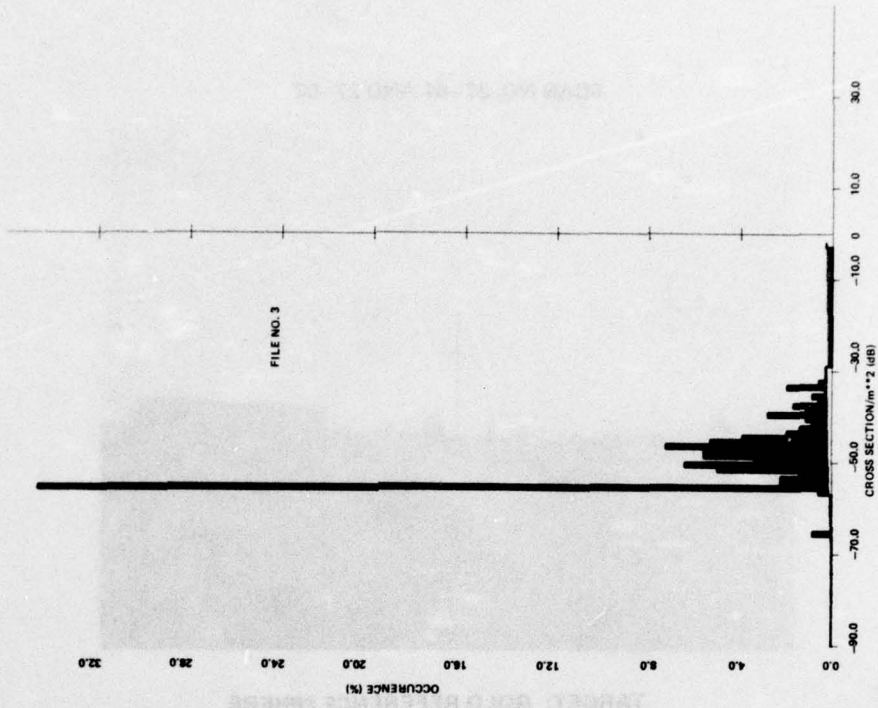
TARGET: GOLD REFERENCE SPHERE

IMAGE SIZE: 18 COLUMNS, 20 ROWS



FILE NO.	V_s	WAVELENGTH
2.5	3.57	3.2 mm
3.6	7.34	10.6 μm
4.7	-	VISIBLE

NOTE: DISTANCE TO SPHERE IS 51 ft. TWO IDENTICAL SCANS OF THE REFERENCE SPHERE WERE MADE. ONLY DATA FOR ONE SCAN IS SHOWN. NO IMAGE PRINTOUT IS GIVEN. FOR SCANS NO. 27-01 THROUGH 28-14, 10 dB OF ATTENUATION WAS PLACED AT THE RECEIVER ANTENNA. IT SHOULD BE NOTED THAT THE LAST TWO COLUMNS OF EACH ROW ARE DUMMY PIXELS WHOSE VALUES ARE ZERO.



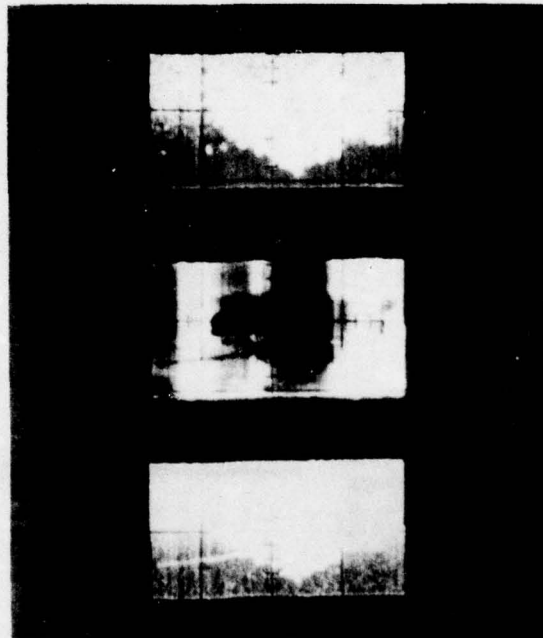
SCAN NO. 27-03



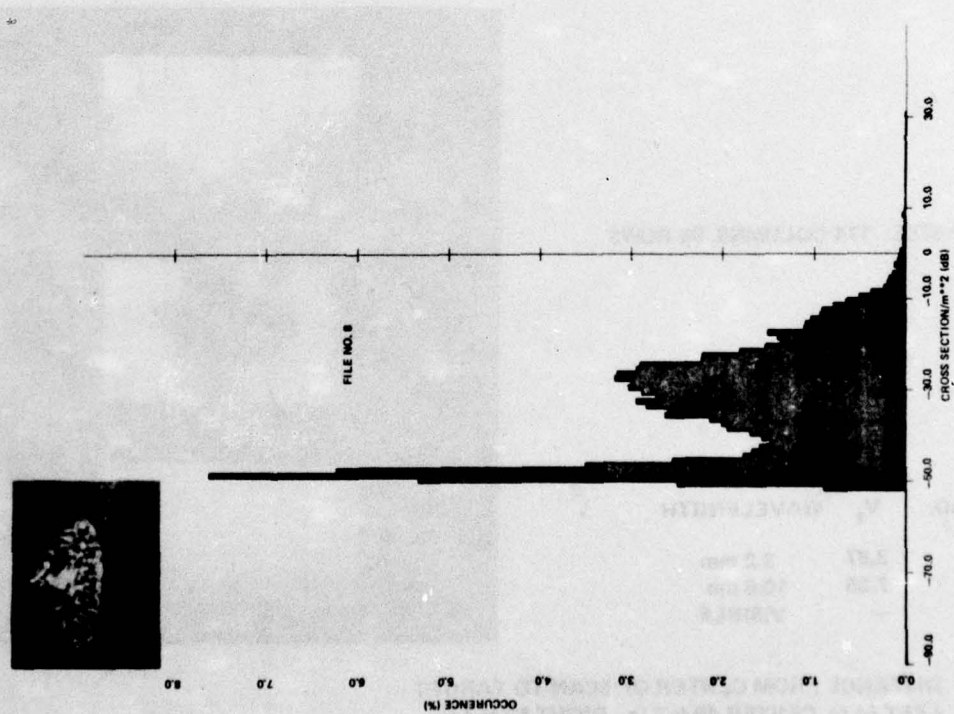
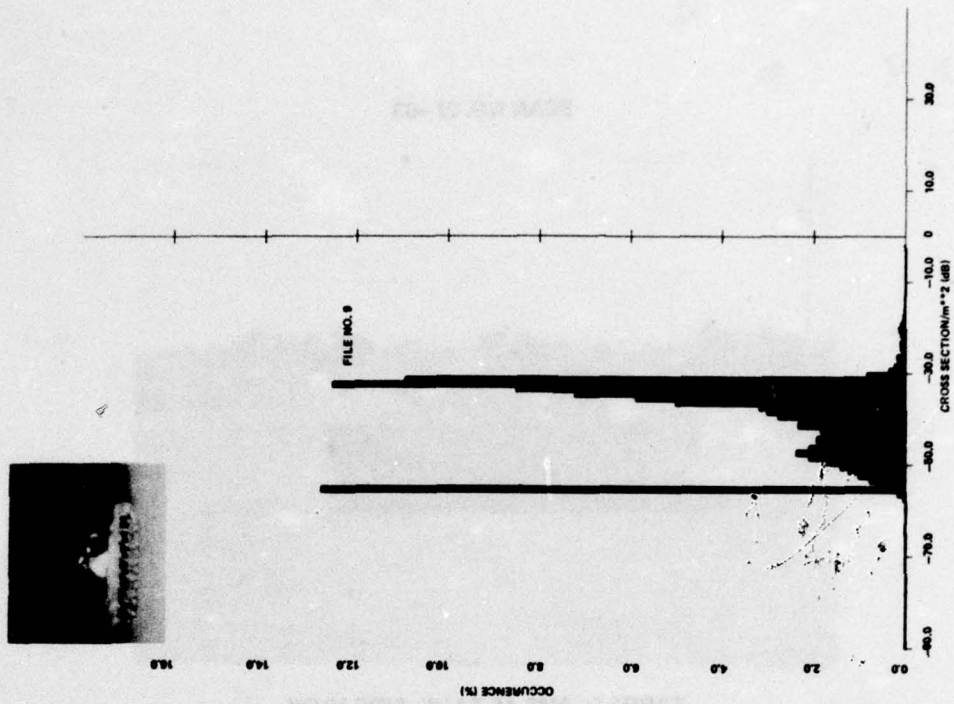
TARGET: M48 A5 TANK, SIDE VIEW

IMAGE SIZE: 174 COLUMNS, 96 ROWS

FILE NO.	V _s	WAVELENGTH
8	3.57	3.2 mm
9	7.35	10.6 μm
10	-	VISIBLE



NOTE: DISTANCE FROM CENTER OF SCAN TO TARGET
LEFT 51 ft CENTER 49 ft 5 in. RIGHT 50 ft 4 in.
VISIBLE SCAN IS STREAKED DUE TO CLOUDS



SCAN NO. 27-04



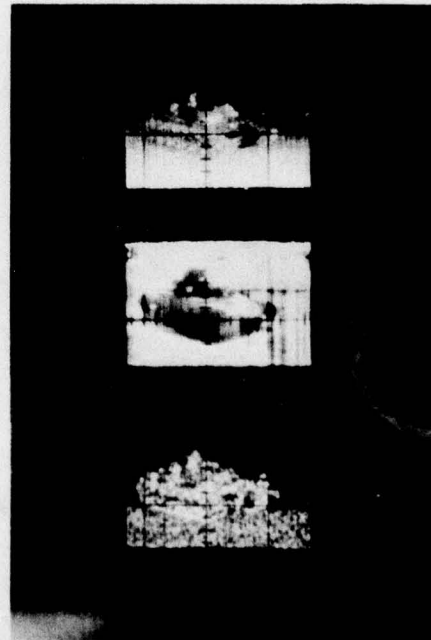
TARGET: M48A5 TANK, 45° VIEW

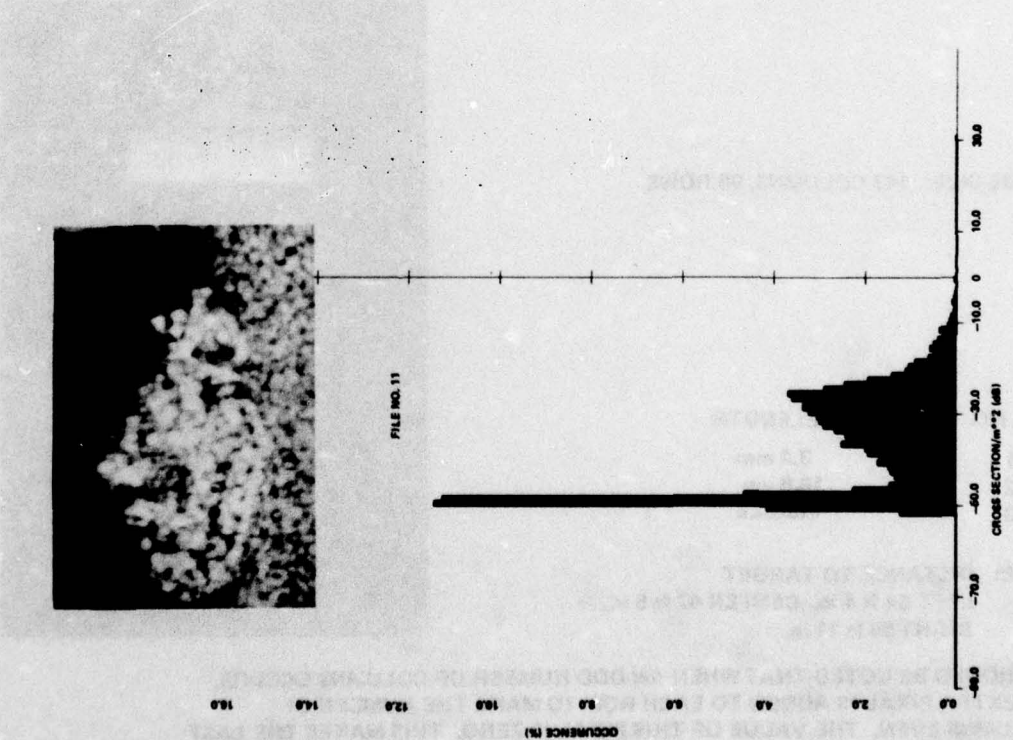
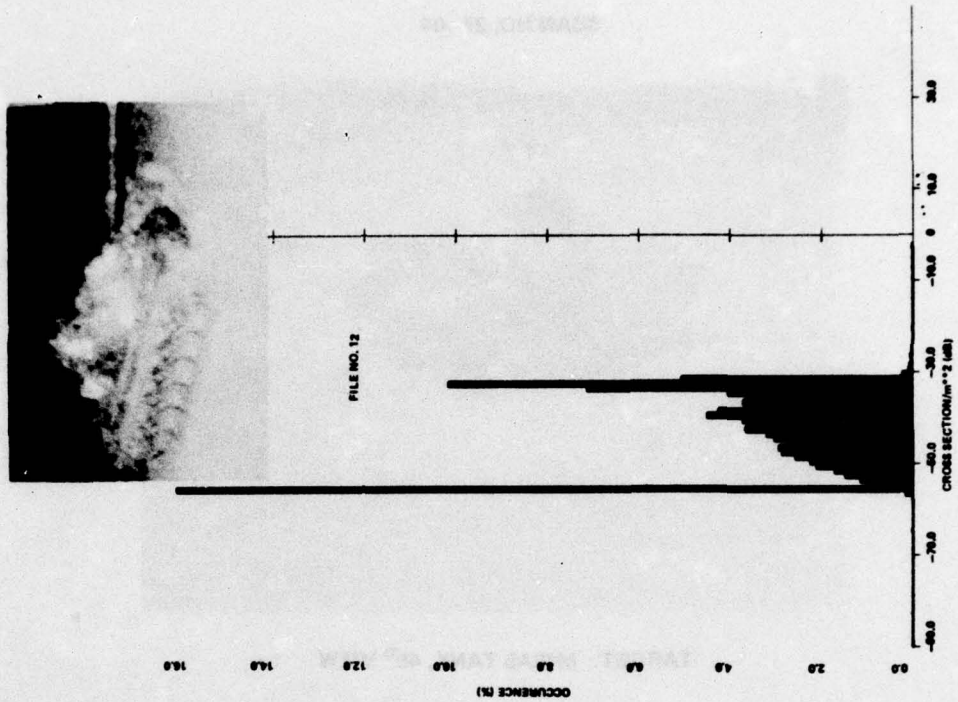
IMAGE SIZE: 147 COLUMNS, 98 ROWS

FILE NO.	V_s	WAVELENGTH
11	3.6	3.2 mm
12	7.35	10.6 μm
13	-	VISIBLE

NOTE: DISTANCE TO TARGET
LEFT 64 ft 4 in. CENTER 47 ft 5 in..
RIGHT 56 ft 11 in.

IT SHOULD BE NOTED THAT WHEN AN ODD NUMBER OF COLUMNS OCCURS,
AN EXTRA PIXEL IS ADDED TO EACH ROW TO MAKE THE NUMBER OF
COLUMNS EVEN. THE VALUE OF THIS PIXEL IS ZERO. THIS MAKES THE LAST
THREE COLUMNS ZERO.





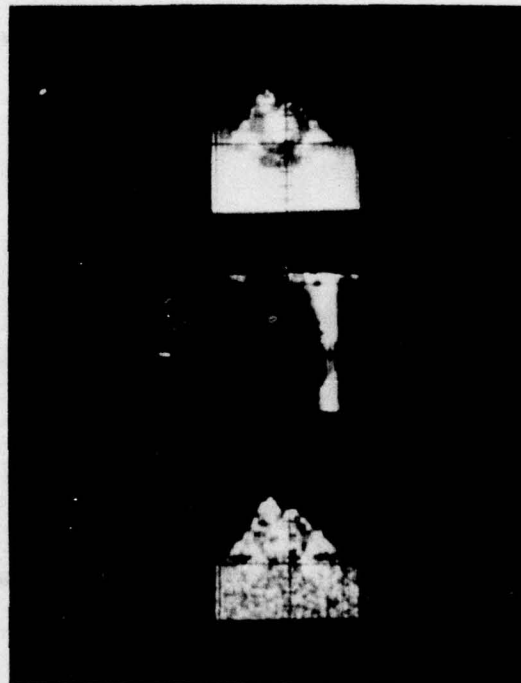
SCAN NO. 27-5



TARGET: M48A5 TANK, HEAD-ON

IMAGE SIZE: 102 COLUMNS, 96 ROWS

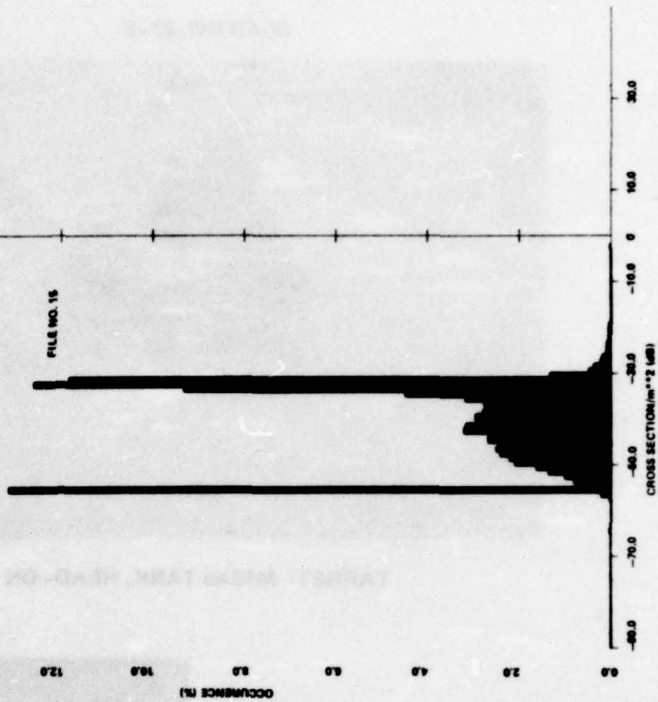
FILE NO.	V_s	WAVELENGTH
14	3.6	3.2 mm
15	7.35	10.6 μm
16		VISIBLE



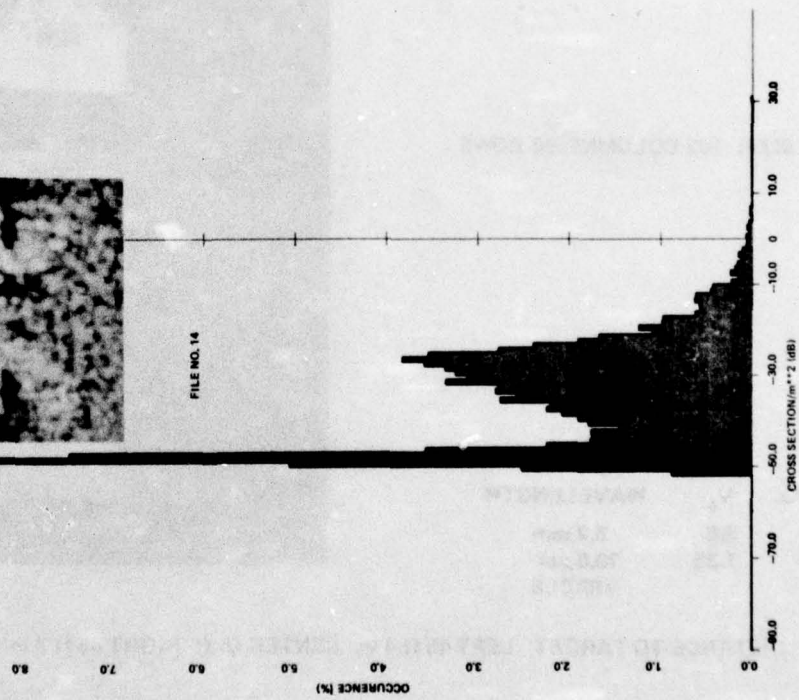
NOTE: DISTANCE TO TARGET LEFT 45 ft 4 in. CENTER 45 ft RIGHT 45 ft 3 in.



FILE NO. 15



FILE NO. 14



BAD DATA

SCAN NO. 27-6

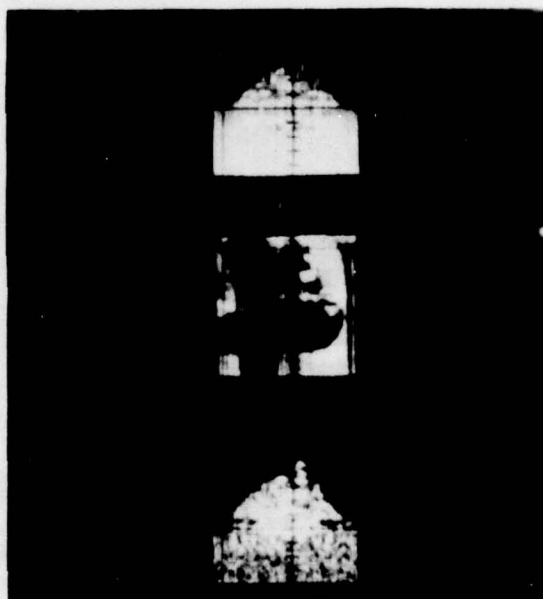
SCAN NO. 27-7



TARGET: M48A5 TANK, REAR VIEW

IMAGE SIZE: 99 COLUMNS, 98 ROWS

FILE NO.	V _s	WAVELENGTH
20	3.6	3.2 mm
21	7.35	10.6 μm
22	-	VISIBLE



NOTE: ANOTHER TANK PASSED BEHIND TARGET DURING THE SCAN. SCAN NO. 27-8 IS A REPEAT OF THIS SCAN AND CAN BE USED FOR SPECKLE AVERAGING.

SCAN NO. 27-8

IMAGE SIZE: 90 COLUMNS, 98 ROWS

A REPEAT OF SCAN NO. 27-7. CALIBRATION VOLTAGES ARE IDENTICAL.

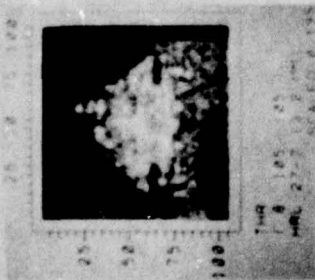
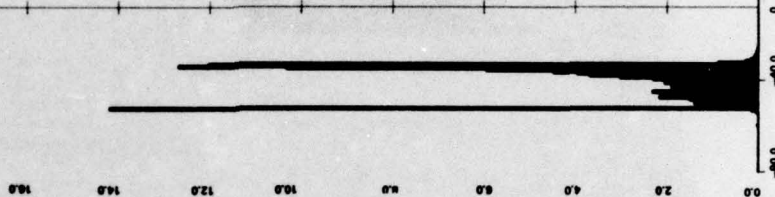
DISTANCE TO TARGET: LEFT 45 ft 1 in. CENTER 45 ft 4 in. RIGHT 45 ft 2 in.



FILE NO. 21
 HRL 27-7 (10.6 μ)
 SCALED 53, 190

OCCURRENCE (%)

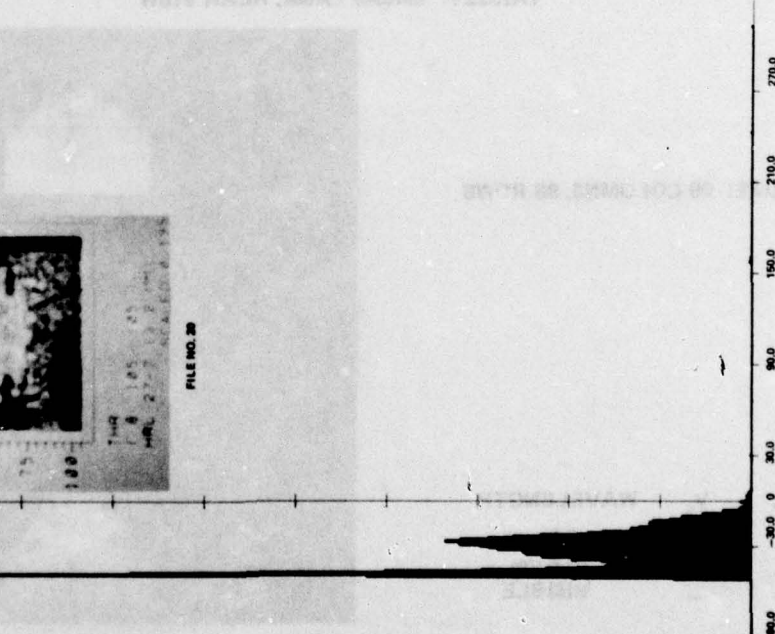
CROSS SECTION/m² (dB)

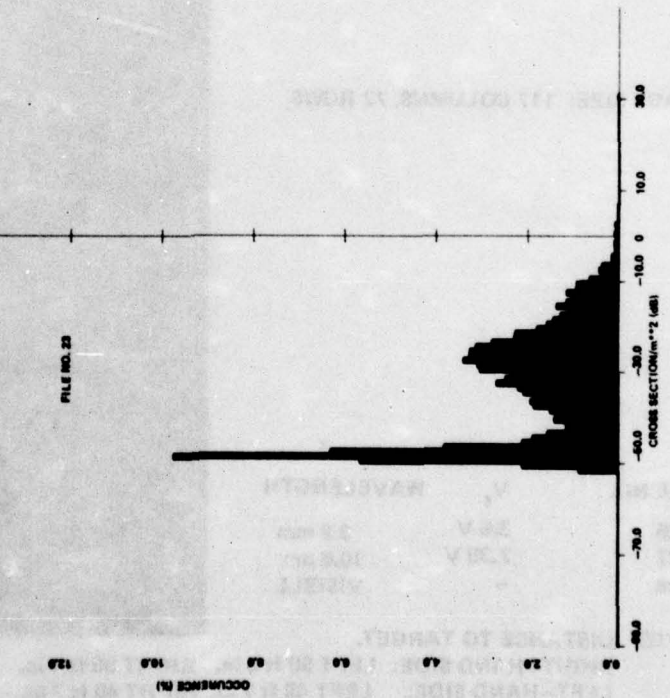
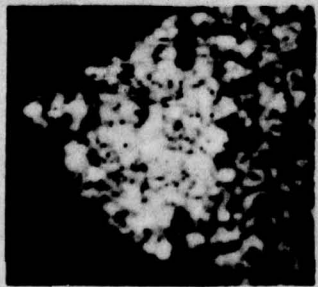
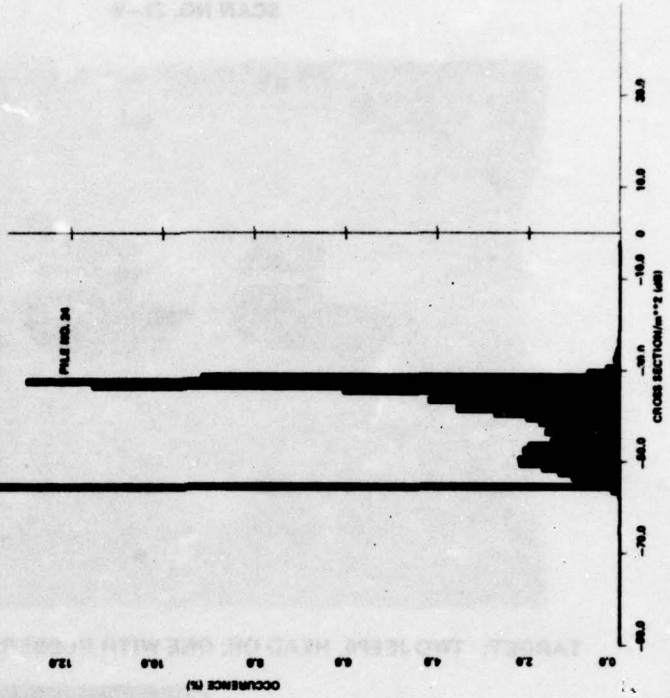
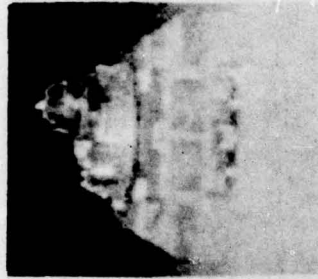


FILE NO. 20

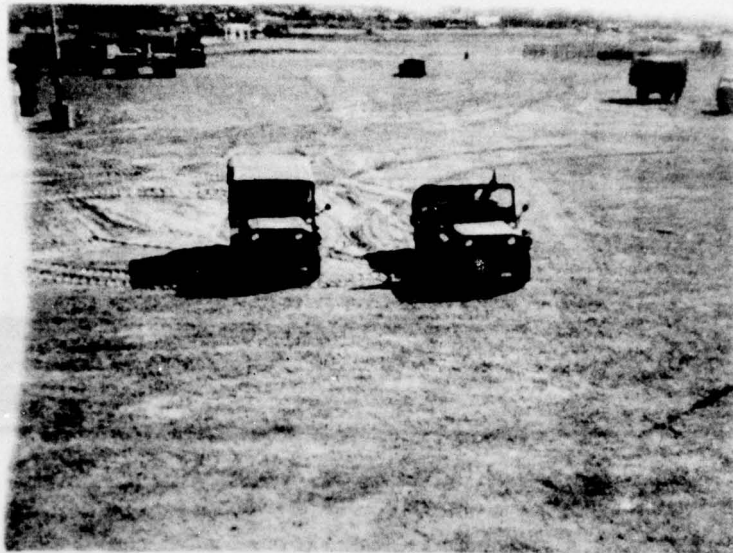
OCCURRENCE (%)

CROSS SECTION/m² (dB)



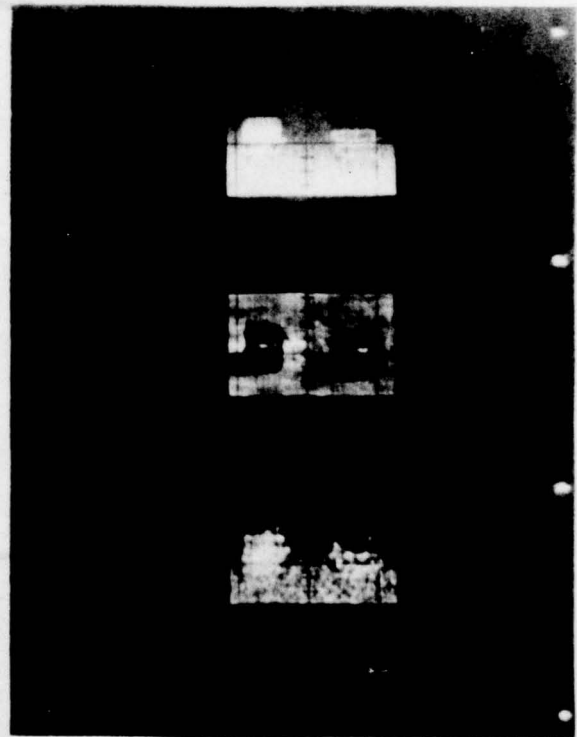


SCAN NO. 27-9



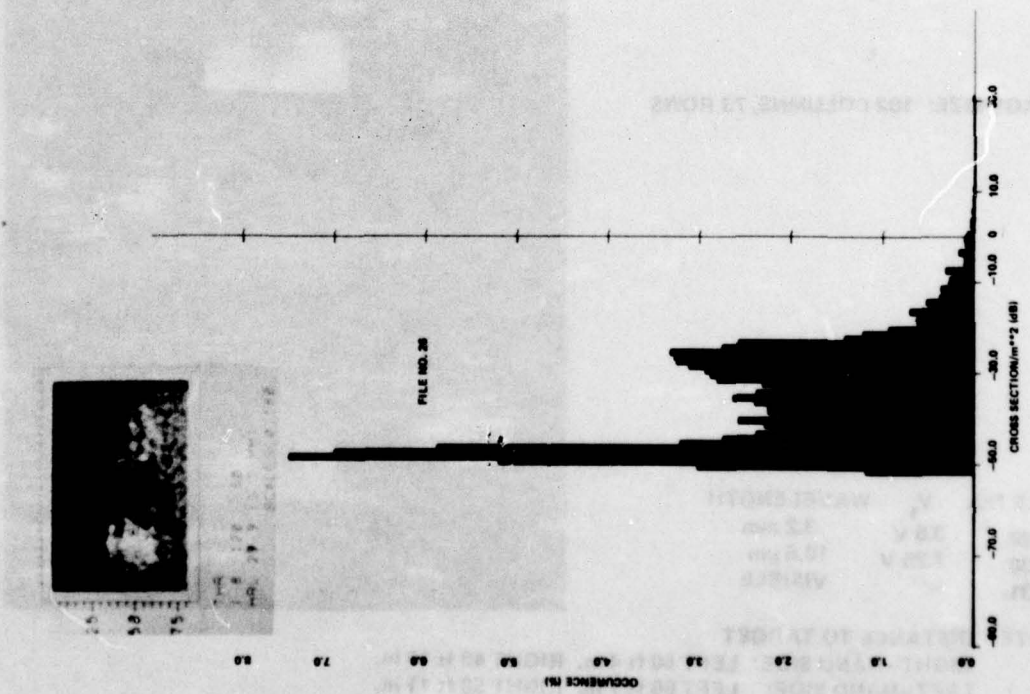
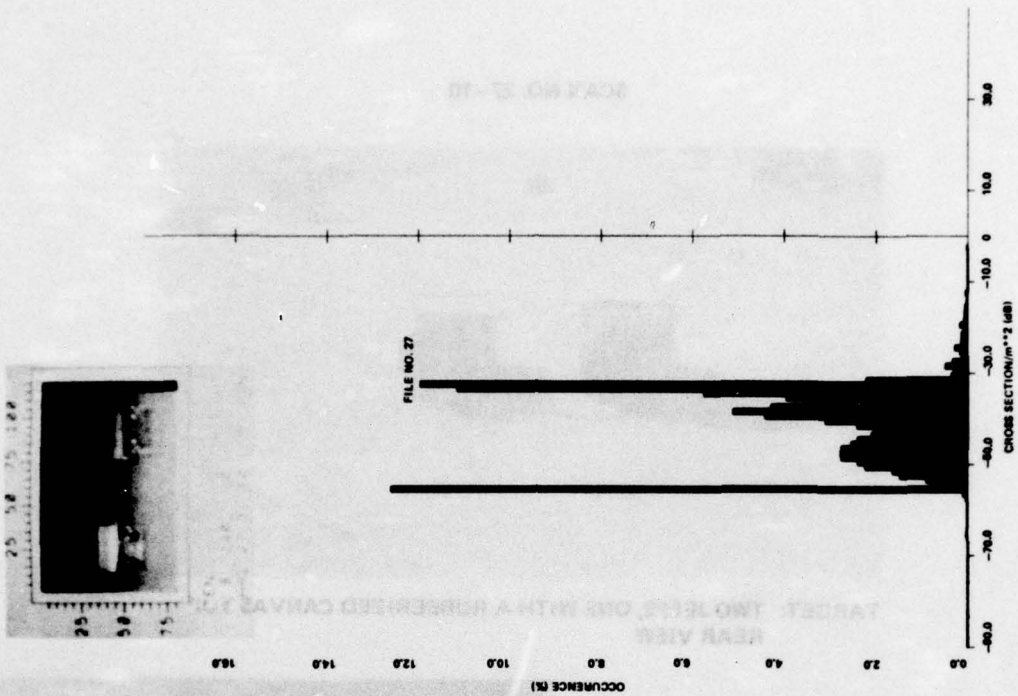
TARGET: TWO JEEPS, HEAD ON; ONE WITH RUBBERIZED CANVAS TOP.

IMAGE SIZE: 117 COLUMNS, 72 ROWS



FILE NO.	V _s	WAVELENGTH
26	3.6 V	3.2 mm
27	7.35 V	10.6 μm
28	-	VISIBLE

NOTE: DISTANCE TO TARGET.
RIGHT-HAND SIDE: LEFT 50 ft 5 in. RIGHT 50 ft 4 in.
LEFT-HAND SIDE: LEFT 48 ft 7 in. RIGHT 49 ft 7 in,
FILE NO. 28 HAS A GOOD VISIBLE RECORD.

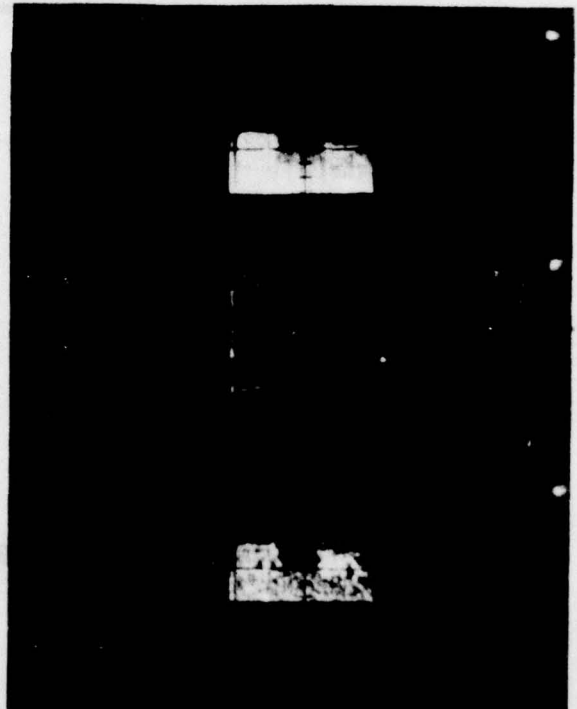


SCAN NO. 27-10



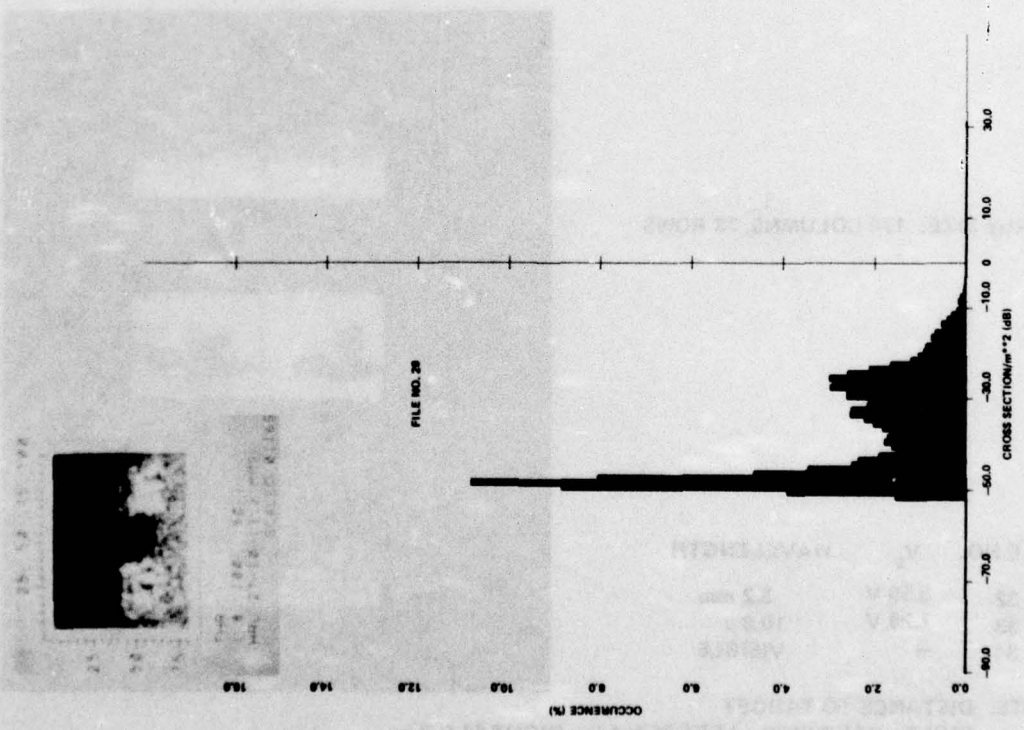
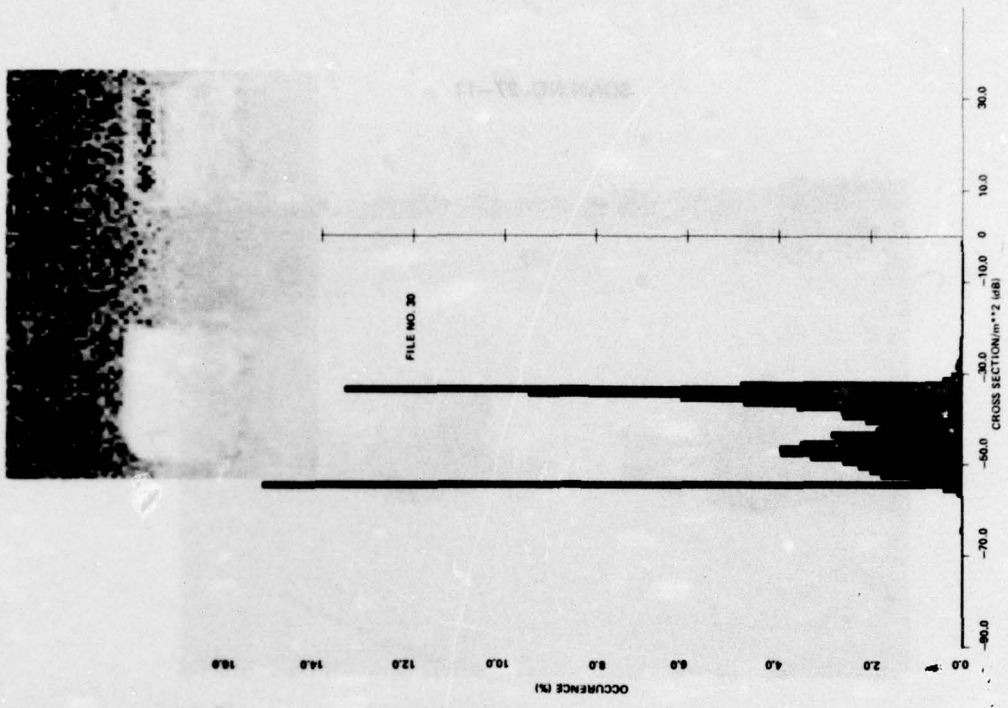
TARGET: TWO JEEPS, ONE WITH A RUBBERIZED CANVAS TOP
REAR VIEW

IMAGE SIZE: 102 COLUMNS, 73 ROWS



FILE NO.	V _s	WAVELENGTH
29	3.6 V	3.2 mm
30	7.25 V	10.6 μm
31	-	VISIBLE

NOTE: DISTANCE TO TARGET
RIGHT-HAND SIDE: LEFT 50 ft 4 in. RIGHT 49 ft 10 in.
LEFT-HAND SIDE: LEFT 50 ft 7 in. RIGHT 50 ft 11 in.
FILE NO. 31 HAS A GOOD VISIBLE RECORD.

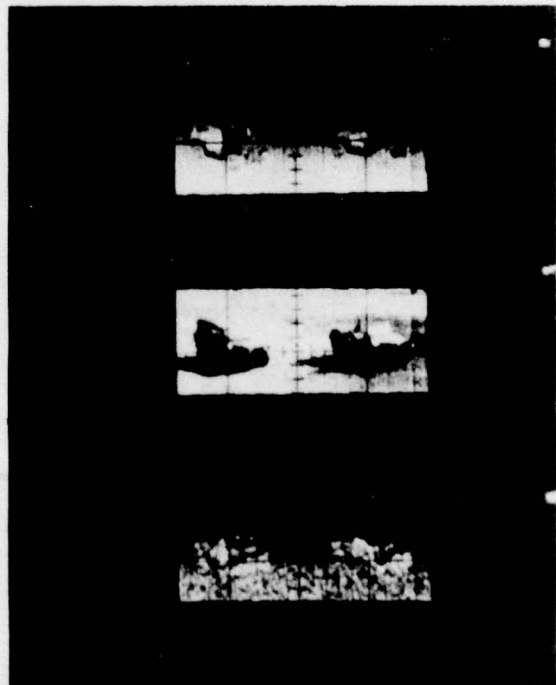


SCAN NO. 27-11



TARGET: TWO JEEPS, ONE WITH A RUBBERIZED CANVAS TOP, 45° VIEW

IMAGE SIZE: 174 COLUMNS, 73 ROWS



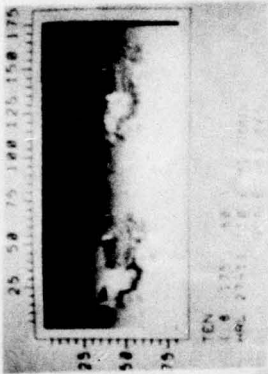
FILE NO.	V _s	WAVELENGTH
32	3.55 V	3.2 mm
33	7.20 V	10.6 μ
34	—	VISIBLE

NOTE: DISTANCE TO TARGET

RIGHT-HAND SIDE: LEFT 56 ft 1 in. RIGHT 51 ft 7 in.

LEFT-HAND SIDE: LEFT 58 ft RIGHT 55 ft 4 in.

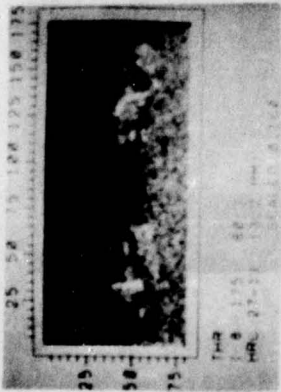
FILE NO. 34 HAS A GOOD VISIBLE RECORD.



16.0 14.0 12.0 10.0 8.0 6.0 4.0 2.0 0.0

FILE NO. 33

CROSS SECTION/mm² (μB)

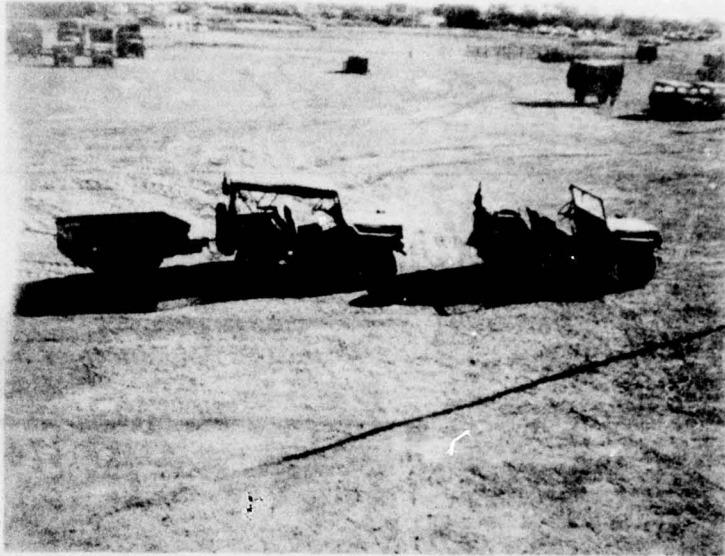


16.0 14.0 12.0 10.0 8.0 6.0 4.0 2.0 0.0

FILE NO. 32

CROSS SECTION/mm² (μB)

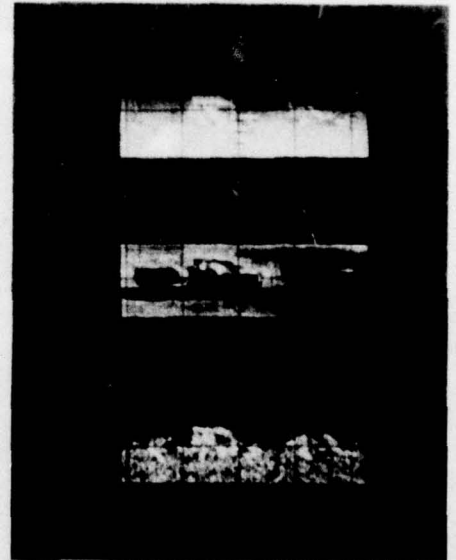
SCAN NO. 27-12



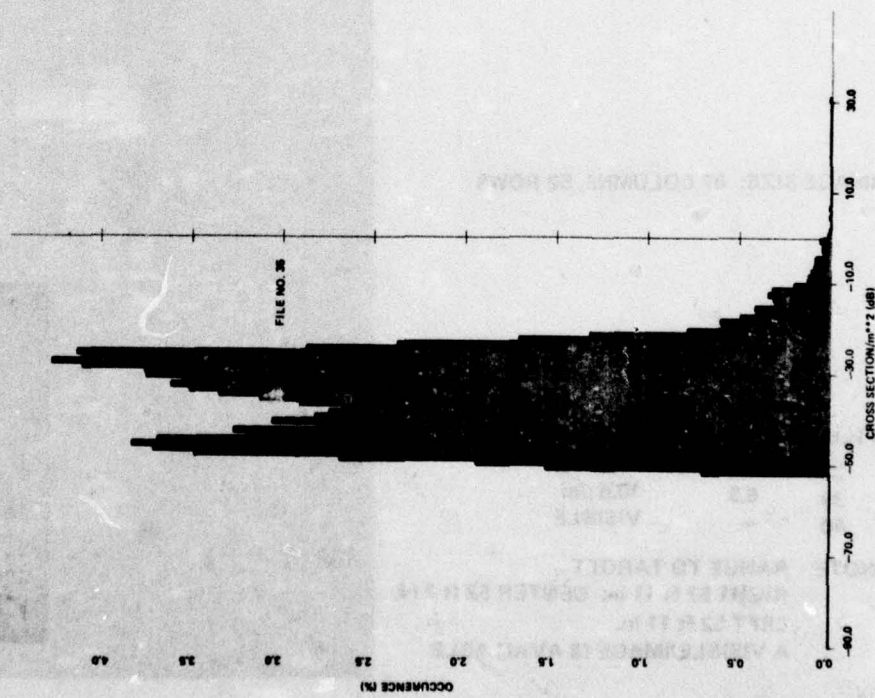
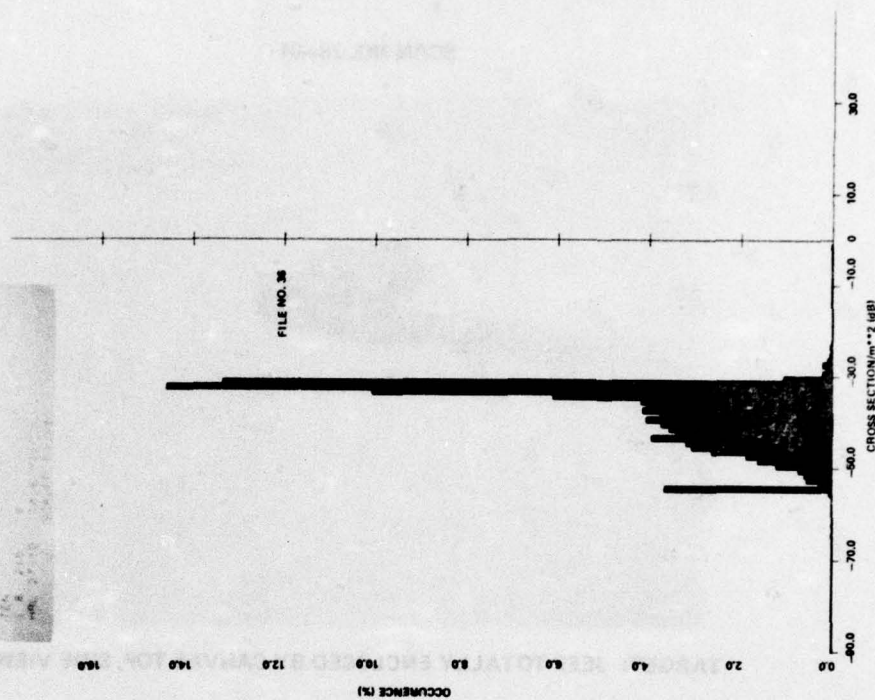
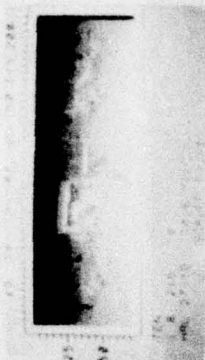
**TARGET: TWO JEEPS AND ONE TRAILER, SIDE VIEW.
ONE JEEP WITH RUBBERIZED CANVAS TOP**

IMAGE SIZE: 213 COLUMNS, 64 ROWS

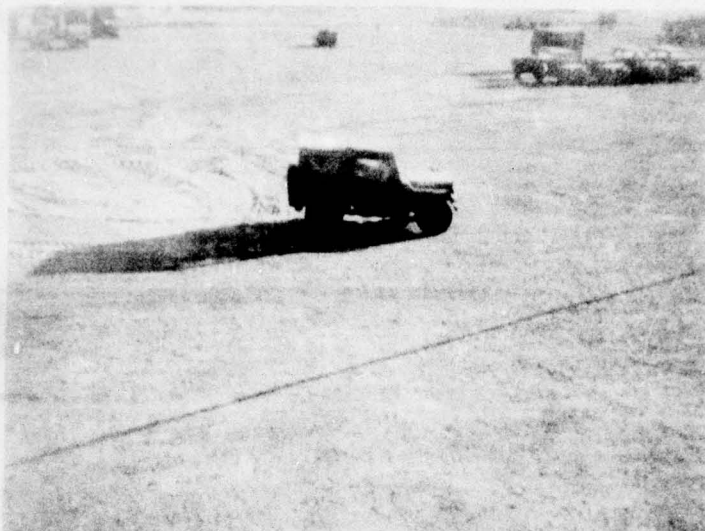
FILE NO.	V _s	WAVELENGTH
35	3.6	3.2 mm
36	7.15	10.8 μm
37	-	VISIBLE



NOTE: DISTANCE TO TARGET
TRAILER: LEFT 47 ft 6 in. RIGHT 49 ft
COVERED JEEP: LEFT 49 ft 2 in. RIGHT 49 ft 2 in.
JEEP: LEFT 49 ft 1 in. RIGHT 52 in.
FILE NO. 37 CONTAINS A GOOD VISIBLE RECORD.



SCAN NO. 28-01

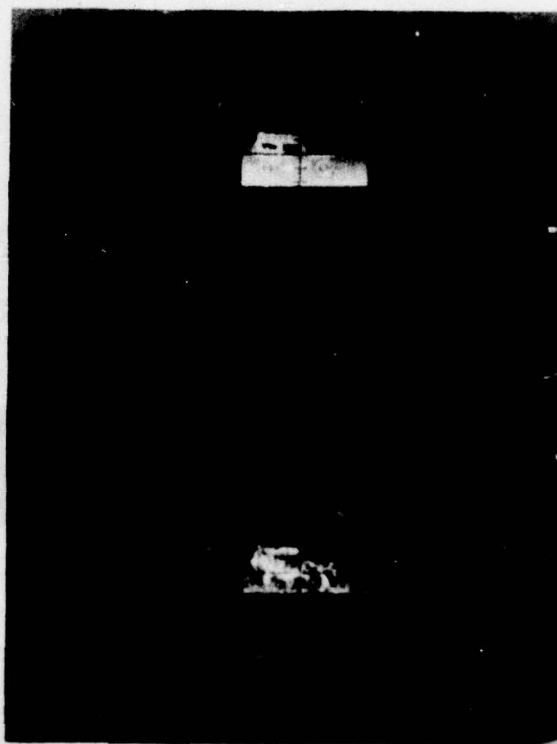


TARGET: JEEP TOTALLY ENCLOSED BY CANVAS TOP, SIDE VIEW

IMAGE SIZE: 87 COLUMNS, 52 ROWS

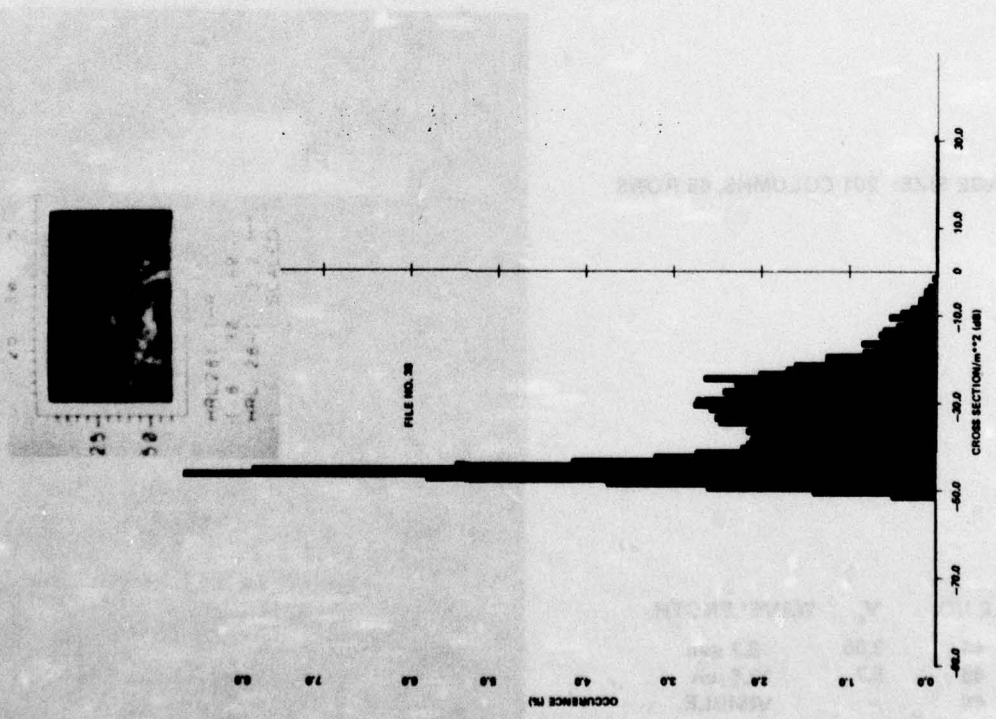
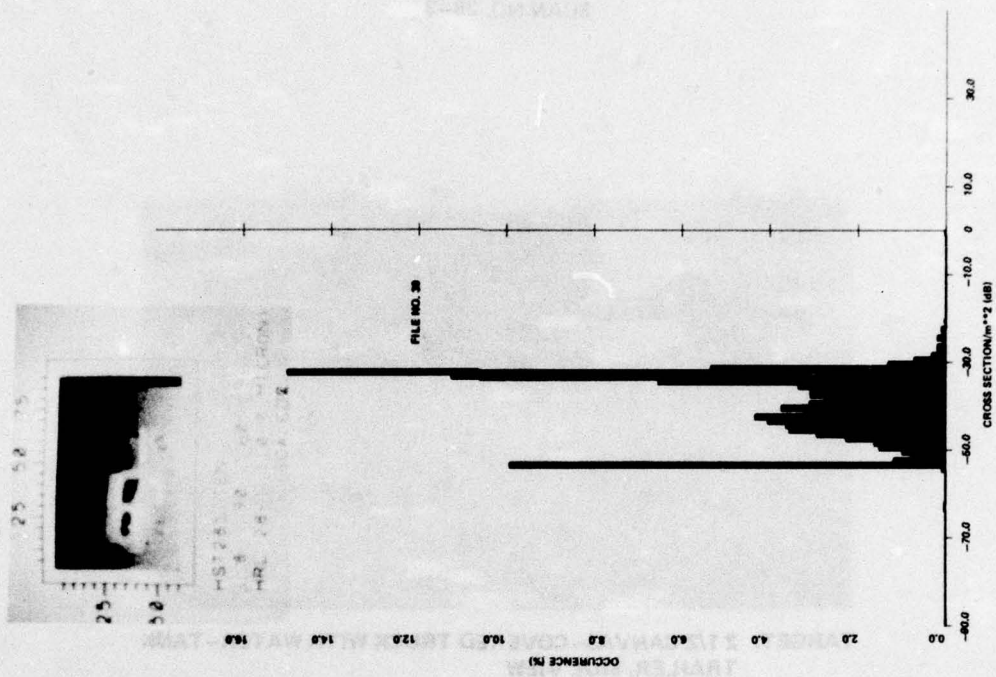
FILE NO.	V_s	WAVELENGTH
38	3.55	3.2 mm
39	6.9	10.6 μm
40	-	VISIBLE

NOTE: RANGE TO TARGET
RIGHT 52 ft 11 in. CENTER 52 ft 7 in.
LEFT 52 ft 11 in.
A VISIBLE IMAGE IS AVAILABLE

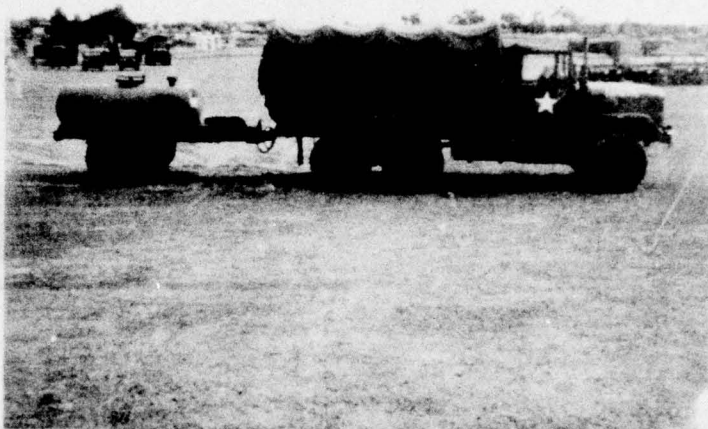


SCAN NO. 29-02

BAD FILE

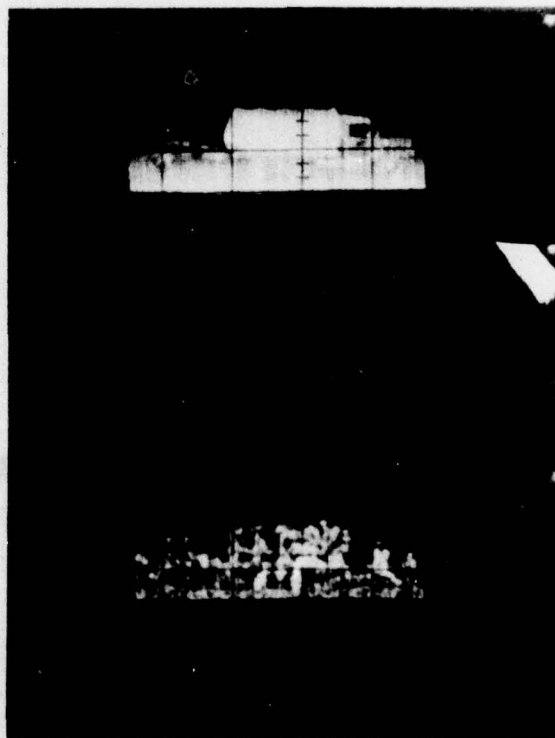


SCAN NO. 28-3



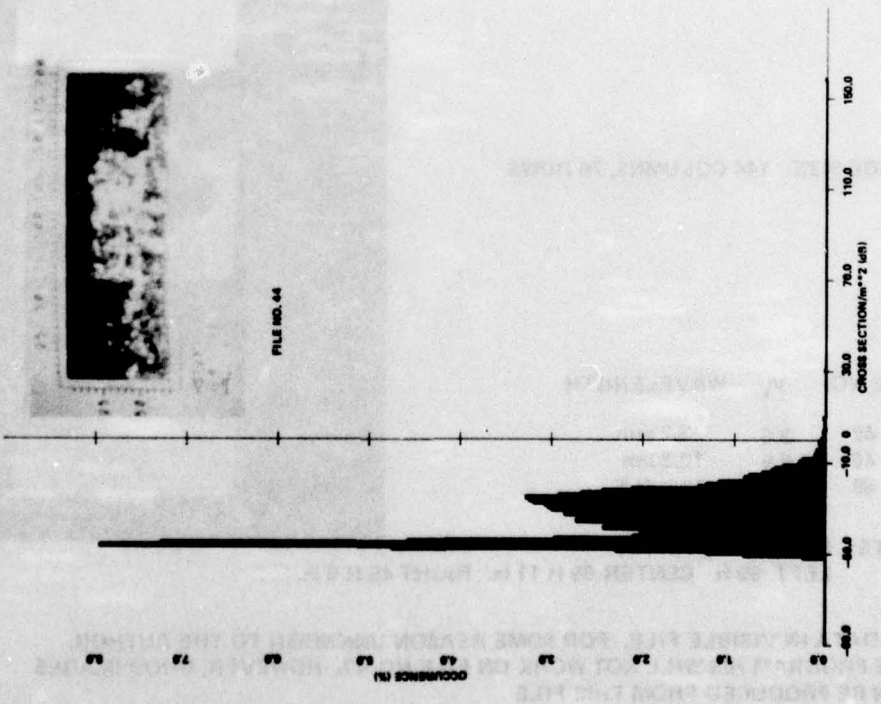
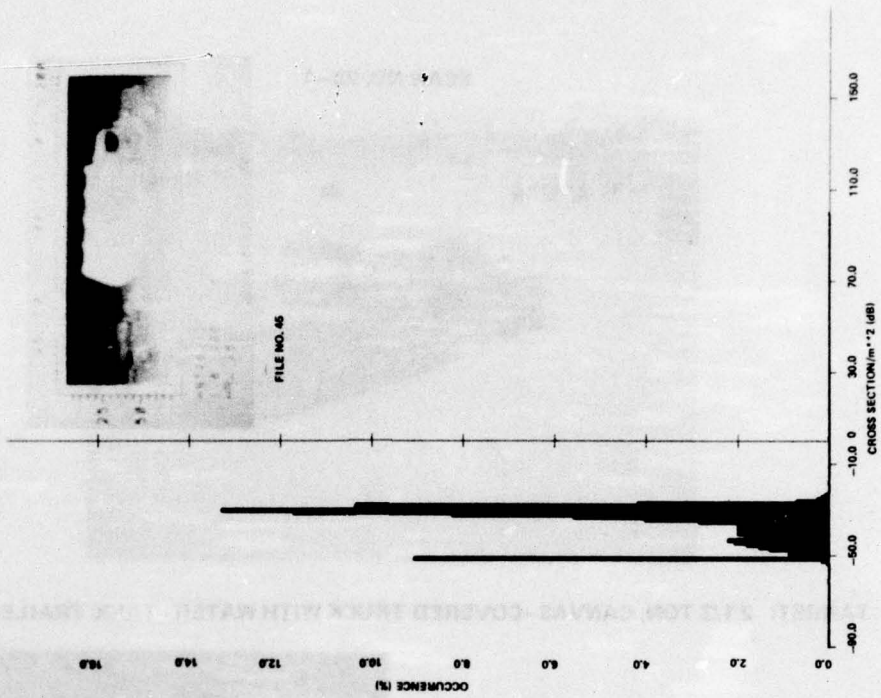
TARGET: 2 1/2 CANVAS-COVERED TRUCK WITH WATER-TANK TRAILER, SIDE VIEW

IMAGE SIZE: 201 COLUMNS, 65 ROWS

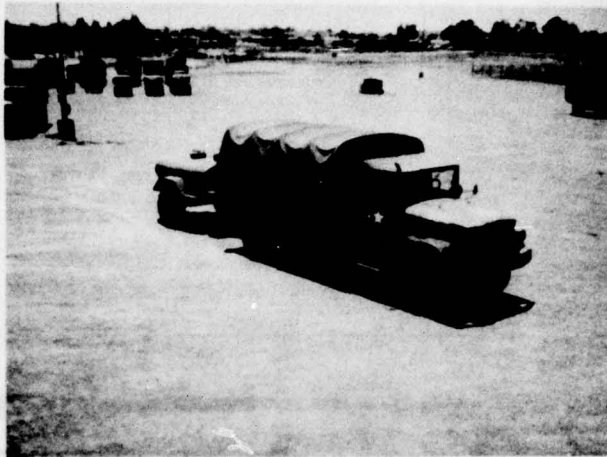


FILE NO.	V _s	WAVELENGTH
44	3.55	3.2 mm
45	6.7	10.6 μm
46	-	VISIBLE

NOTE: NO VISIBLE IMAGE.



SCAN NO. 28-4



TARGET: 2 1/2 TON, CANVAS-COVERED TRUCK WITH WATER-TANK TRAILER AT 45°

IMAGE SIZE: 144 COLUMNS, 76 ROWS

FILE NO.	V _s	WAVELENGTH
47	3.6	3.2 mm
48	6.9	10.6 μm
49	-	VISIBLE

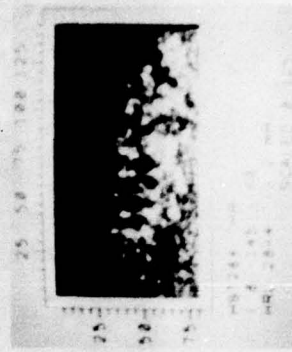


NOTE: RANGE TO TARGET
LEFT 69 ft CENTER 65 ft 11 in. RIGHT 45 ft 6 in.

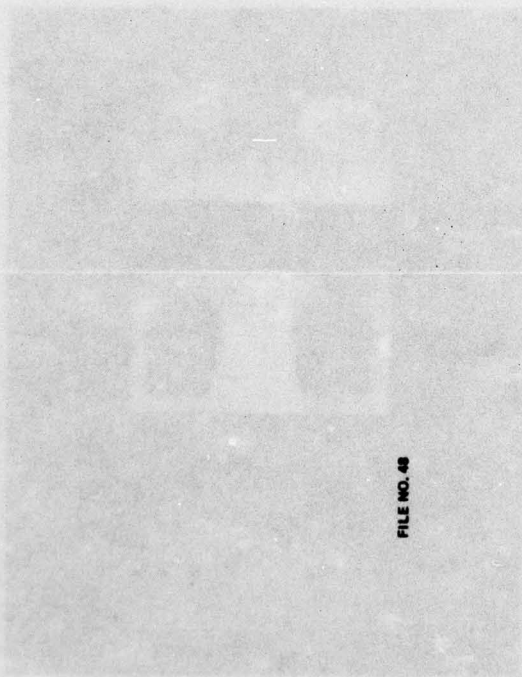
NO DATA IN VISIBLE FILE. FOR SOME REASON UNKNOWN TO THE AUTHOR,
THE PROGRAM HIS WILL NOT WORK ON FILE NO. 47. HOWEVER, GOOD IMAGES
CAN BE PRODUCED FROM THIS FILE



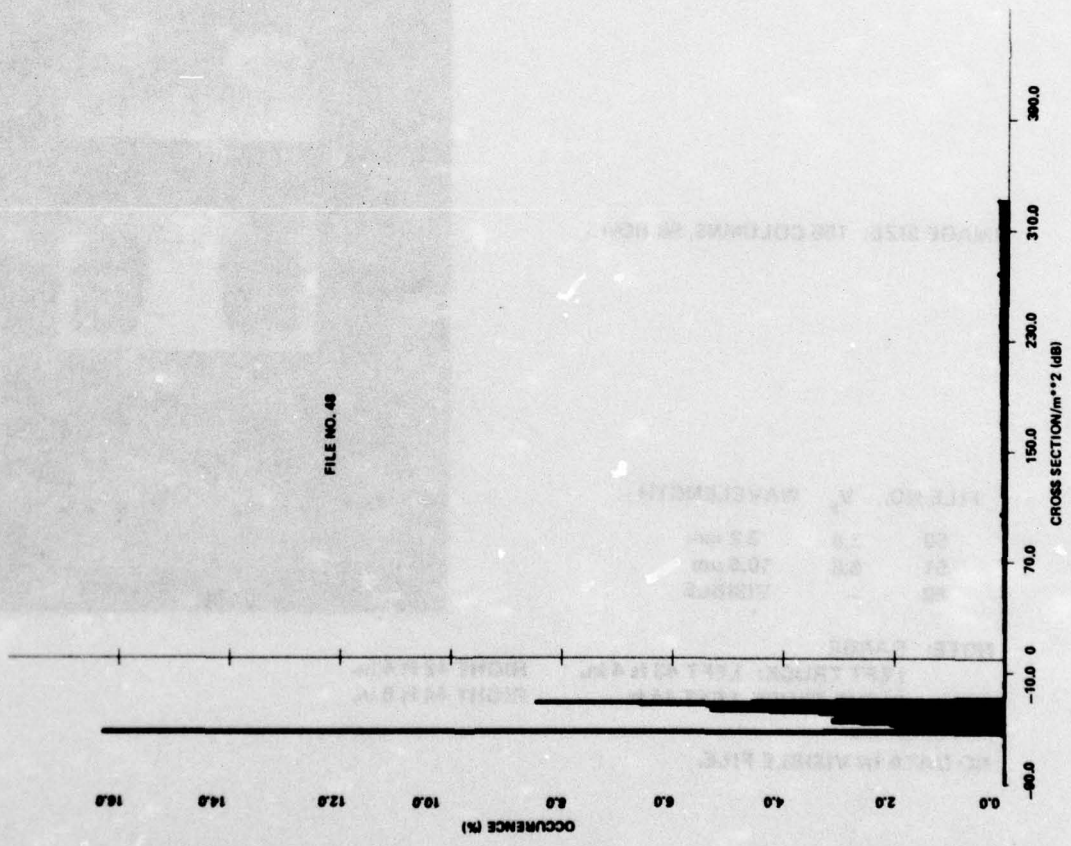
FILE NO. 46



FILE NO. 47



FILE NO. 48

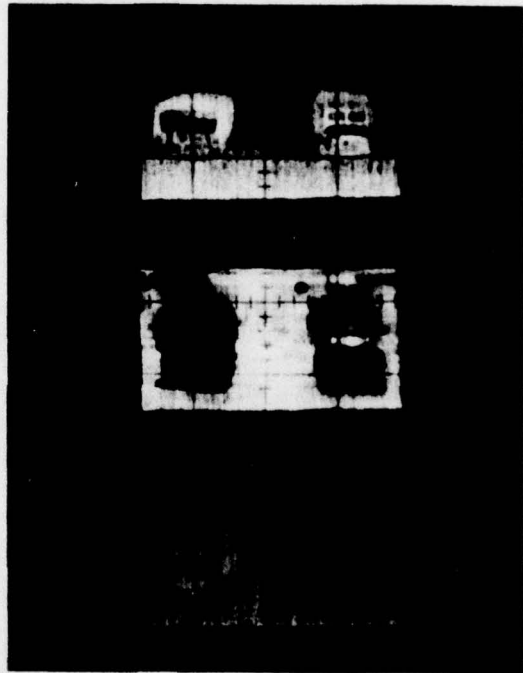


SCAN NO. 28-5



TARGET: FRONT AND BACK VIEW OF 2 1/2 TON CANVAS-COVERED TRUCK

IMAGE SIZE: 156 COLUMNS, 98 ROWS



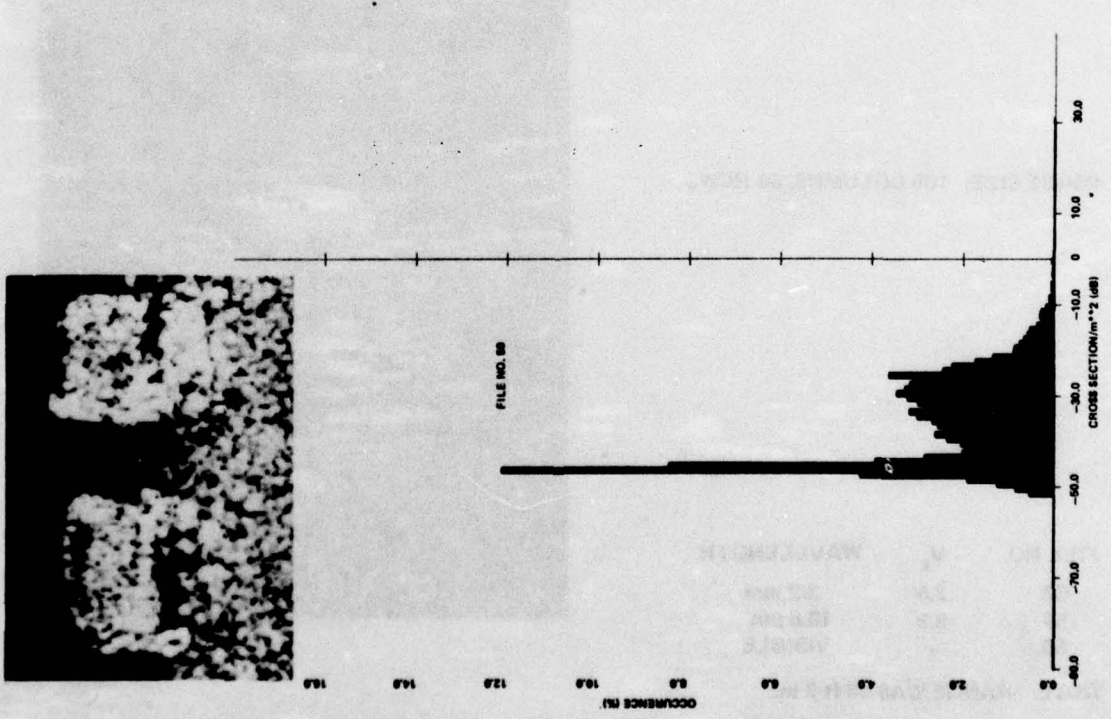
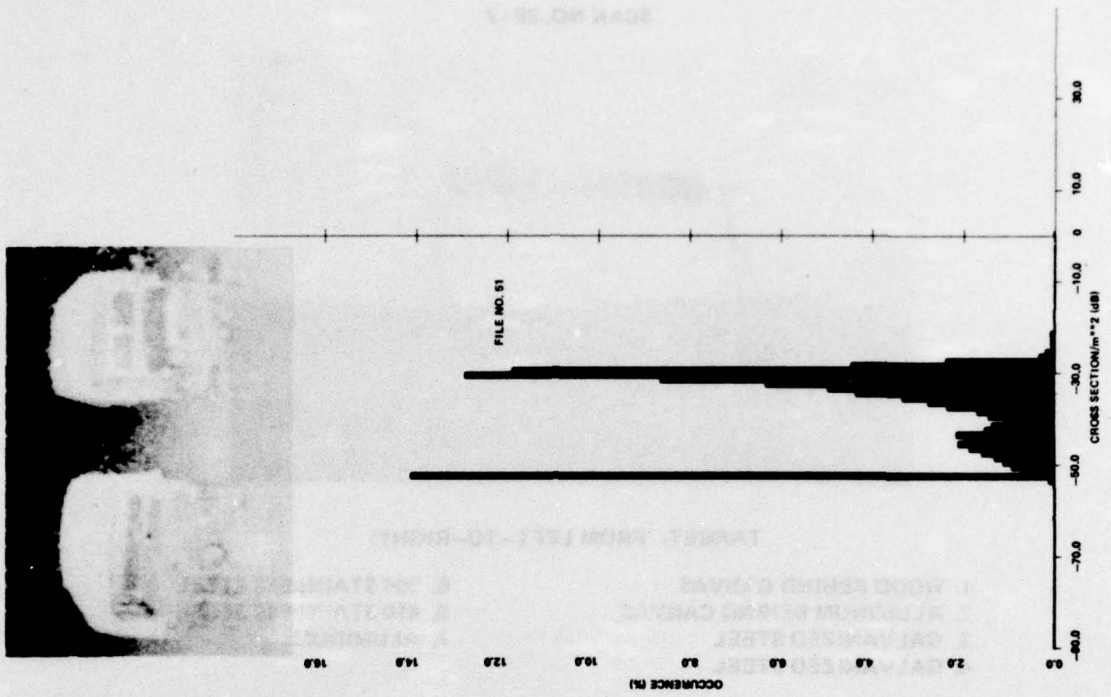
FILE NO.	V _s	WAVELENGTH
50	3.6	3.2 mm
51	6.8	10.6 μm
52	-	VISIBLE

NOTE: RANGE

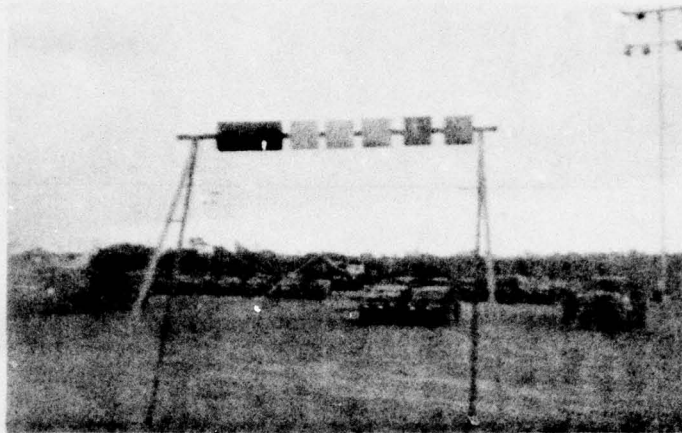
LEFT TRUCK: LEFT 43 ft 4 in.
RIGHT TRUCK: LEFT 44 ft

RIGHT 42 ft 4 in.
RIGHT 44 ft 8 in.

NO DATA IN VISIBLE FILE.



SCAN NO. 28-7

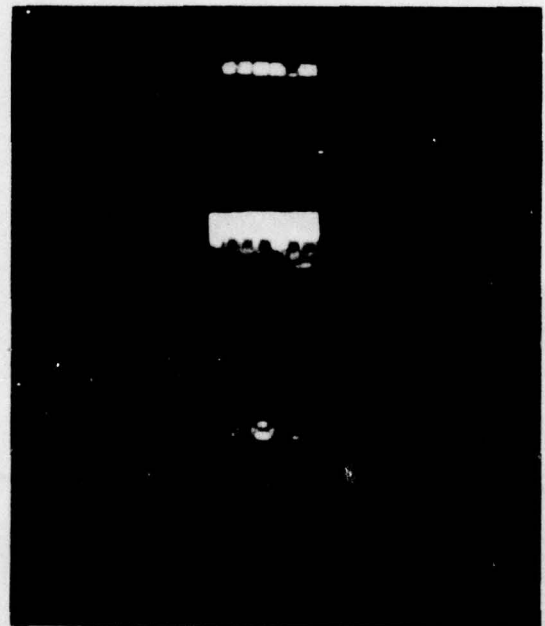


TARGET: FROM LEFT-TO-RIGHT:

1. WOOD BEHIND CANVAS
2. ALUMINUM BEHIND CANVAS
3. GALVANIZED STEEL
4. GALVANIZED STEEL

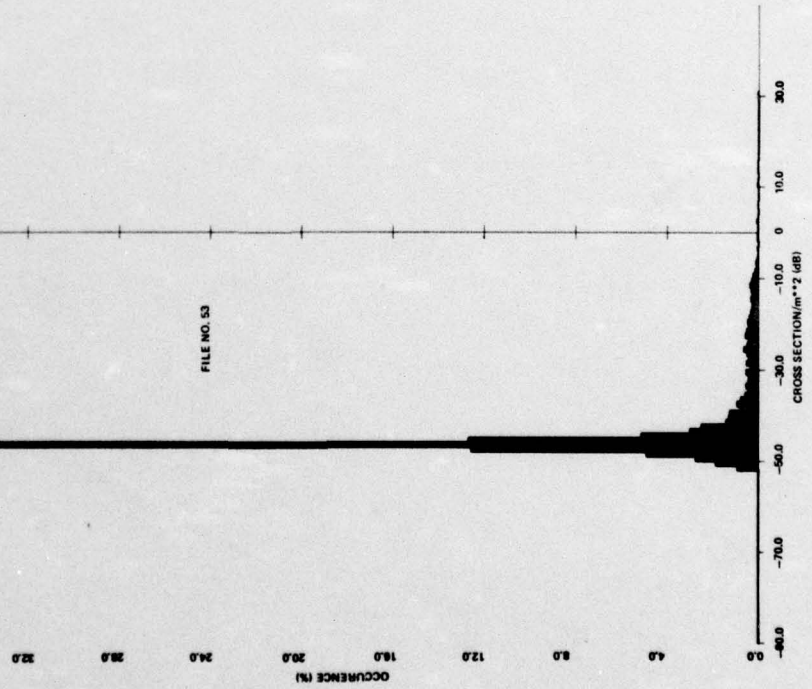
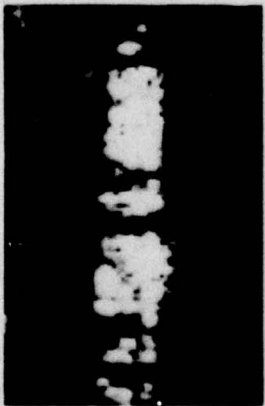
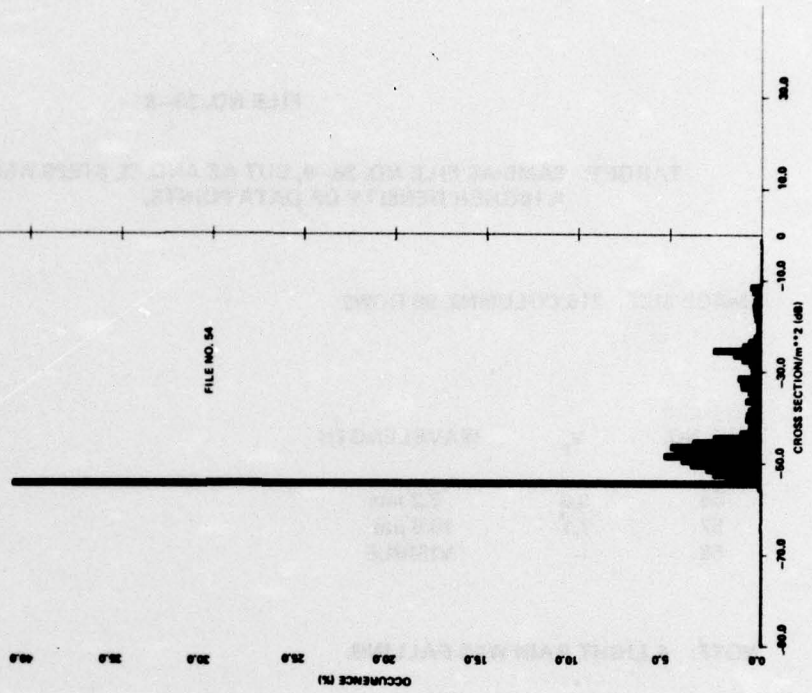
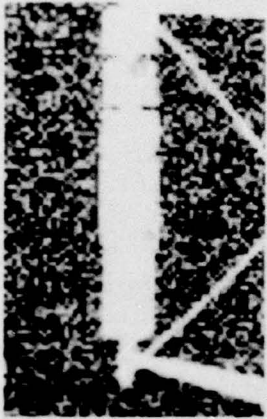
5. 304 STAINLESS STEEL
6. 410 STAINLESS STEEL
7. ALUMINUM

IMAGE SIZE: 108 COLUMNS, 64 ROWS



FILE NO.	V _s	WAVELENGTH
53	3.6	3.2 mm
54	6.8	10.6 μm
55	-	VISIBLE

NOTE: RANGE WAS 48 ft 2 in.



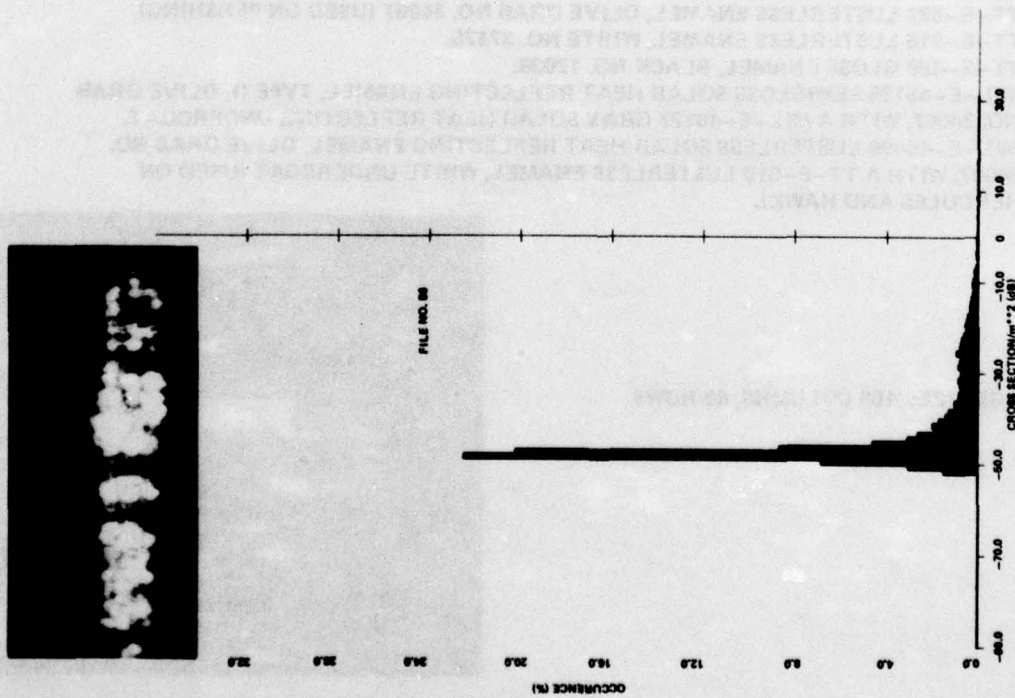
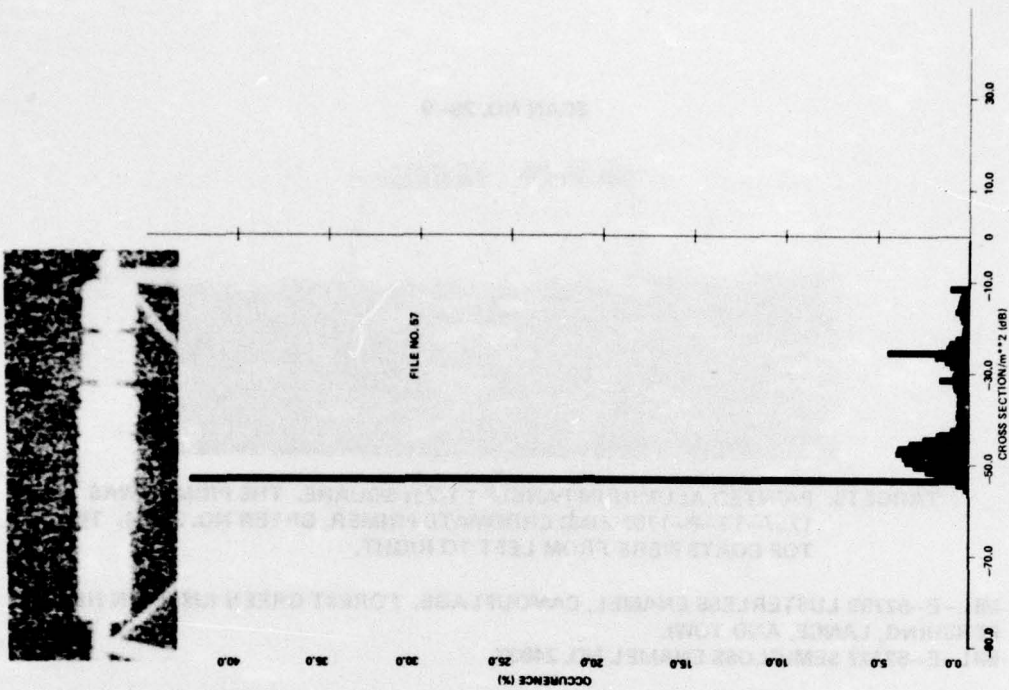
FILE NO. 28-8

TARGET: SAME AS FILE NO. 28-9, BUT AZ AND EL STEPS WERE 1.7 mrad, GIVING A HIGHER DENSITY OF DATA POINTS.

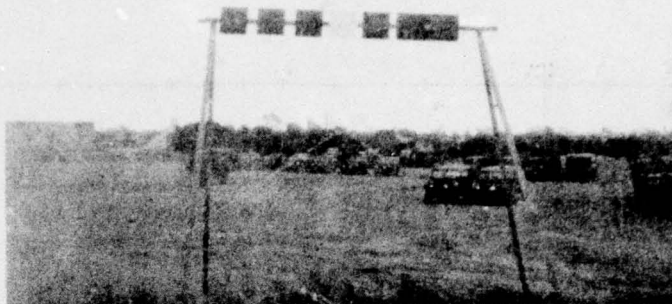
IMAGE SIZE: 216 COLUMNS, 90 ROWS

FILE NO.	V _r	WAVELENGTH
56	3.6	3.2 mm
57	7.1	10.6 μm
58	-	VISIBLE

NOTE: A LIGHT RAIN WAS FALLING.



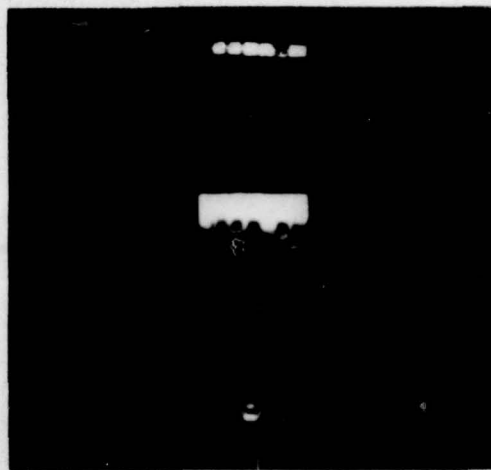
SCAN NO. 28-9



TARGETS: PAINTED ALUMINUM PANELS 1 1/2 ft SQUARE. THE PRIMER WAS 1757-TT-P-1757 ZINC CHROMATE PRIMER, GREEN NO. 34151. THE TOP COATS WERE FROM LEFT TO RIGHT.

1. MIL-E-52798 LUSTERLESS ENAMEL, CAMOUFLAGE. FOREST GREEN (USED ON NEW PERSHING, LANCE, AND TOW).
2. MIL-E-52227 SEMIGLOSS ENAMEL NO. 24037,
1. MIL-E-52798 LUSTERLESS ENAMEL, CAMOUFLAGE. FOREST GREEN (USED ON NEW PERSHING, LANCE, AND TOW).
2. MIL-E-52227 SEMIGLOSS ENAMEL, OLIVE DRAB NO. 24037, (USED ON LANCE).
3. TT-E-527 LUSTERLESS ENAMEL, OLIVE DRAB NO. 34087 (USED ON PERSHING).
4. TT-E-516 LUSTERLESS ENAMEL, WHITE NO. 37875.
5. TT-E-489 GLOSS ENAMEL, BLACK NO. 17038.
6. MIL-E-46136 SEMIGLOSS SOLAR HEAT REFLECTING ENAMEL, TYPE II, OLIVE DRAB NO. 24087, WITH A MIL-E-46127 GRAY SOLAR HEAT REFLECTING UNDERCOAT.
7. MIL-E-46096 LUSTERLESS SOLAR HEAT REFLECTING ENAMEL, OLIVE DRAB NO. 34087, WITH A TT-E-516 LUSTERLESS ENAMEL, WHITE UNDERCOAT (USED ON HERCULES AND HAWK).

IMAGE SIZE: 168 COLUMNS, 43 ROWS



NOTE: THE 3.2 mm HETERODYNE LOST LOCK SO THE RUN WAS REPEATED IN SCAN NO. 28-10. RAIN WAS FALLING AND SCAN NO. 28-10 HAD TO BE TERMINATED BEFORE A CALIBRATION CHECK COULD BE OBTAINED. WHEN THE EQUIPMENT WAS TURNED ON AGAIN AFTER THE RAIN, THE CALIBRATION VOLTAGES WERE THE SAME AS IN SCAN NO. 28-8.

SCAN NO. 28-10

TARGETS: SAME AS IN SCAN NO. 28-9

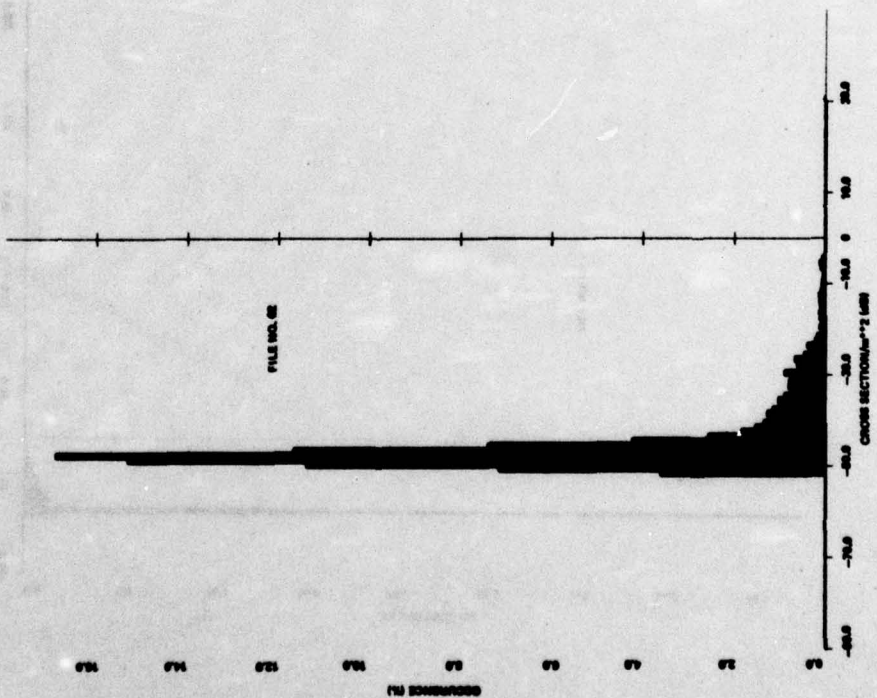
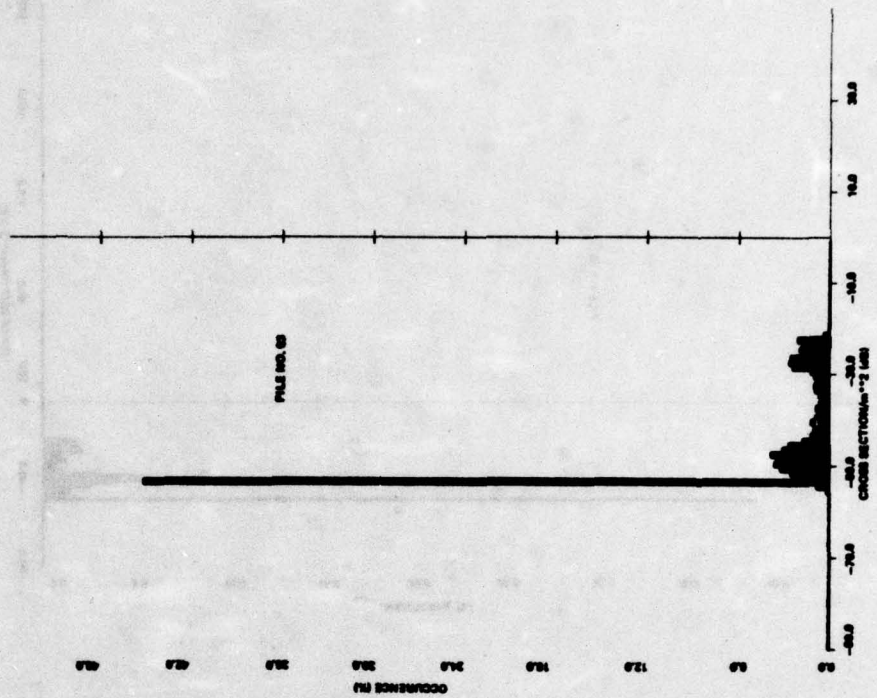
IMAGE SIZE: 186 COLUMNS, 41 ROWS

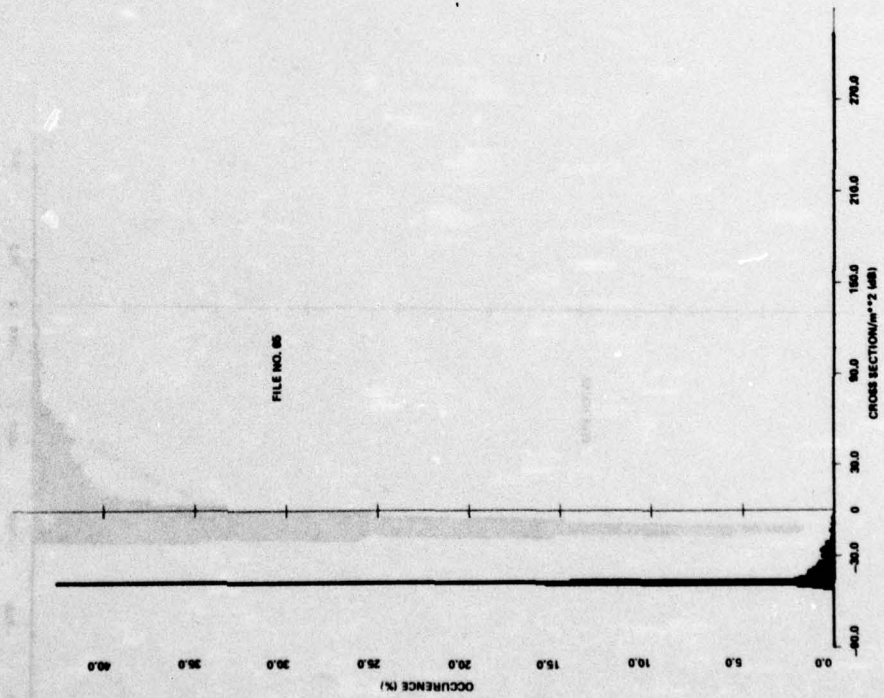
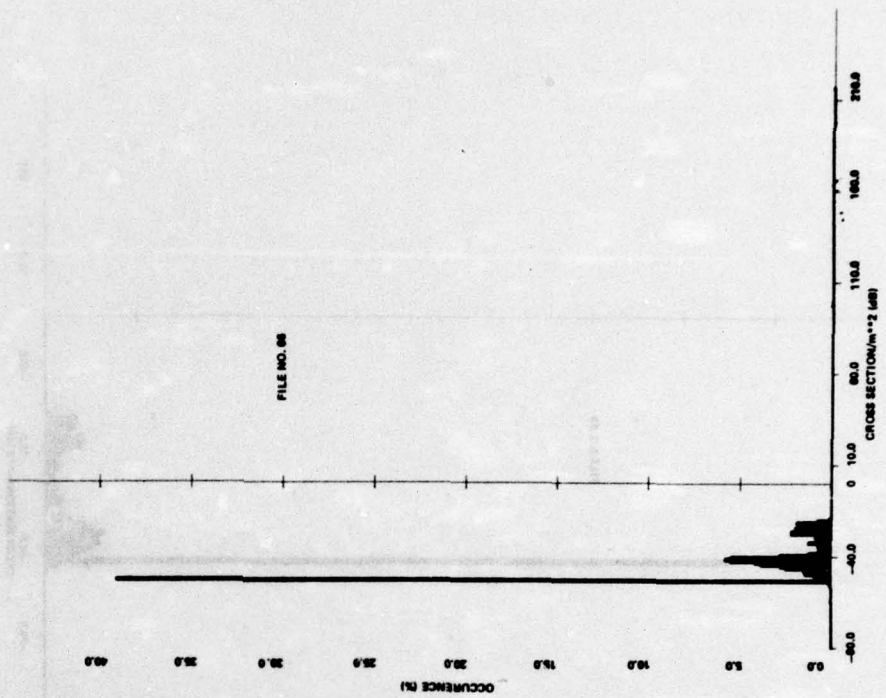
SCAN NO. 28-11

TARGETS: SAME AS IN SCAN NO. 28-9, BUT WITH STEP SIZES OF 3.5 mrad
IN AZ AND 3.4 mrad IN EL.

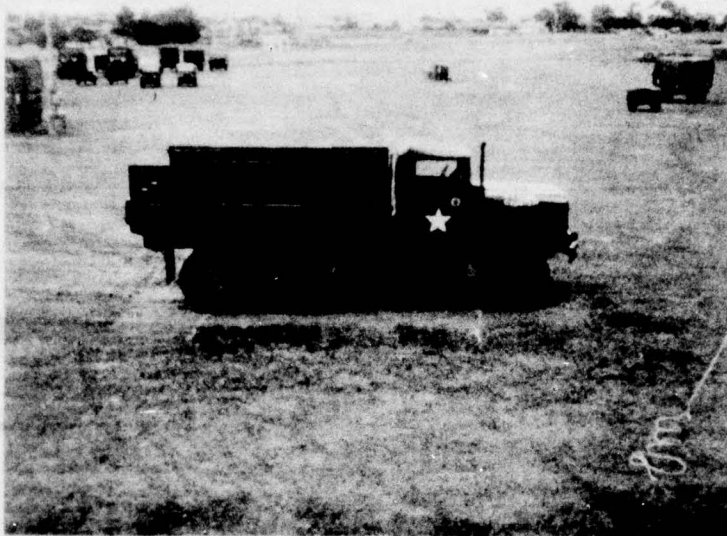
IMAGE SIZE: 99 COLUMNS, 44 ROWS

FILE NO.	V _s	WAVELENGTH
65	3.8	3.2 mm
66	7.1	10.6 μm
67	-	VISIBLE





SCAN NO. 28-12



TARGET: 2 1/2 TON TRUCK WITH WOOD SIDE RAILS, SIDE VIEW.

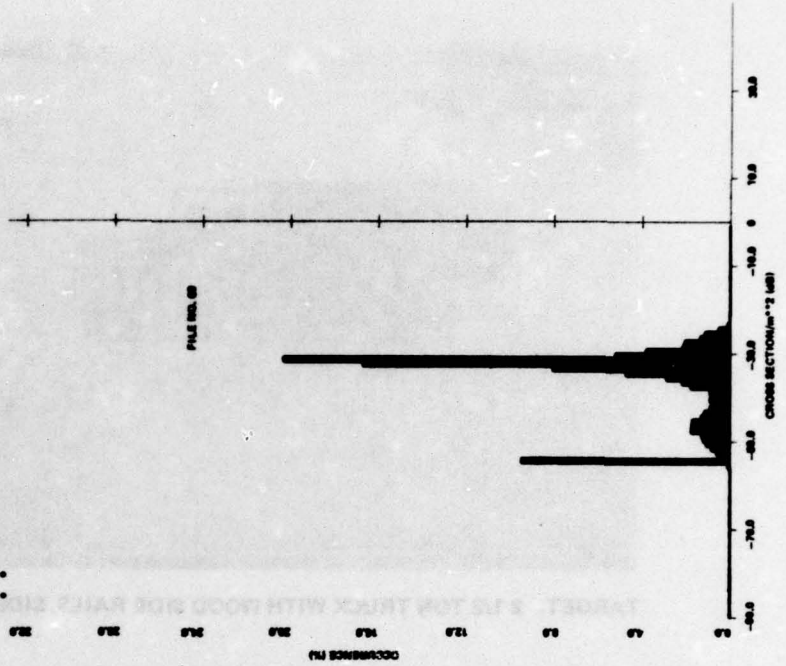
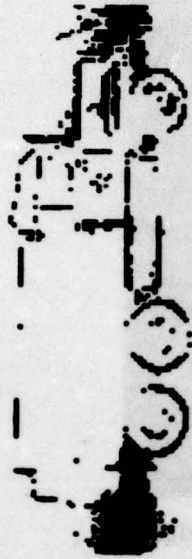
IMAGE SIZE: 156 COLUMNS, 88 ROWS

FILE NO.	V _s	WAVELENGTH
68	3.7	3.2 mm
69	7.2	10.6 μm
70	-	VISIBLE

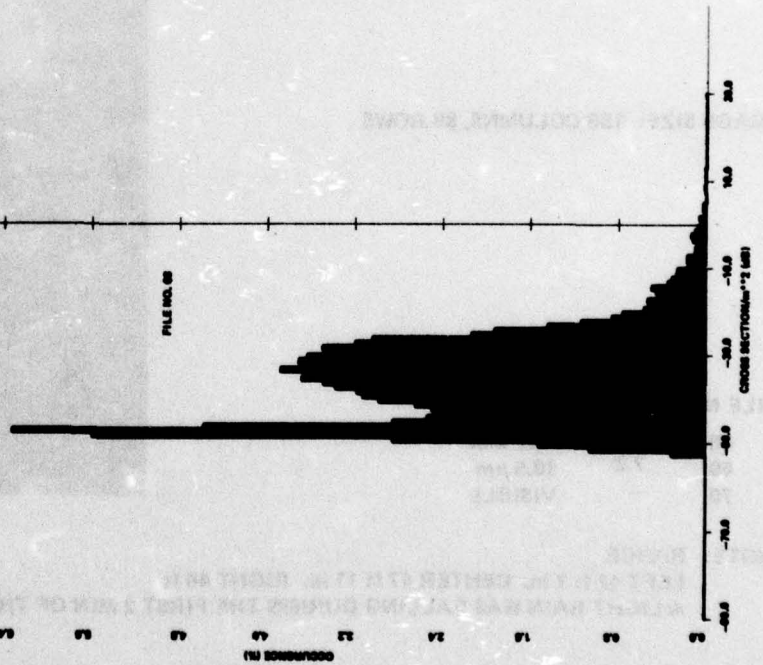


NOTE: RANGE
LEFT 47 ft 1 in. CENTER 47 ft 11 in. RIGHT 46 ft
A LIGHT RAIN WAS FALLING DURING THE FIRST 2 MIN OF THE SCAN.

FILE NO. 00
DATE: 10/10/70
TIME: 10:00 AM
BY: J. J. [unclear]



FILE NO. 00
DATE: 10/10/70
TIME: 10:00 AM
BY: J. J. [unclear]



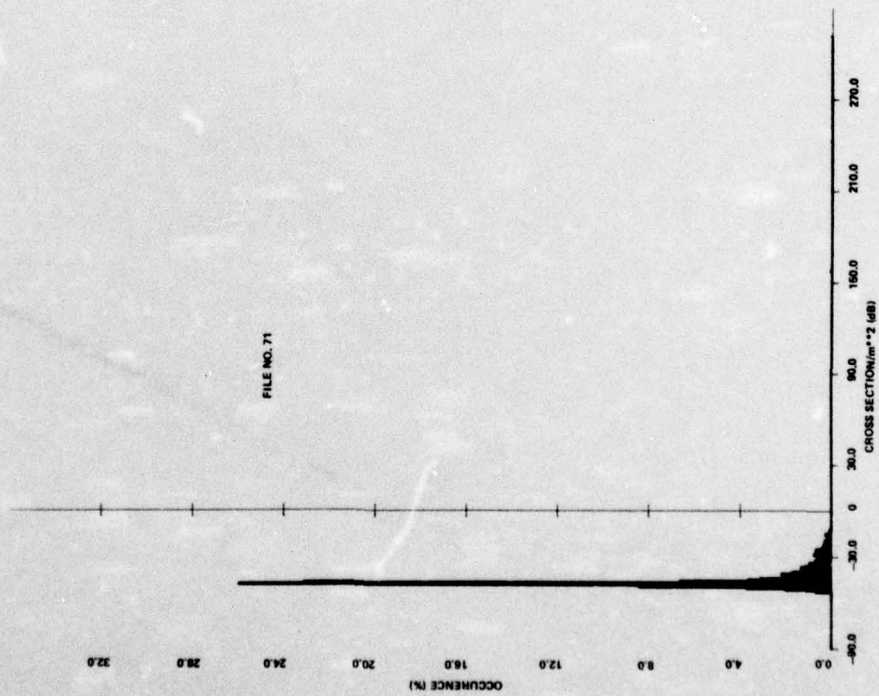
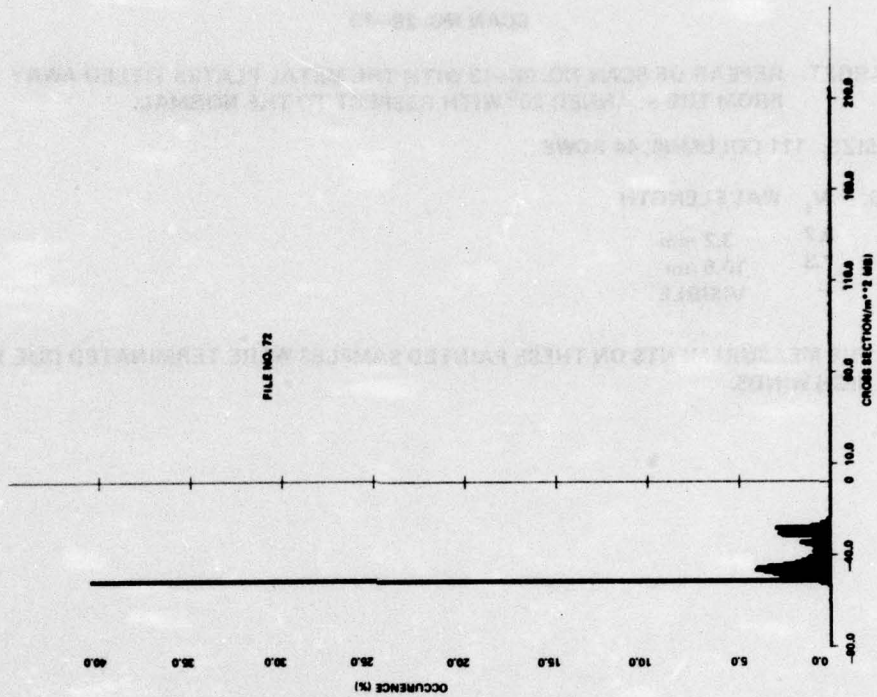
SCAN NO. 28-13

TARGET: REPEAT OF SCAN NO. 28-13 WITH THE METAL PLATES TITLED AWAY
FROM THE SCANNER 20° WITH RESPECT TO THE NORMAL

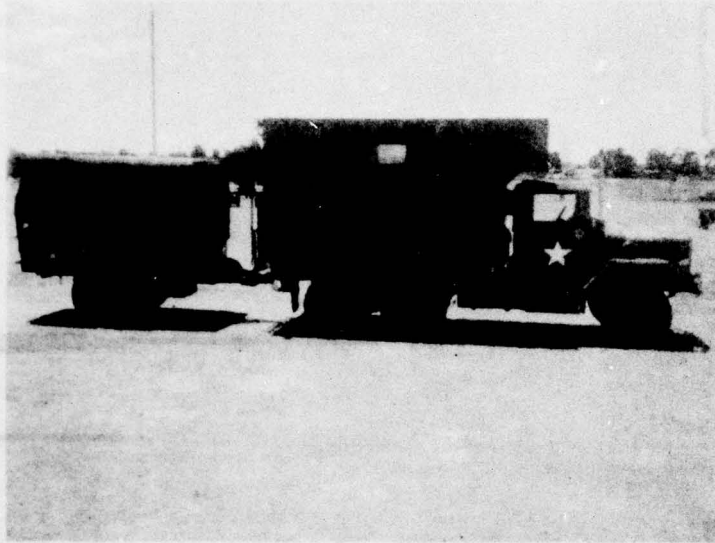
IMAGE SIZE: 111 COLUMNS, 44 ROWS

FILE NO.	V _s	WAVELENGTH
71	3.7	3.2 mm
72	7.3	10.6 μm
73	-	VISIBLE

NOTE: THE MEASUREMENTS ON THESE PAINTED SAMPLES WERE TERMINATED DUE TO
HIGH WINDS.

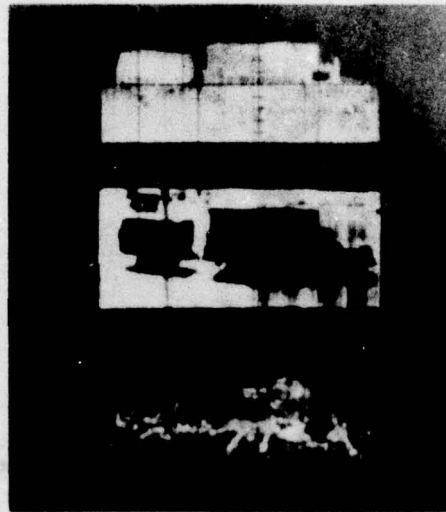


SCAN NO. 28-14



**TARGET: SIZE VIEW OF MOBILE FIELD KITCHEN, CONSTRUCTED OF PLYWOOD
ON A 2 1/2 TON TRUCK BEN. SUPPLY TRAILER IS ATTACHED TO TRUCK.**

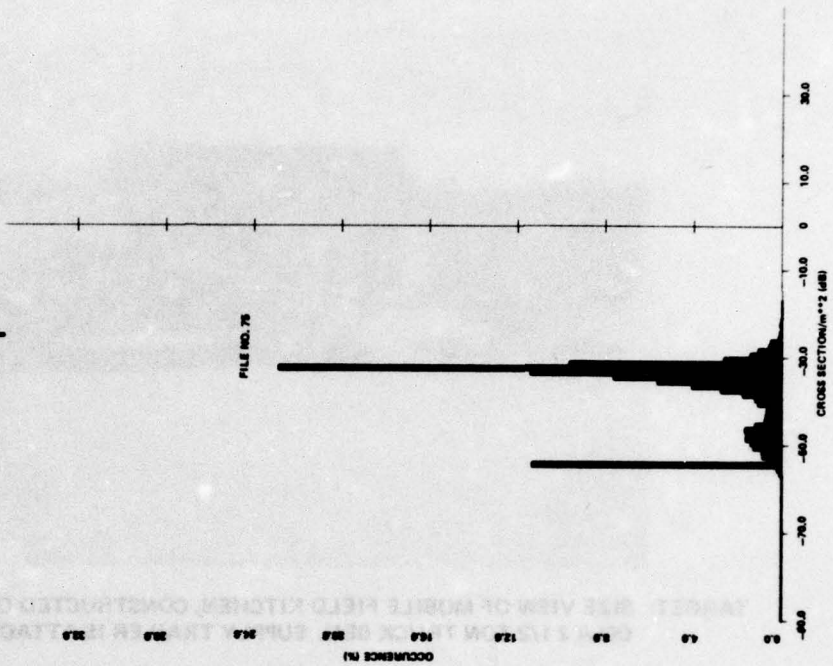
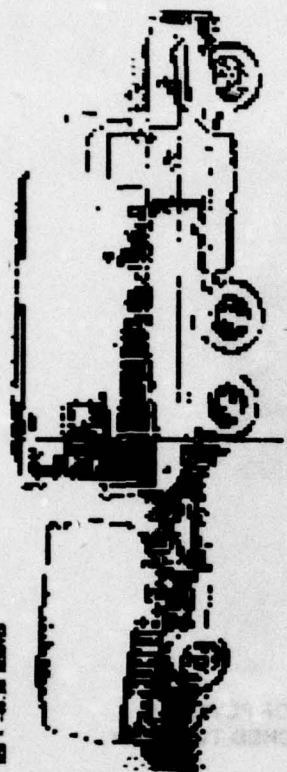
IMAGE SIZE: 225 COLUMNS, 100 ROWS



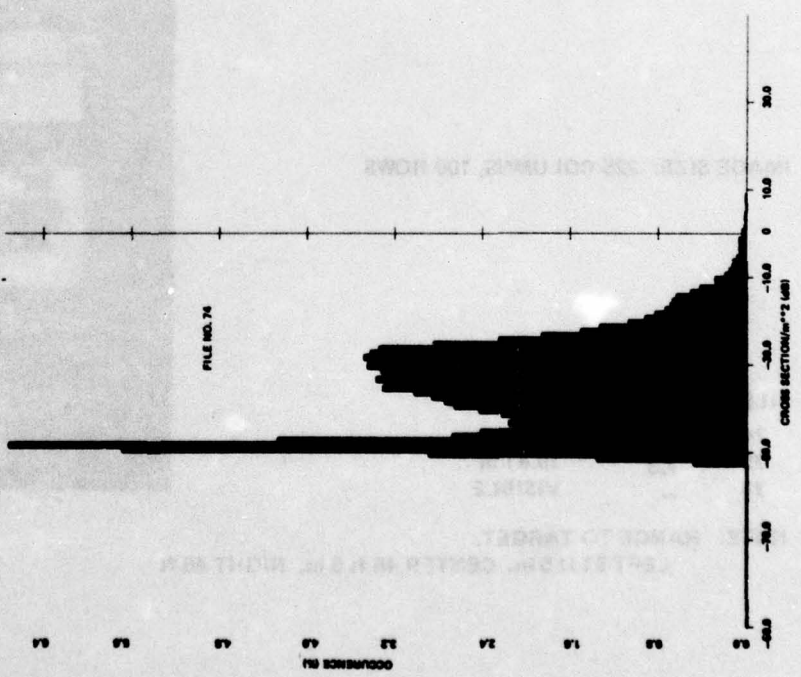
FILE NO.	V_s	WAVELENGTH
74	3.7	3.2 mm
75	7.3	10.6 μm
76	-	VISIBLE

**NOTE: RANGE TO TARGET.
LEFT 51 ft 5 in. CENTER 46 ft 5 in. RIGHT 46 ft**

FILE NO. 75
 DATE: 10-10-75
 TIME: 10:00 AM
 LOCATION: 10000



FILE NO. 76
 DATE: 10-10-75
 TIME: 10:00 AM
 LOCATION: 10000



SCAN NO. 29-1

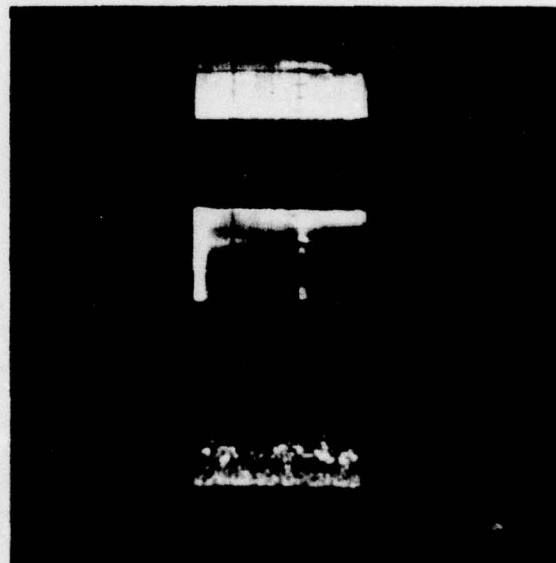


TARGET: SIDE VIEW OF JEEP WITH TRAILER.

IMAGE SIZE: 123 COLUMNS, 69 ROWS

FILE NO. V_s WAVELENGTH

77	•	3.2 mm
78	7.1	10.6 μm
79	-	VISIBLE

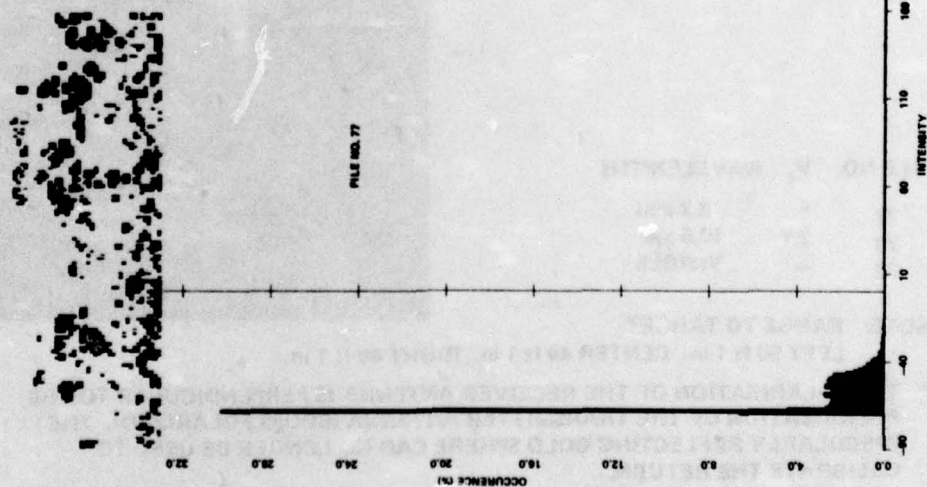


NOTE: RANGE TO TARGET.

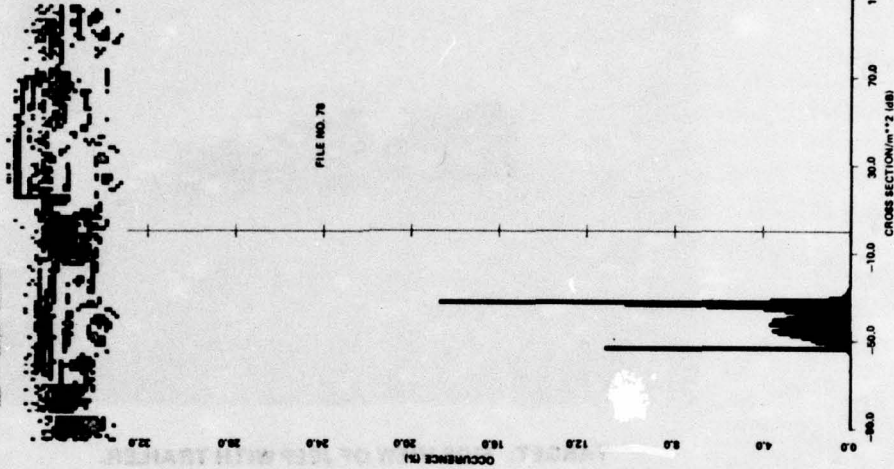
LEFT 50 ft 1 in. CENTER 49 ft 1 in. RIGHT 49 ft 1 in.

- **THE POLARIZATION OF THE RECEIVER ANTENNA IS PERPENDICULAR TO THE POLARIZATION OF THE TRANSMITTER ANTENNA (CROSS POLARIZED). THE SPECULARLY REFLECTING GOLD SPHERE CAN NO LONGER BE USED TO CALIBRATE THE RETURN.**
- IN ALL PREVIOUS SCANS, 10 dB OF ATTENUATION WAS PLACED AT THE RECEIVER ANTENNA; IN ALL OF THE REMAINING SCANS, NO ATTENUATION WAS USED IN THE RECEIVER.**
- IN ALL OF THE CROSS POLARIZED SCANS THE 10.6 μm SCANS WERE NOT MODIFIED; THUS, THEY CONTAIN NO NEW INFORMATION.**

FILE NO. 77
MAX NO. : -0.20
MIN NO. : -0.20
NO. : -0.20



FILE NO. 78
MAX NO. : -0.20
MIN NO. : -0.20
NO. : -0.20

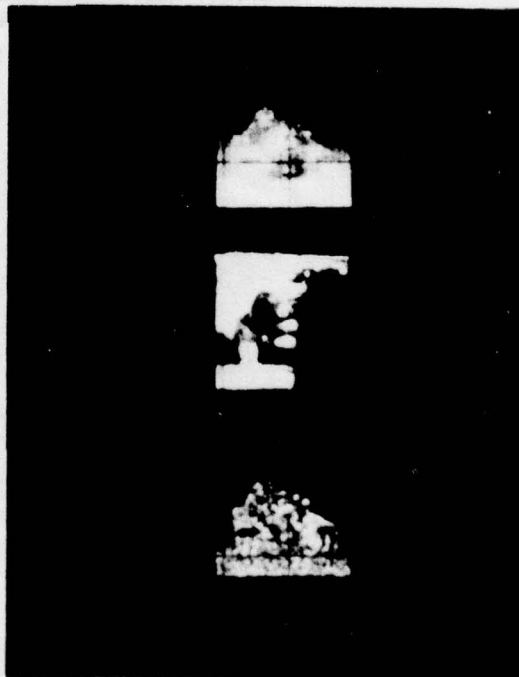


SCAN NO. 29-2



TARGET: M48 TANK, VIEW IS HEAD-ON

IMAGE SIZE: 99 COLUMNS, 103 ROWS



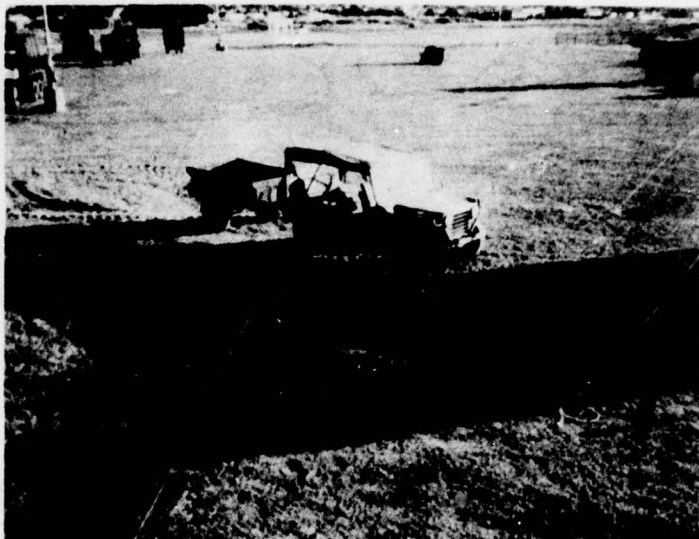
FILES NO. 80 (3.2 mm) AND 82 (VISIBLE) ARE UNCALIBRATED.
FILE NO. 81 (10.6 μ m) HAS A $V_s = 7.1$.

NOTE: RANGE TO TARGET.

LEFT 44 ft 7 in. CENTER 45 ft RIGHT 46 ft 4 in.

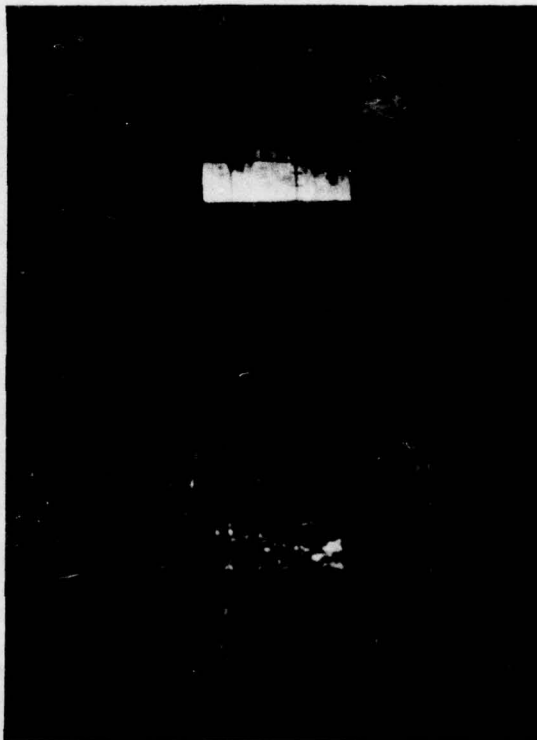
THE 3.2 mm DATA ARE CROSS POLARIZED.

SCAN NO. 29-3



TARGET: JEEP WITH RUBBERIZED CANVAS TOP AND TRAILER - 45° VIEW

IMAGE SIZE: 108 COLUMNS, 79 ROWS



FILE NO. WAVELENGTH

83 3.2 mm

84 10.6 μm CROSS POLARIZED

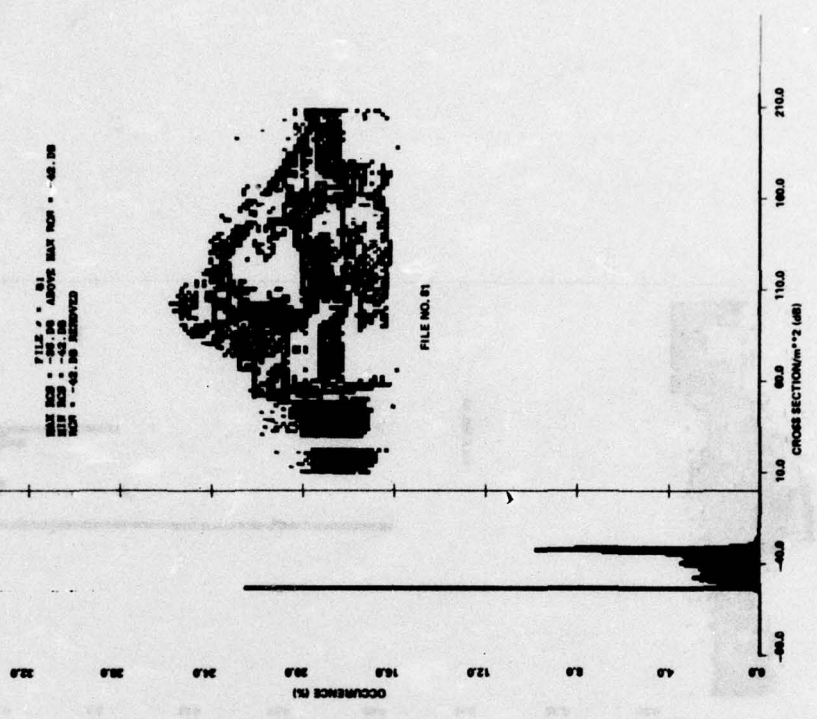
85 VISIBLE

RANGE TO TARGET

LEFT 57 ft 7 in. CENTER 48 ft 11 in. RIGHT 50 ft 3 in.

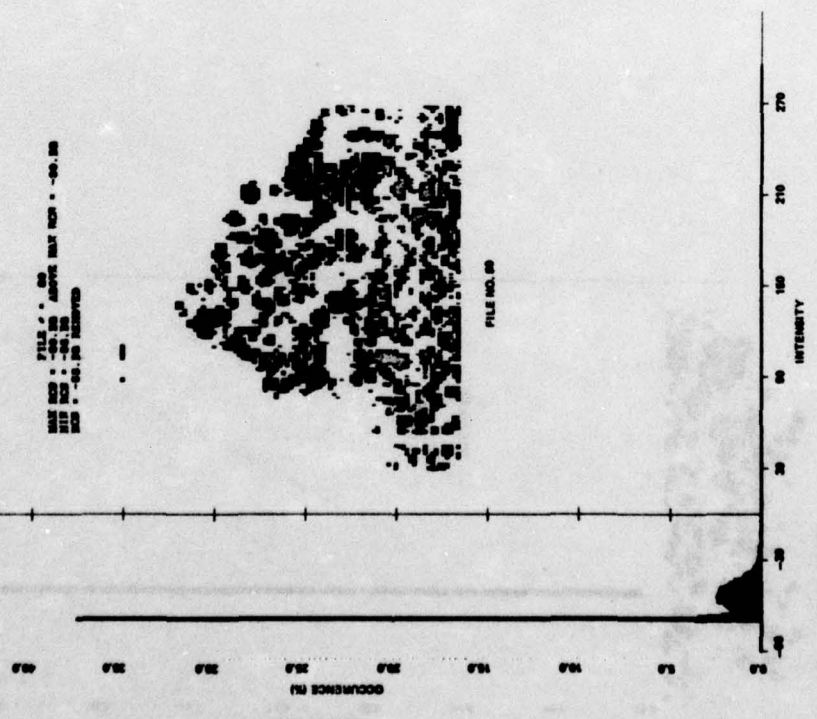
FILE # 81
MAX DBZ = -27.00
MIN DBZ = -45.00
RCP = -45.00

FILE NO. 81



FILE # 80
MAX DBZ = -27.00
MIN DBZ = -45.00
RCP = -45.00

FILE NO. 80



FILE NO. 04
DATE REC'D - 10-10-58
FILE NO. 04
DATE REC'D - 10-10-58
FILE NO. 04
DATE REC'D - 10-10-58



0.0
4.0
8.0
12.0
16.0
20.0
24.0
28.0
32.0

FILE NO. 04

CROSS SECTION (m²) (dB)

30.0

16.0

0

-16.0

-32.0

-48.0

-64.0

FILE NO. 02
DATE REC'D - 10-10-58
FILE NO. 02
DATE REC'D - 10-10-58
FILE NO. 02
DATE REC'D - 10-10-58



0.0
6.0
12.0
18.0
24.0
30.0
36.0
42.0
48.0

FILE NO. 02

INTENSITY

20

10

0

-10

-20

-30

-40

-50

-60

SCAN NO. 29-4

TARGET: 2 JEEPS, ONE REAR VIEW AND ONE FRONT
VIEW

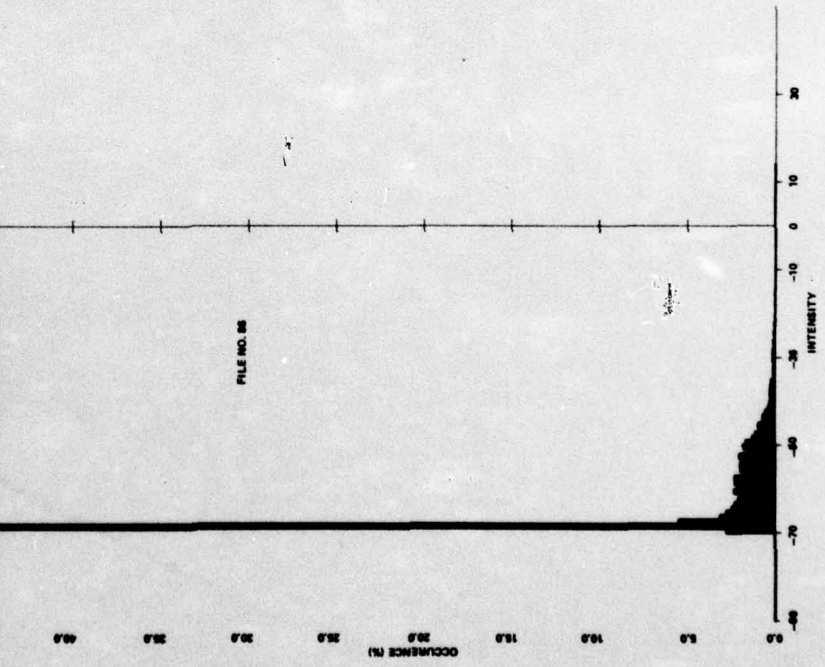
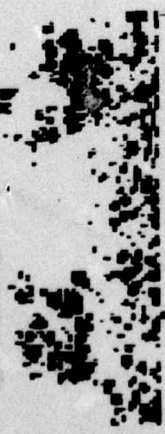
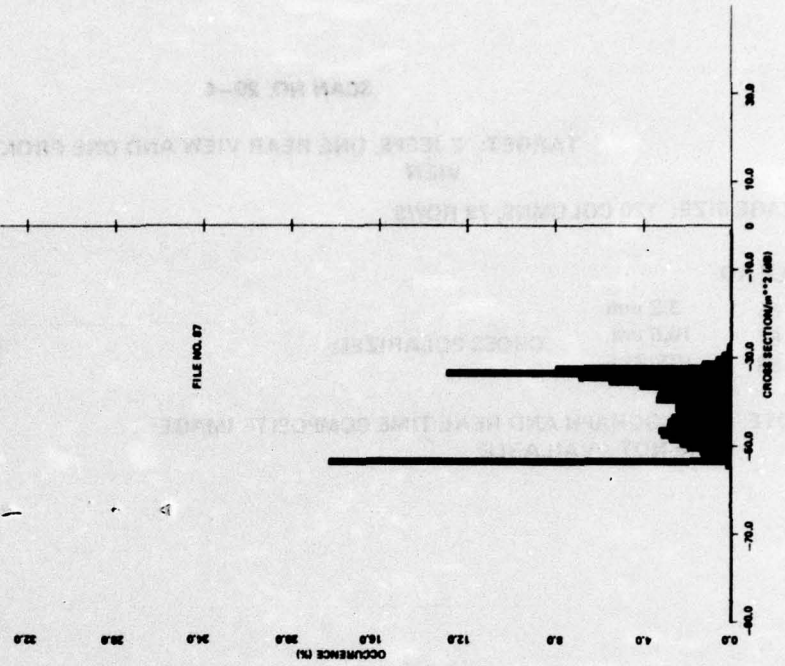
IMAGE SIZE: 120 COLUMNS, 78 ROWS

FILE NO.

86	3.2 mm	
87	10.6 μ m	CROSS POLARIZED
88	VISIBLE	

NOTE: PHOTOGRAPH AND REAL TIME COMPOSITE IMAGE
ARE NOT AVAILABLE

FILE NO. 87
FILE NO. 88



SCAN NO. 29-5

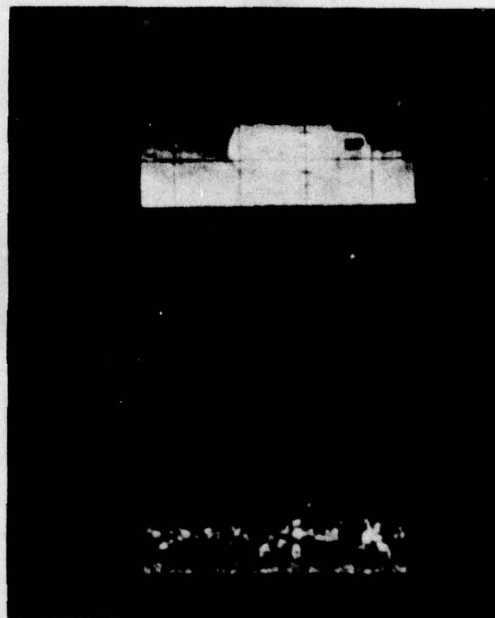


TARGET: 2 1/2 TON CANVAS COVERED TRUCK WITH WATER TANK TRAILER - SIDE VIEW

IMAGE SIZE: 201 COLUMNS, 97 ROWS

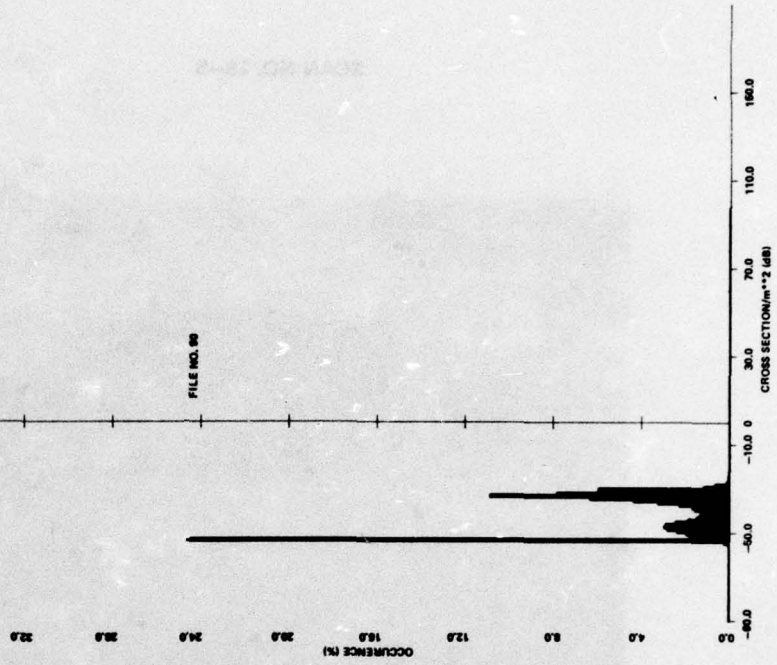
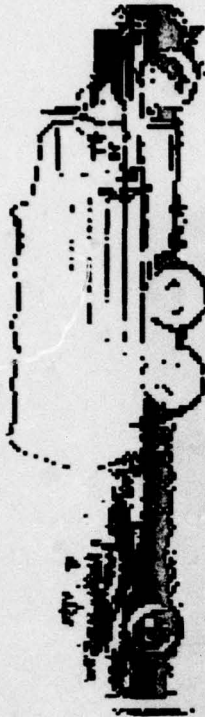
FILE NO.	WAVELENGTH	V_s
89	3.2 mm	CROSS POLARIZED
90	10.6 μm	7.1
91	VISIBLE	-

RANGE TO TARGET
LEFT 53 ft CENTER 48 ft 1 in. RIGHT 50 ft 2 in.

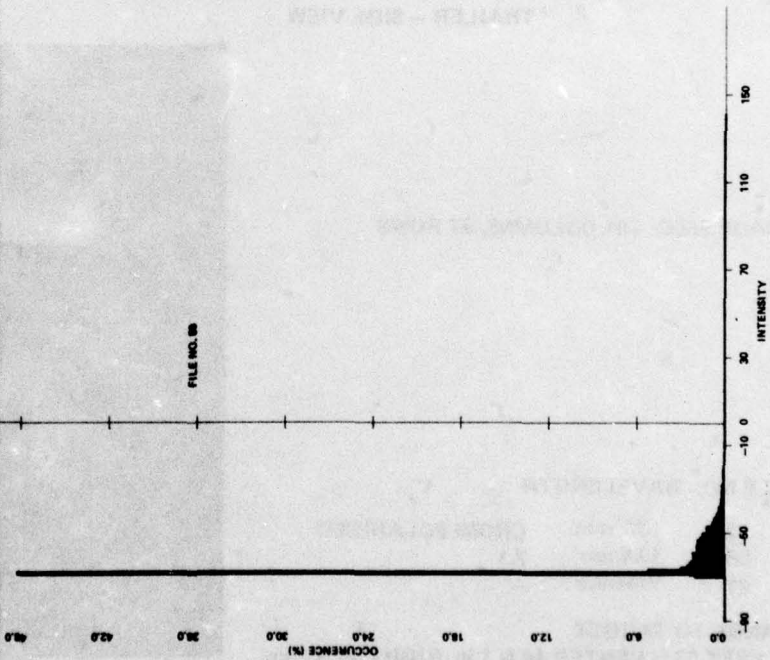


NOTE: SCAN MADE AT DUSK SO THERE IS NO VISIBLE IMAGE

FILE NO. 100
DATE: 10-10-68
TIME: 10:00 AM
CROSS SECTION: 100.00
FILE NO. 100



FILE NO. 100
DATE: 10-10-68
TIME: 10:00 AM
CROSS SECTION: 100.00
FILE NO. 100

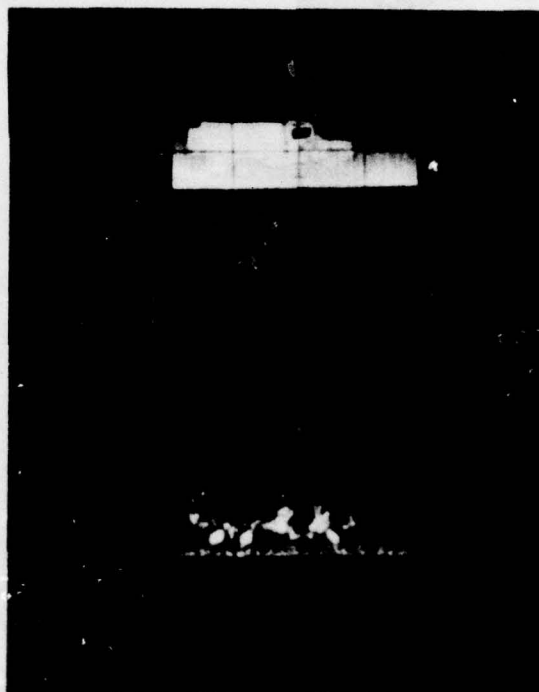


SCAN NO. 29-6



TARGET: 2 1/2 TON TRUCK WITH FLAT BED AND WOODEN SIDE RAILS - SIDE VIEW.

IMAGE SIZE: 183 COLUMNS, 96 ROWS



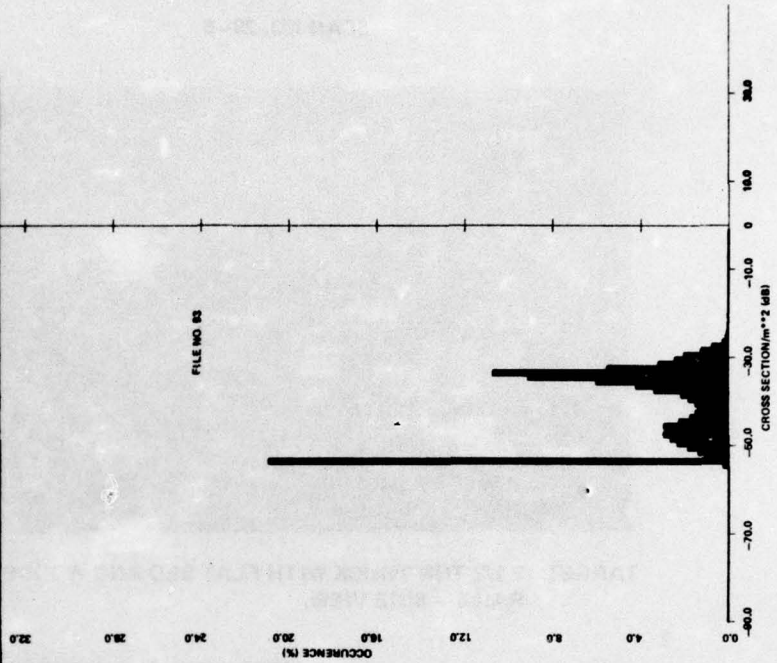
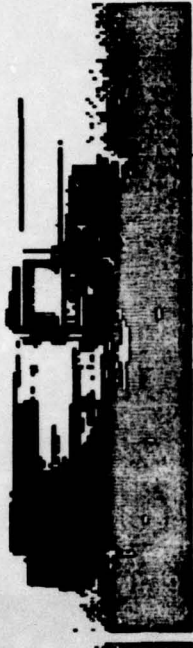
FILE NO.	WAVELENGTH	V _s
92	3.2 mm	CROSS POLARIZED
93	10.6 μm	7.1
94	VISIBLE	-

RANGE TO TARGET

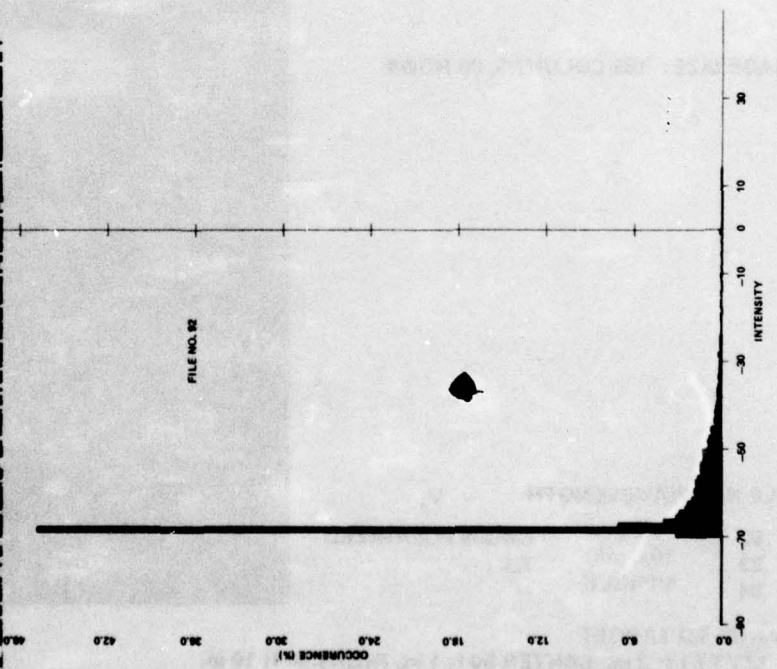
LEFT 51 ft 2 in. CENTER 50 ft 1 in. RIGHT 50 ft 10 in.

NOTE: NO VISIBLE IMAGE - SCAN MADE AT DUSK.

FILE # 99
DATE REC'D - 11/15/58
TIME REC'D - 10:15 AM
ADVICE SENT REC'D - 10:30 AM
RECEIVED



FILE # 100
DATE REC'D - 11/15/58
TIME REC'D - 10:15 AM
ADVICE SENT REC'D - 10:30 AM
RECEIVED

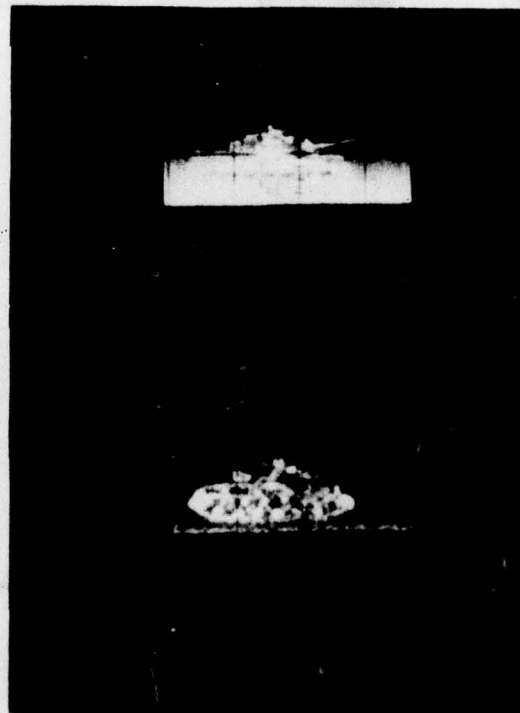


SCAN NO. 29-7



TARGET M48 TANK - SIDE VIEW

IMAGE SIZE: 183 COLUMNS, 89 ROWS

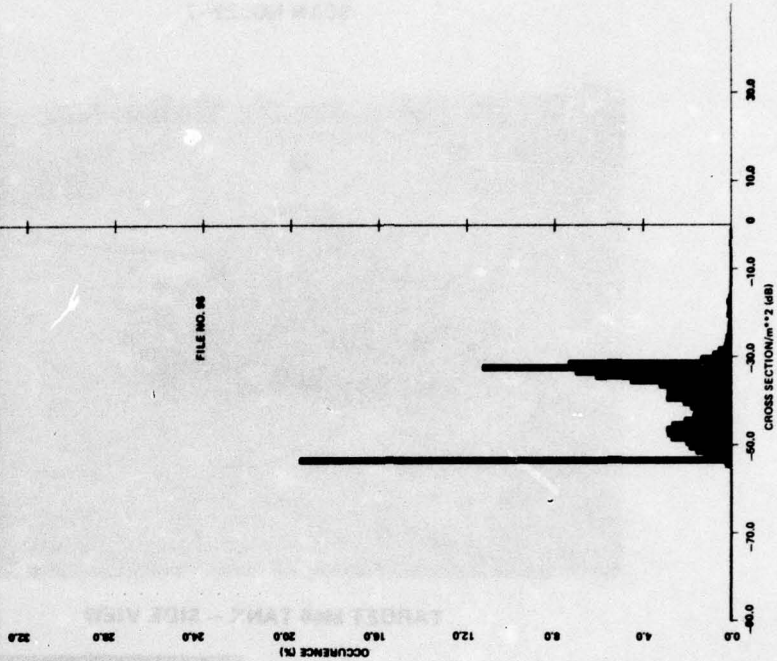


FILE NO.	WAVELENGTH	V_s
95	3.2 mm	CROSS POLARIZED
96	10.6 μ m	7.1 V
97	VISIBLE	

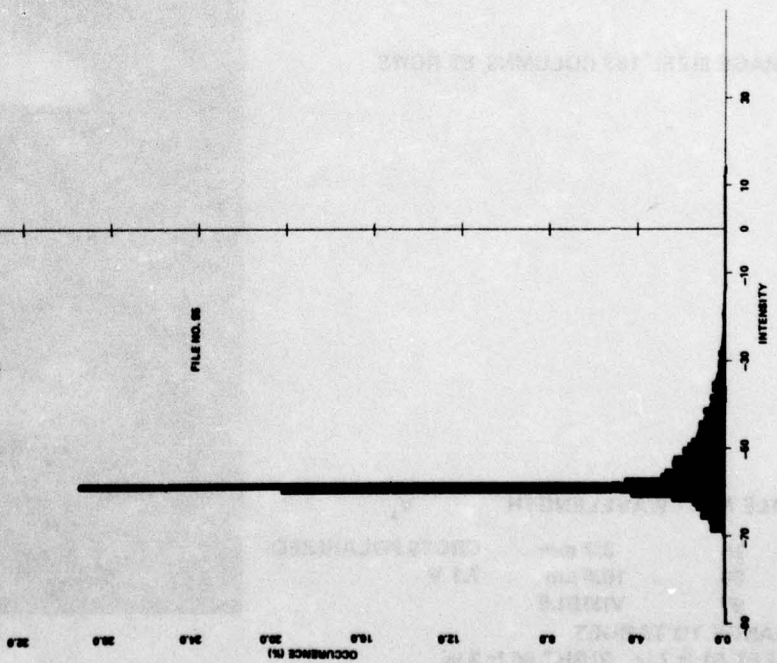
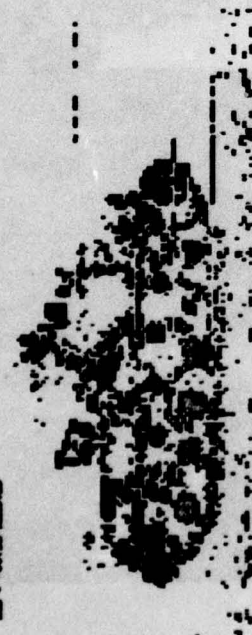
RANGE TO TARGET
LEFT 51 ft 7 in. RIGHT 50 ft 3 in.

NOTE: THE GAIN OF THE 3.2 mm SYSTEM WAS INCREASED BY APPROXIMATELY A FACTOR OF FOUR. NO CHANGE WAS MADE IN THE 10.6 μ m SYSTEM

FILE NO. 98
DATE REC'D : -40.00
TIME REC'D : -40.00
REC'D : -40.00 RECEIVED



FILE NO. 98
DATE REC'D : -40.00
TIME REC'D : -40.00
REC'D : -40.00 RECEIVED



SCAN NO. 29-8

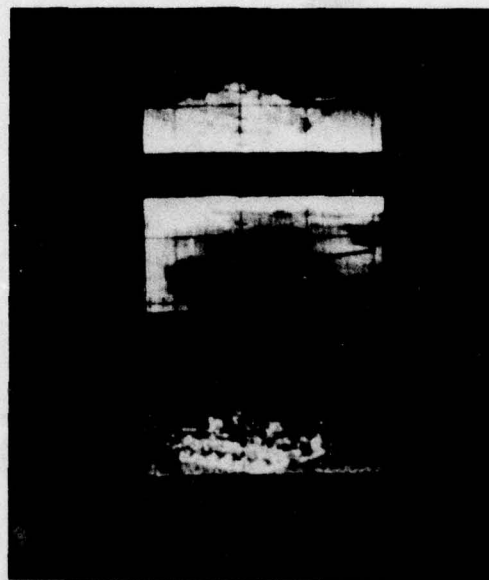


TARGET: M48 TANK AT 45 deg VIEW

IMAGE SIZE: 174 COLUMNS, 100 ROWS

FILE NO. WAVELENGTH

98	3.2 mm	CROSS POLARIZED
99	10.6 μ m	
100	VISIBLE	



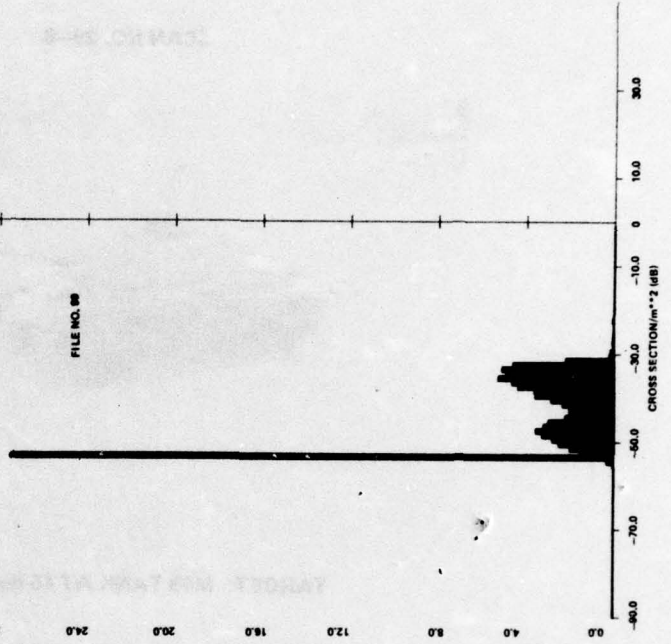
RANGE TO TARGET

LEFT 59 ft 9 in. CENTER 44 ft 11 in. RIGHT 55 ft 5 in.

FILE # 10
MAX SIZE - 100 MB
MIN SIZE - 10 MB
SIZE - 100 MB RECEIVED



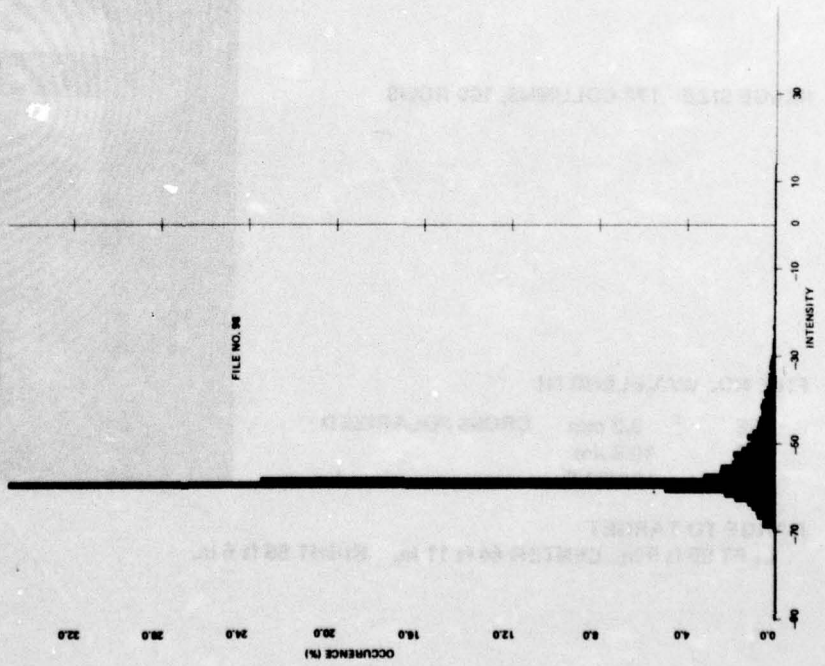
OCURRENCE (%)



FILE # 10
MAX SIZE - 100 MB
MIN SIZE - 10 MB
SIZE - 100 MB RECEIVED



OCURRENCE (%)



SCAN NO. 29-9



TARGET: 2 1/2 TON CANVAS COVERED TRUCK - HEAD ON

IMAGE SIZE: 75 COLUMNS, 100 ROWS

FILE NO. WAVELENGTH

101	3.2 mm
102	10.6 μ m
103	VISIBLE

RANGE TO TARGET

LEFT 46 ft 6 in. RIGHT 47 ft 8 in.

NOTE: THE PAINT ON MANY OF THE VEHICLES WAS QUITE WEATHERED. THE HOOD ON THIS TRUCK WAS RUSTY.



AD-A040 245

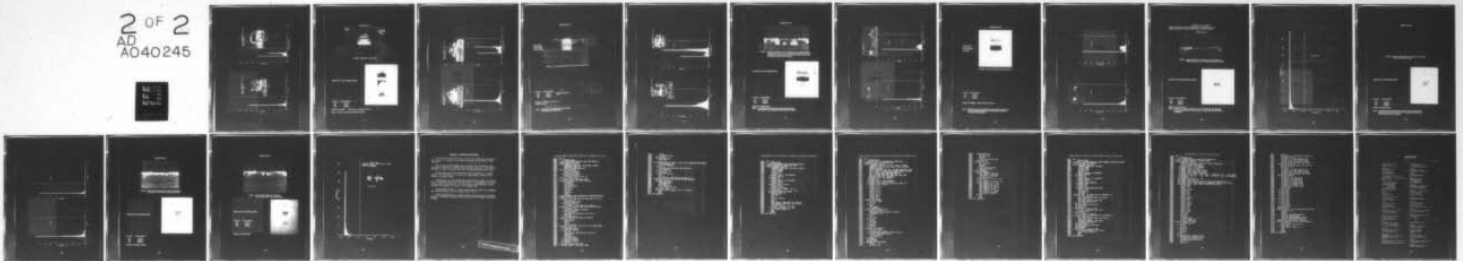
ARMY MISSILE RESEARCH AND DEVELOPMENT COMMAND REDSTO--ETC F/G 17/5
INDEX OF 3.2-MM AND 10.6-MICROMETERS IMAGE DATA TAPES.(U)

UNCLASSIFIED

DRDMI-TR-77-2

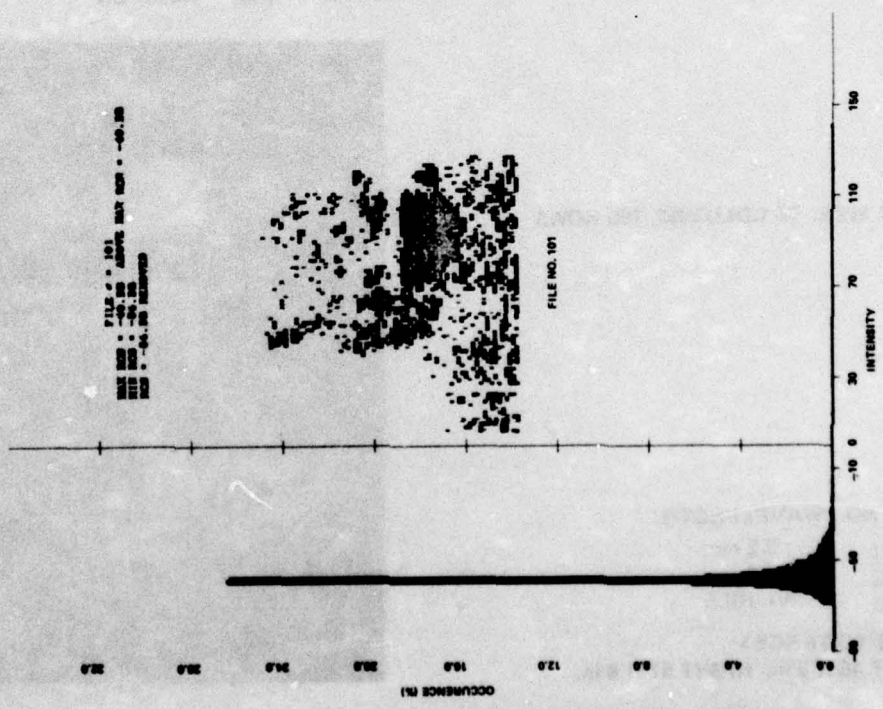
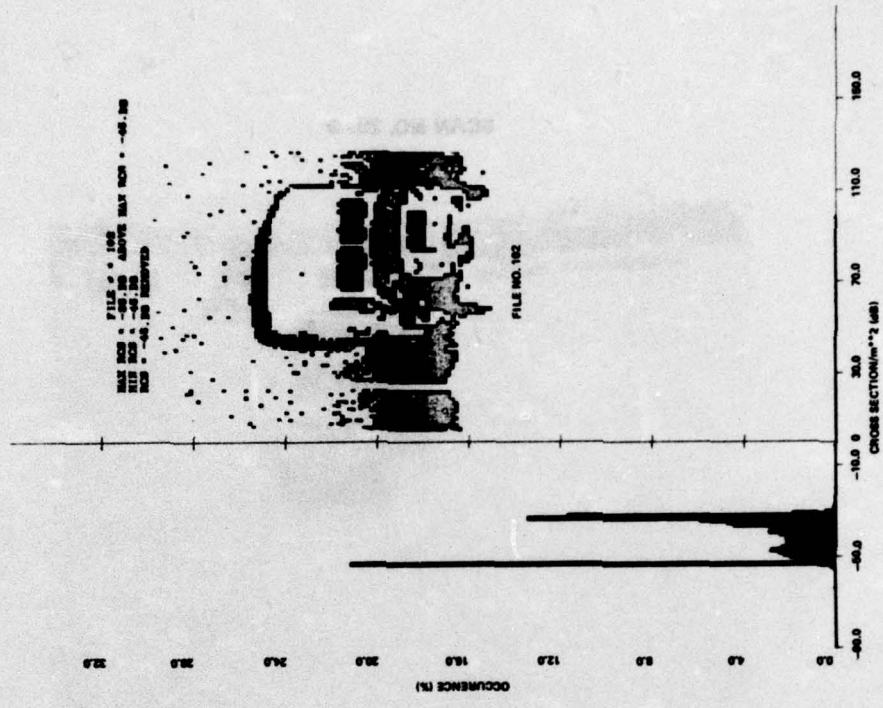
NL

2 OF 2
AD
A040245



END

DATE
FILMED
6-77

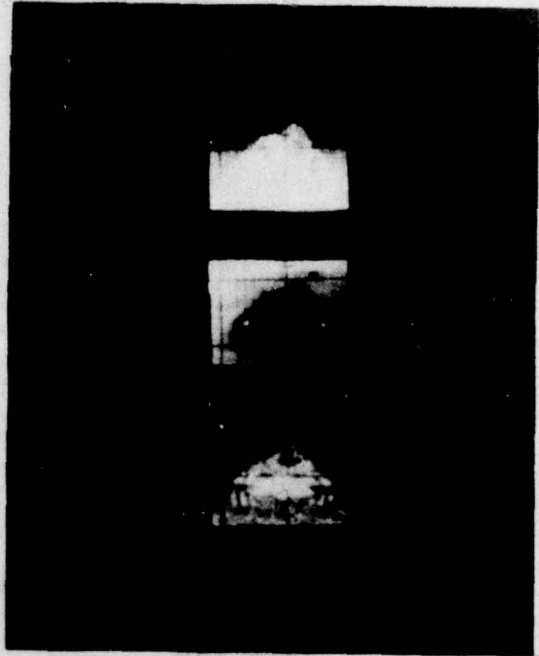


SCAN NO. 29-11



TARGET: M48 TANK - BACK VIEW

IMAGE SIZE: 102 COLUMNS 95 ROWS



FILE NO.	WAVELENGTH
104	3.2 mm
105	10.6 μ m
106	VISIBLE

RANGE TO TARGET LEFT 45 ft 11 in. RIGHT 45 ft 10 in.

NOTE: A VERY LIGHT DRIZZLE WAS FALLING.

FILE # : 100
MAX SIZE : 100 MB
MIN SIZE : 10 MB
SIZE : 100 MB RECEIVED

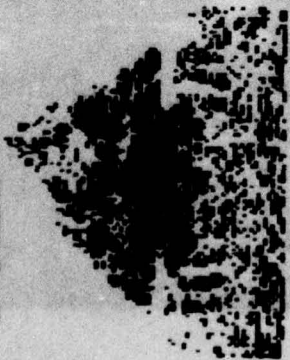


FILE NO. 100

OCCURRENCE (%)

CROSS SECTION (m**2 MB)

FILE # : 100
MAX SIZE : 100 MB
MIN SIZE : 10 MB
SIZE : 100 MB RECEIVED



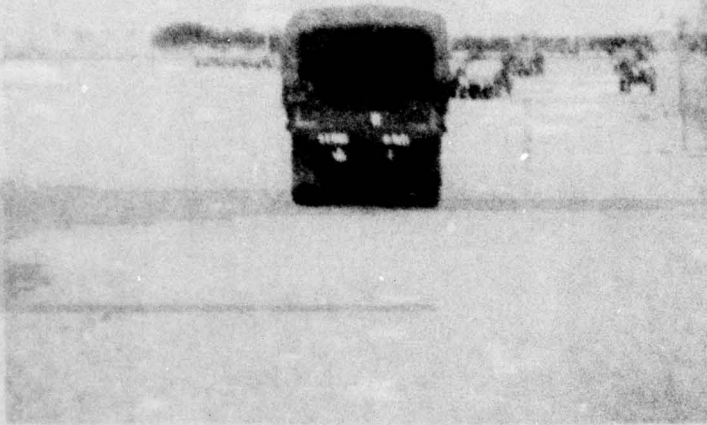
FILE NO. 100

OCCURRENCE (%)

INTENSITY

SCAN NO. 29-12

IMAGE SIZE:
78 COLUMNS
AND 95 ROWS



TARGET: 2 1/2 TON TRUCK WITH CANVAS TOP—REAR VIEW

FILE NO.	WAVELENGTH	V _s
107	3.2 mm	CROSS POLARIZED
108	10.8 μm	7.2 V
100	VISIBLE	-

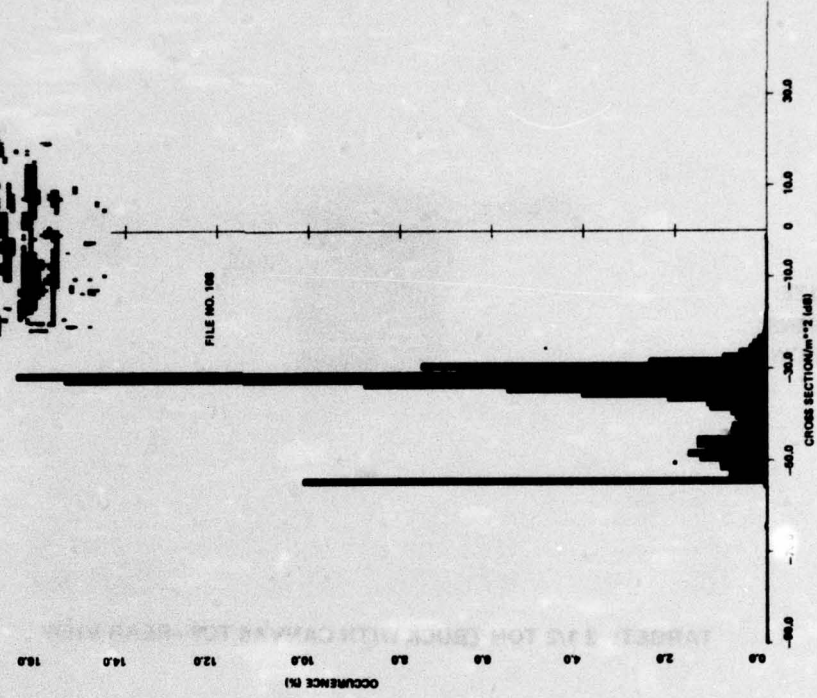
RANGE TO TARGET LEFT 43 ft 7 in.
RIGHT 43 ft 7 in.

NOTE: THE REAL TIME COMPOSITE IMAGE IS NOT
AVAILABLE FOR THIS SCAN.

FILE # 109
MIN MAX - 10.0 30.0
MIN MAX - 10.0 30.0
MIN MAX - 10.0 30.0



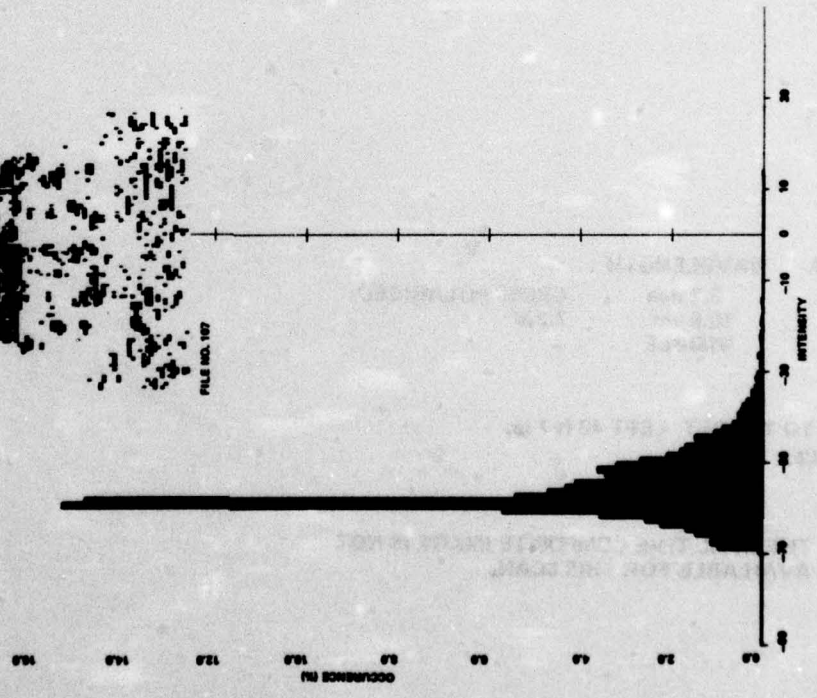
FILE NO. 109



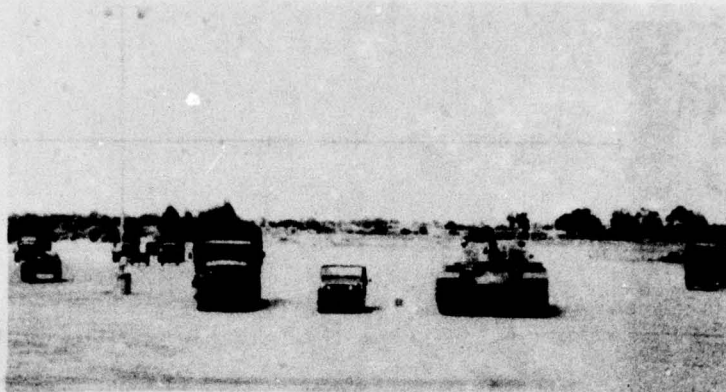
FILE # 107
MIN MAX - 10.0 30.0
MIN MAX - 10.0 30.0
MIN MAX - 10.0 30.0



FILE NO. 107

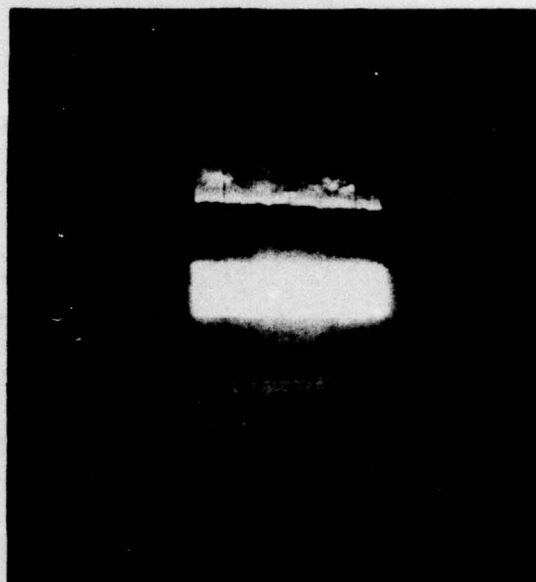


SCAN NO. 29-13



TARGET: FRONT VIEW FROM LEFT TO RIGHT OF A 2 1/2 TON CANVAS COVERED TRUCK A JEEP, A CORNER CUBE MOUNTED IN THE CENTER OF A BLACK SQUARE OF PAPER MOUNTED ON WHITE CARDBOARD, AND AN M-48 TRUCK.

IMAGE SIZE 138 COLUMNS 59 ROWS

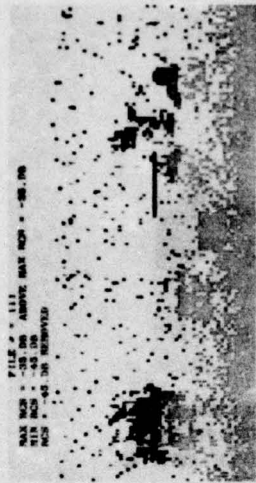


FILE NO. WAVELENGTH

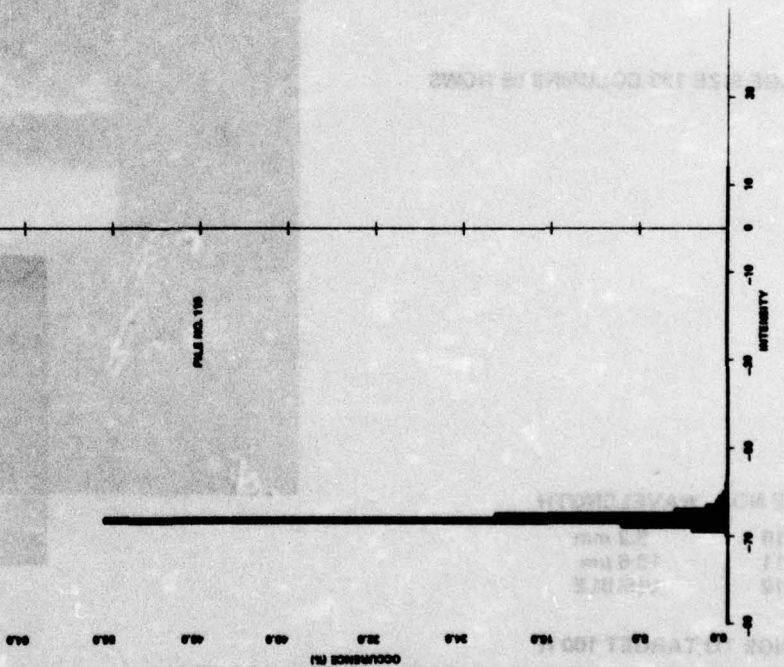
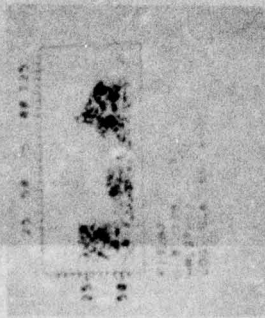
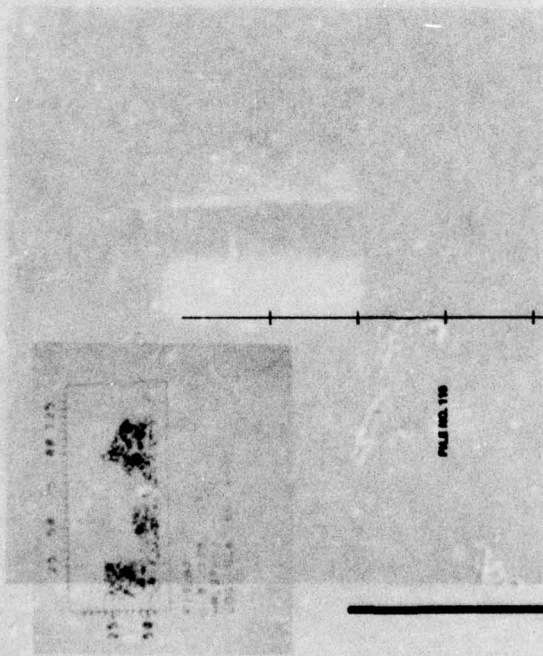
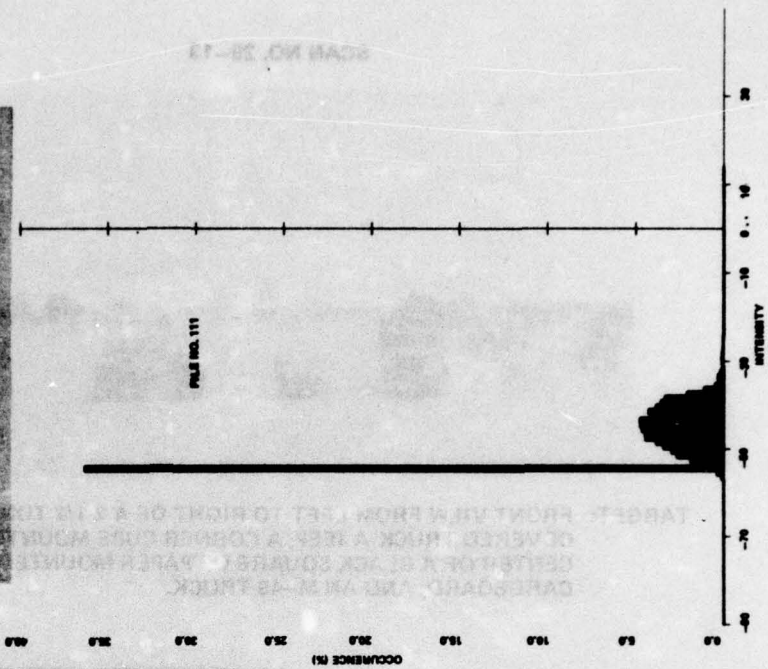
110	3.2 mm
111	10.6 μm
112	VISIBLE

RANGE TO TARGET 100 ft

NOTE: THE TRANSMIT AND RECEIVE ANTENNA ARE CROSS POLARIZED. THE RECEIVED SIGNAL WAS QUIET WEAK.

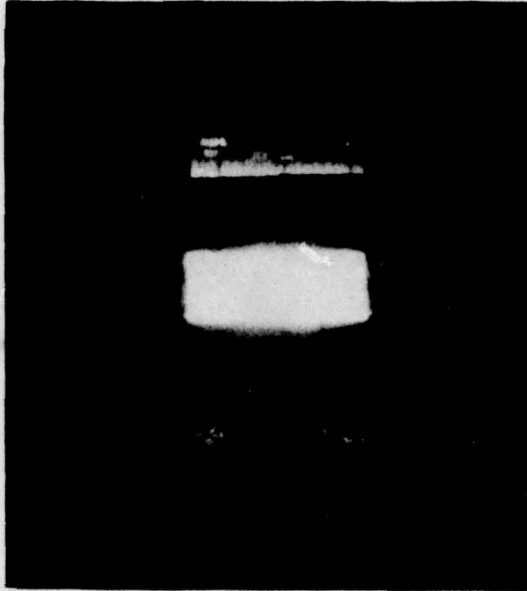


FILE # 111
 MAX RES = 150 IN
 MIN RES = 150 IN
 RES = 150 IN



SCAN NO. 29-14

IMAGE SIZE
129 COLUMNS
62 ROWS

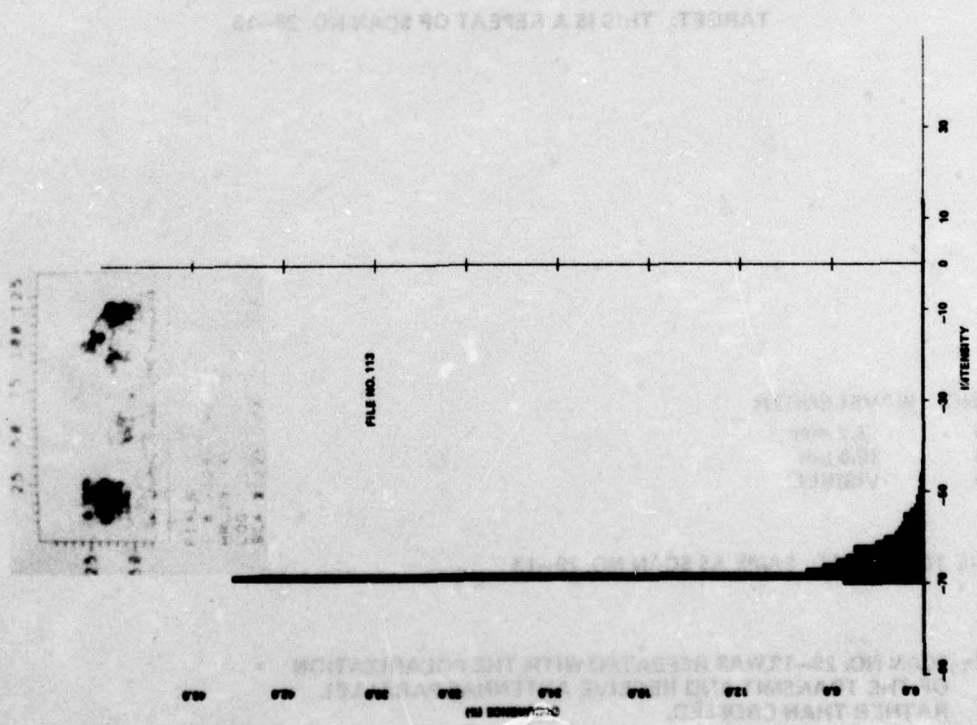
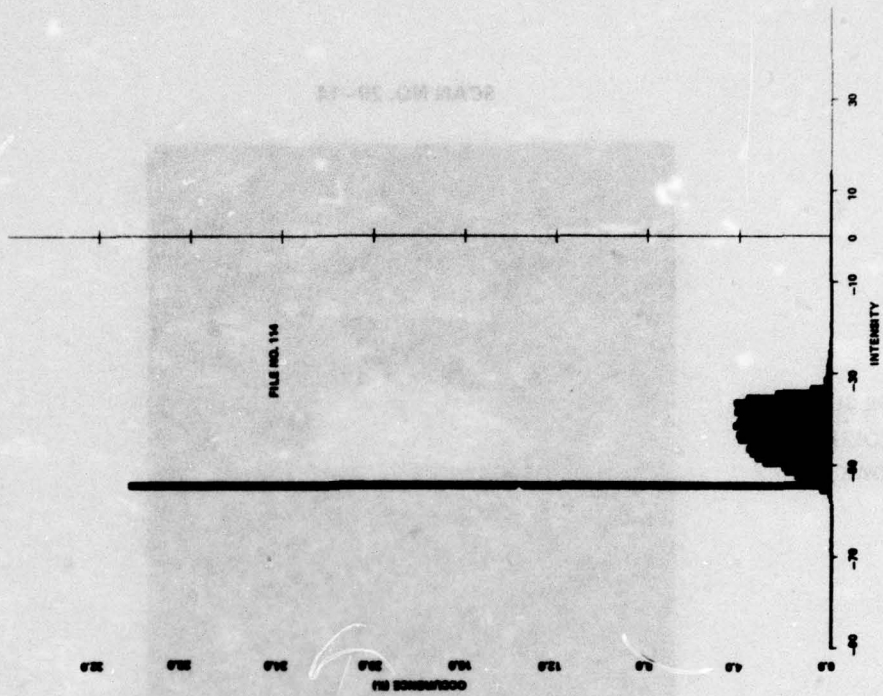


TARGET: THIS IS A REPEAT OF SCAN NO. 29-13

FILE NO.	WAVELENGTH
113	3.2 mm
114	10.6 μ m
115	VISIBLE

RANGE TO TARGET: SAME AS SCAN NO. 29-13

NOTE: SCAN NO. 29-13 WAS REPEATED WITH THE POLARIZATION OF THE TRANSMIT AND RECEIVE ANTENNAS PARALLEL RATHER THAN CROSSED.



SCAN NO. 29-15, 16 AND 17
THESE FILES DO NOT CONTAIN MEANINGFUL INFORMATION. THE
SCANS WERE USED TO ALIGN THE SYSTEM AT THE 400 ft RANGE.

SCAN NO. 29-18

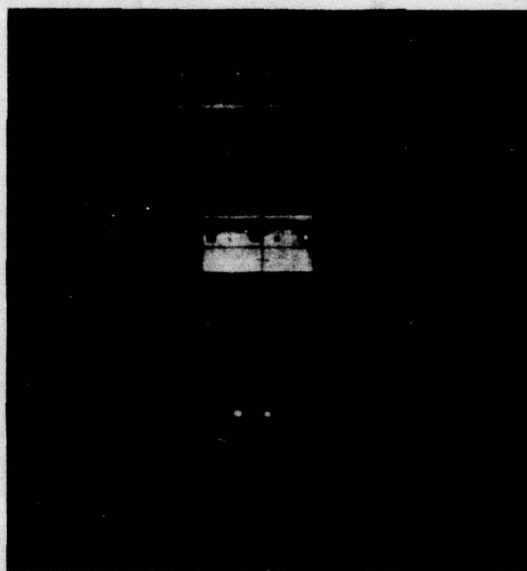


TARGET: FRONT VIEW LEFT TO RIGHT A 2 1/2 TON TRUCK, A
CORNER CUBE, A JEEP, A CORNER CUBE AND A TANK.

IMAGE SIZE: 81 COLUMNS AND 49 ROWS

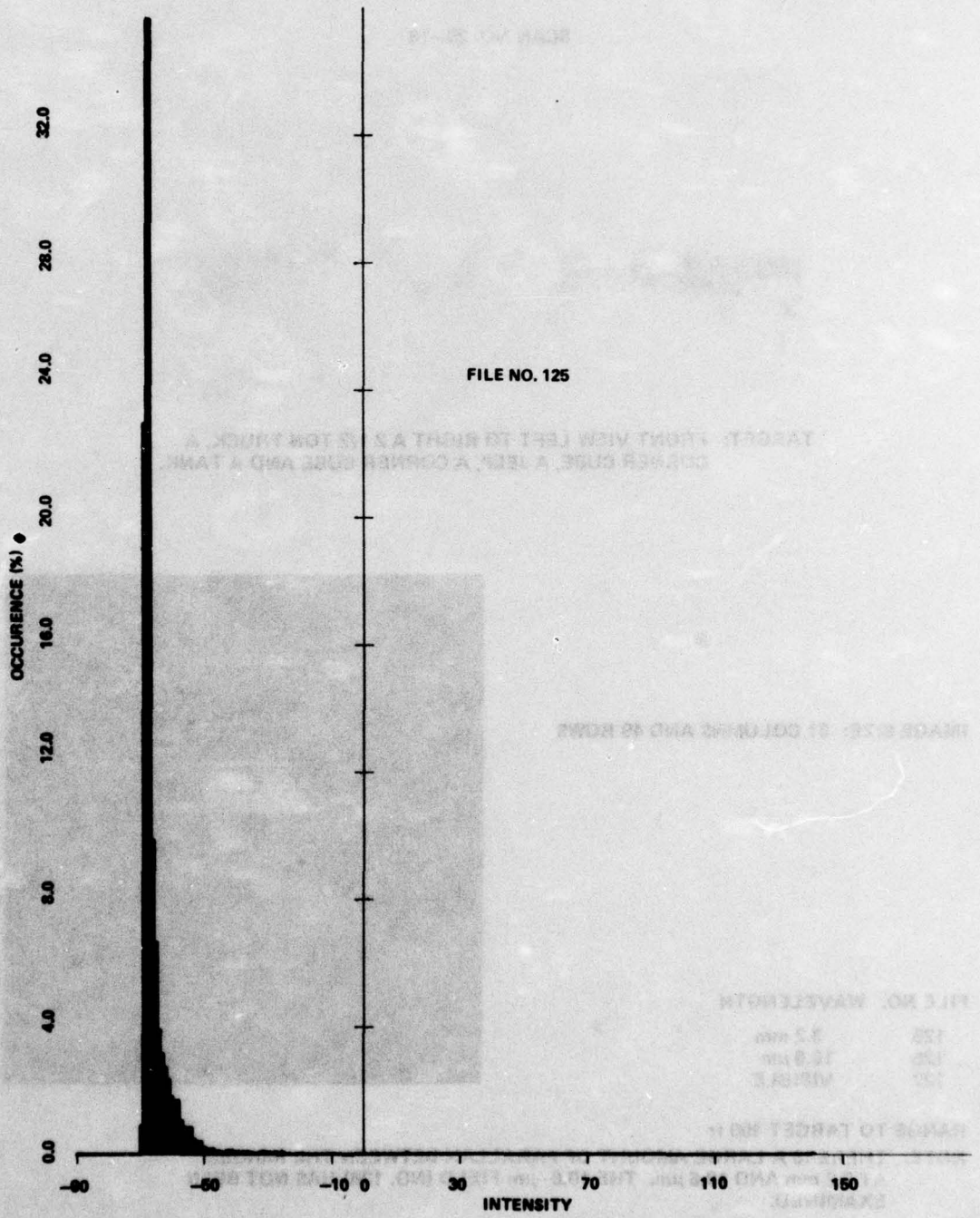
FILE NO. WAVELENGTH

125	3.2 mm
126	10.6 μ m
127	VISIBLE



RANGE TO TARGET 400 ft

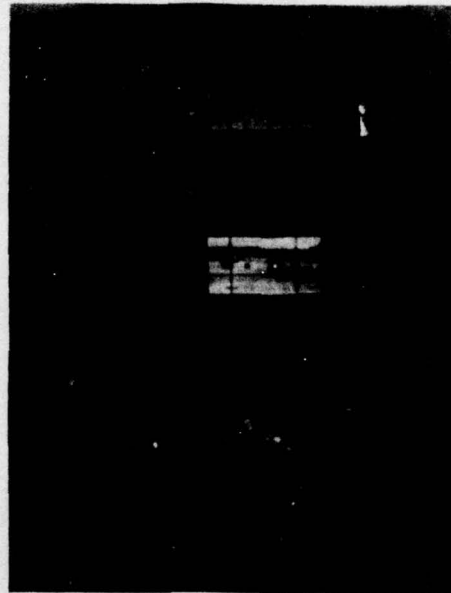
NOTE: THERE IS A LARGE AMOUNT OF PARALLAX BETWEEN THE IMAGES
AT 3.2 mm AND 10.6 μ m. THE 10.6- μ m FIELD (NO. 126) HAS NOT BEEN
EXAMINED.



SCAN NO. 29-19

TARGET: FRONT VIEW FROM LEFT TO RIGHT A 2 1/2 TON
TRUCK, A JEEP AND A TANK

IMAGE SIZE: 84 COLUMNS 48 ROWS



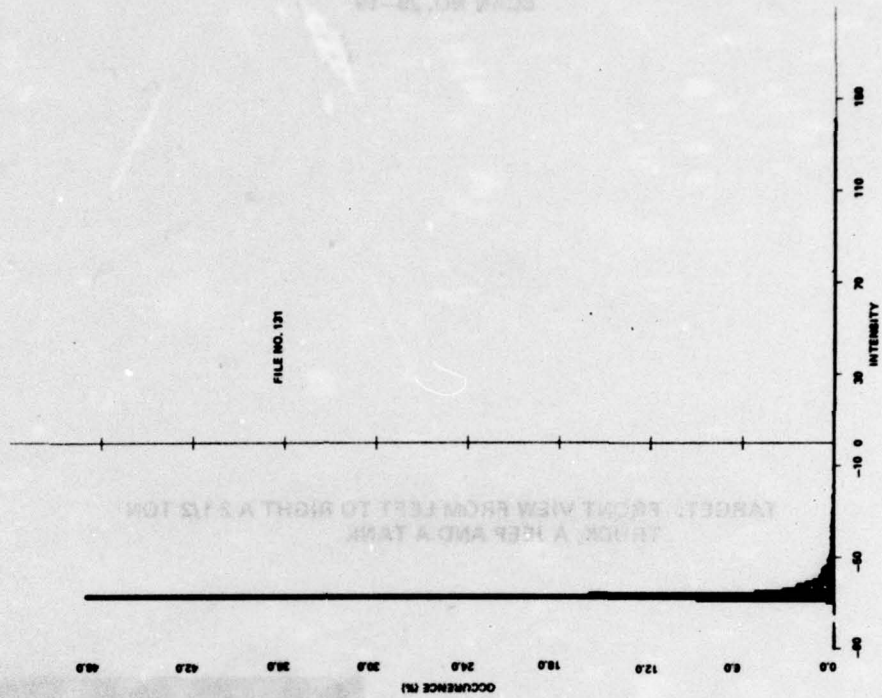
FILE NO.	WAVELENGTH
128	3.2 mm
129	10.6 μ m
130	VISIBLE

RANGE TO TARGET 400 ft

NOTE: THE LARGE OIL STORAGE TANK VISIBLE IN THE PHOTOGRAPH
ON THE RIGHT SIDE OF THE TANK AT A RANGE OF 250 ft DOES
APPEAR IN THE 3.2-mm IMAGE.

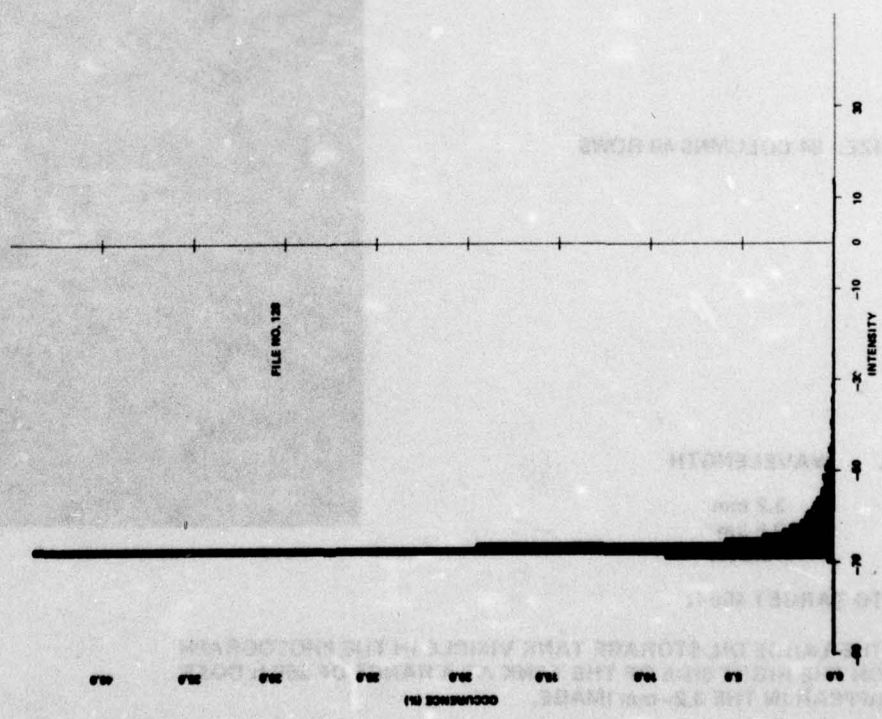
FORM NO. 28-72

FILE NO. 131



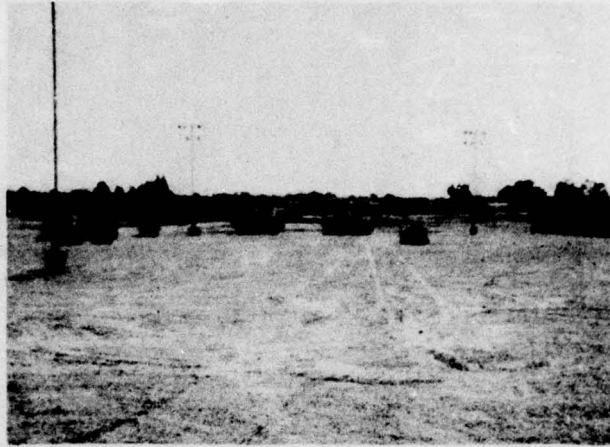
TARGET: FRONT VIEW FROM LEFT TO RIGHT AT 1/2 TON
THICK A HEP AND A TANK

FILE NO. 132



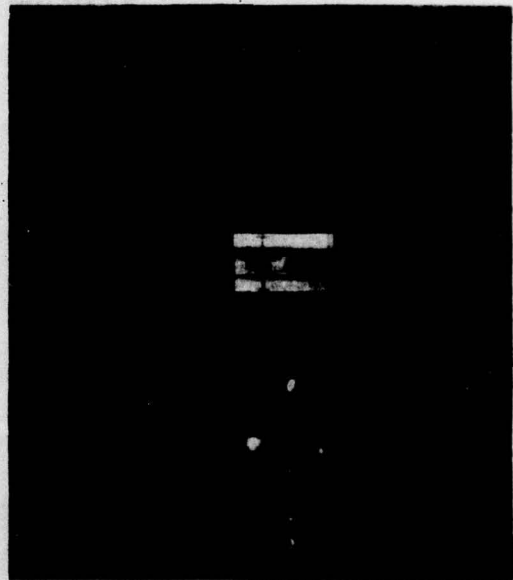
NOTE: ALL DATA STORED TANK WHICH IS THE PROCEEDING
IN THE 25-TH IMAGE
RANGE TO TARGET AREA
FILE NO. WAVELENGTH
132 2.5 mm
131 2.5 mm

SCAN NO. 29-20



TARGET: SIDE VIEW FROM LEFT TO RIGHT OF A CANVAS COVERED 2 1/2 TON TRUCK AND AN M48 TANK

IMAGE SIZE 75 COLUMNS 40 ROWS



FILE NO.	WAVELENGTH
131	3.2 mm
132	10.6 μ m
133	VISIBLE

RANGE TO TARGET IS 400 ft

SCAN NO. 29-21

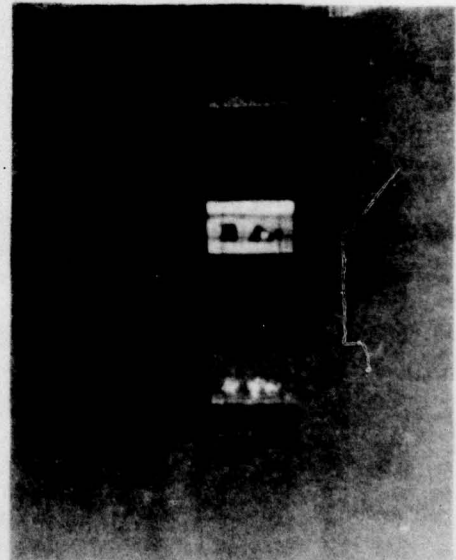


TARGET: FRONT VIEW FROM LEFT TO RIGHT
A 2 1/2 TON TRUCK AND AN M48 TANK

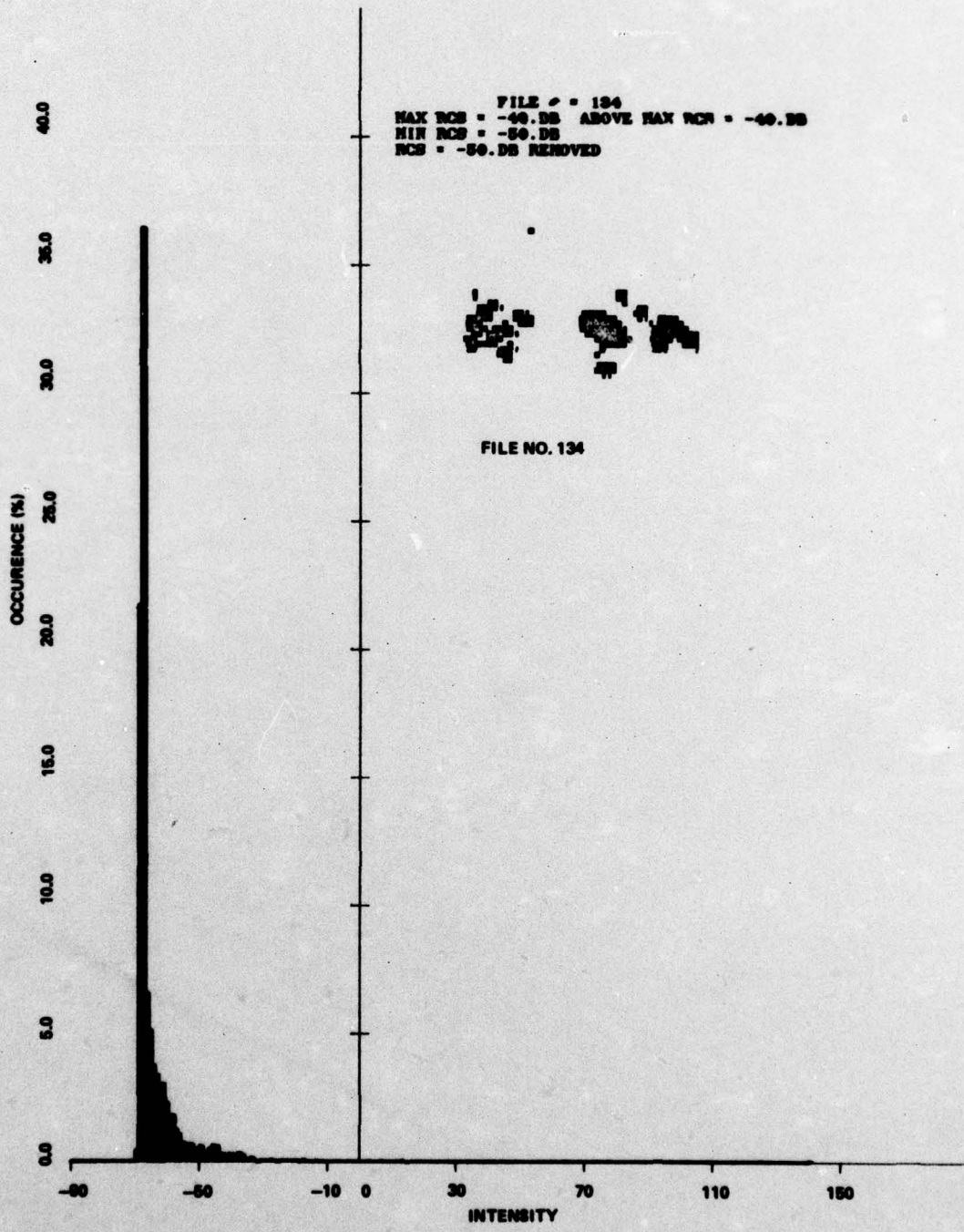
IMAGE SIZE 75 COLUMNS 48 ROWS

FILE NO.	WAVELENGTH
134	3.2 mm
135	10.6 μ m
136	VISIBLE

RANGE TO TARGET 200 ft



HTTMBLBYWVW JON 2119
mm 3.2 10F
mm 10.6 10F
VISIBLE 10F
RANGE TO TARGET 200 FT



Appendix B. COMPUTER PROGRAMS

To indicate the methods used to handle the image data described in this report, a listing of the computer programs is provided in this appendix.

The program entitled RDMT reads the data from the magnetic tape and stores the data in a computer disk file for later use. The data are arranged so that individual rows can be accessed from the disk file.

Program WDT allows the binary data to be printed out in integer format. No modification to the data is made except a change from binary to integer format.

Program HIS uses the calibration information to convert the binary data to effective radar cross section values. A histogram of the data is then created and plotted. The resolution of the histogram can be modified by changing the value of the variable INT.

Program WDMT produces a crude visible image of the data by mapping the intensity values onto the numbers from 0 to 9.

Program BIWT produces a visible image of the data using a Versatic Plotter. Calibrated intensity contours can also be created using this program.

Program RDMT to Read Data Files into Computer Disk File

```

0001 FTN L T
0002 PROGRAM RDMT
0003 C READ IMAGE DATA FROM DATA TAPE AND STORE IN
0004 C DISK FILE CALLED DATA1
0005 C.B.D.GUENTHER 12/27/76
0006 DIMENSION JBUF(128) IDATA(1024) IPRAM(5)
0007 DIMENSION IFILE(3)
0008 DATA IFILE/2HDA 2HTA 1H1/
0009 C GO TO PROPER FILE
0010 CALL RMPAR(IPRAM)
0011 IPRAM(1)=IPRAM(1)-1
0012 10 CALL EXEC(3 1310B)
0013 IPRAM(1)=IPRAM(1)-1
0014 IF(IPRAM(1).GT.0) GO TO 10
0015 C READ IN FIRST RECORD
0016 CALL EXEC(1 110B IDATA 1024)
0017 C CALCULATE NUMBER OF PIVALS IN FILE
0018 IC=IDATA(1)
0019 IP=IDATA(2)
0020 IRR=1024/IC
0021 LEF=1024-IC*IRR
0022 IC1=IC/2
0023 IC2=IC-IC1
0024 IC1=IC2
0025 IC=2*IC2
0026 IROW=0
0027 KTAB=0
0028 C STORE COMPLETE ROWS CONTAINED IN RECORD ONTO DISK
0029 100 DO 11 KB=1 IRR
0030 C STORE FIRST 1/2 OF ROW INTO ODD SECTOR OF DISK
0031 DO 12 KC=1 IC1
0032 L=KC+IC*(KB-1)+KTAB
0033 12 JBUF(KC)=IDATA(L)
0034 JS=2*(KB+IROW)-1
0035 CALL EXEC(15 102B JBUF IC1 IFILE JS)
0036 C STORE LAST 1/2 OF ROW INTO EVEN SECTOR OF DISK
0037 DO 13 KC=1 IC2
0038 L=KC+KB*IC1+(KB-1)*IC2+KTAB
0039 13 JBUF(KC)=IDATA(L)
0040 JS=2*(KB+IROW)
0041 CALL EXEC(15 102B JBUF IC2 IFILE JS)
0042 11 CONTINUE
0043 IF(LEF)50 50 70
0044 C STORE ROW DIVIDED BETWEEN TWO RECORDS
0045 70 IROW=IROW+1
0046 IFOL=LEF-IC1
0047 ICOL=0
0048 JN=0
0049 IF(IFOL)19 20
0050 C IF OVER 1/2 OF ROW STORE FIRST 1/2 IN ODD SECTOR
0051 20 DO 22 KA=1 IC1
0052 L=KA+IC*IRR+KTAB
0053 22 JBUF(KA)=IDATA(L)
0054 JS=JS+1
0055 CALL EXEC(15 102B JBUF IC1 IFILE JS)
0056 LEF=LEF-IC1
0057 ICOL=IC2
0058 IF(LEF)24 24 19
0059 DO 23 KA=1 LEF
0060 L=KA+IC*IRR+KTAB
0061 23 JBUF(KA)=IDATA(L)
0062 JS=JS+1
0063 C GET NEXT RECORD FROM TAPE
0064 24 CALL EXEC(1 110B IDATA 1024)

```

```

0065      ITAB=0
0066      IF(IFOL)30 40 31
0067      30 ICOL=IC1
0068      31 ITAB=ICOL-LEF
0069      ISEC=LEF+1
0070      L=1
0071      C STORE REMAINDER OF FIRST 1/2 OF ROW DIVIDED BETWEEN "EO"
0072      DO 32 KA=ISEC ICOL
0073      JBUF(KA)=IDATA(L)
0074      32 L=L+1
0075      CALL EXEC(15 102B JBUF ICOL IFILE JS)
0076      IF(IFOL)40 50
0077      40 DO 41 KA=1 IC2
0078      L=KA+ITAB
0079      41 JBUF(KA)=IDATA(L)
0080      JH=1
0081      JS=JS+1
0082      CALL EXEC(15 102B JBUF IC2 IFILE JS)
0083      C STORE LAST 1/2 OF ROW DIVIDED BETWEEN RECORDS
0084      50 IROW=IROW+IRR
0085      KTAB=ITAB+IC2*JH
0086      ITAB=1024-KTAB
0087      IRR=ITAB/IC
0088      LEF=ITAB-IC*IRR
0089      IF(In-In0)60 60 100
0090      60 WRITE(1 90)Jc
0091      90 FORMAT("DATA LOADED" 1X 13 1X "SECTORS")
0092      END
0093      ENDS
**** LIST END ****

```

Program WDT to List Contents of Image File Stored in Computer

```
0001 FTN L T
0002 PROGRAM WDT
0003 C PRINT THE CONTENTS OF THE DISK FILE DATA1
0004 C WHICH CONTAINS AN IMAGE DATA FILE
0005 C B.D. GUENTHER 12/27/76
0006 DIMENSION IBUF(128) JBUF(128) IFILE(3)
0007 IFILE(1)=2HDA
0008 IFILE(2)=2HTA
0009 IFILE(3)=1H1
0010 WRITE(1 1)
0011 1 FORMAT('INPUT # OF SECTORS')
0012 READ(1 90)ISEC
0013 90 FORMAT(I3)
0014 WRITE(1 4)
0015 4 FORMAT('INPUT # OF COLUMNS')
0016 READ(1 90)ICOL
0017 WRITE(1 92)
0018 92 FORMAT('INPUT FILE #')
0019 READ(1 90)IFY
0020 WRITE(6 91)IFY
0021 91 FORMAT('FILE NUMBER: ' I3 //)
0022 IC1=ICOL/2
0023 93 FORMAT('IMAGE ROW NUMBER ' I3)
0024 5 FORMAT(10(I5 2X))
0025 IC2=ICOL-IC1
0026 IC1=IC2
0027 N=0
0028 DO 3 K=2 ISEC 2
0029 J=K-1
0030 N=N+1
0031 CALL EXEC(14 103B IBUF IC1 IFILE J)
0032 CALL EXEC(14 103B JBUF IC2 IFILE K)
0033 WRITE(6 93)N
0034 WRITE(6 5)(IBUF(L) L=1 IC1)
0035 3 WRITE(6 5)(JBUF(L) L=1 IC2)
0036 CALL EXEC(3 1106B -1)
0037 END
0038 ENDS
**** LIST END ****
```

Program HIS to Calculate and Plot a Histogram of an Image File

```

0001 FTN L T
0002 PROGRAM HIS
0003 C CALCULATE AND PLOT HISTOGRAM OF IMAGE DATA
0004 C STORED IN DATA FILE CALLED DATA1
0005 C B.D. GUENTHER 12/27/76
0006 DIMENSION JBUF(128) X(1024) Y(1024) IFILE(3)
0007 DIMENSION IPAT(4) IT1(4) IX(6) IY1(5) IY2(13)
0008 COMMON ICOM(135)
0009 DATA IFILE/2HDA 2HTA 1H1/ IT1/2HFI 2HLE 2H # 2H= /
0010 DATA SA/9999./ IPAT/10421B 21042B 42104B 104210B/
0011 DATA IY/2HX 2HOC 2HC# 2HRE 2HNC 2HE /
0012 DATA IY1/2HIN 2HTE 2HNS 2HIT 2HY /
0013 DATA IY2/2HCP 2HOS 2HS 2HSE 2HCT 2HIO 2HN
0014 12E/M 2H** 2H2 2H( 2HDB 2H )/
0015 1 FORMAT("INPIT # OF SECTORS")
0016 2 FORMAT(13)
0017 3 FORMAT("INPIT # OF COLUMNS")
0018 4 FORMAT("INPIT SPHERE VOLTAGE")
0019 5 FORMAT("INPIT 001-10.6 -01-3.2 0" 000-"IC")
0020 6 FORMAT("INPIT FILE #")
0021 WRITE(1 1)
0022 READ(1 2) ISEC
0023 WRITE(1 3)
0024 READ(1 2) ICOL
0025 WRITE(1 4)
0026 READ(1 *) SVOL
0027 WRITE(1 5)
0028 READ(1 2) KOD
0029 WRITE(1 6)
0030 READ(1 2) IPV
0031 C CLEAR PLOT BUFFER
0032 DO 10 J=1 1024
0033 X(J)=0.
0034 10 Y(J)=0.
0035 M2=0
0036 IC1=ICOL/2
0037 IC1=ICOL-IC1
0038 C READ IMAGE DATA OFF DISK
0039 DO 20 I=1 ISEC
0040 CALL EYEC(14 103B JBUF IC1 IFILE I)
0041 IF(KOD)30 11 31
0042 11 A=6.91
0043 C=0.
0044 GO TO 32
0045 30 A=6.91
0046 C=26.9
0047 GO TO 32
0048 31 A=5.346
0049 C=26.9
0050 32 MIN=-90
0051 INT=1
0052 C CALCULATE HISTOGRAM
0053 DO 19 J=1 IC1
0054 IF(JBUF(J))19 19 33
0055 33 VOL=A*((FLOAT(JBUF(J))/409.6)-SVOL)-C
0056 K1=IFIX((VOL-MIN)/INT)+1
0057 X(K1)=X(K1)+1
0058 IF(K1-M2)19 34
0059 34 M2=K1
0060 19 CONTINUE
0061 20 CONTINUE
0062 C CONVERT TO X OCCURRENCE
0063 SIG=0.
0064 DO 40 J=1 M2

```

```

0065      40 BIG=BIG+X(J)
0066      DO 50 J=1 M2
0067      K1=(2*J)-1
0068      K2=2*J
0069      Y(K1)=(X(J)*100.)/BIG
0070      50 Y(K2)=Y(K1)
0071 C CREATE X-Axis
0072      DO 51 J=1 M2
0073      K1=(2*J)-1
0074      K2=2*J
0075      X(K1)=INT*(J-1)+MIN
0076      51 X(K2)=INT*J+MIN
0077      M2=2*M2
0078 C PLOT HISTOGRAM
0079      60 CALL MODE(0 2. 0. 1.)
0080      CALL SCAN(X Y -M2 440)
0081      CALL DRAW(X Y M2 444)
0082      IF(KOD)61 62 61
0083      62 CALL AVE(9.0 IY1 11.1 IY)
0084      GO TO 63
0085      61 CALL AVE(26.1 IV2 11.1 IV)
0086      63 CALL MODE(4 .16 .1 CA)
0087      CALL NOTE(2.5 6. IY1 8)
0088      CALL NOTE(CA CA IFV 0)
0089      CALL MODE(10 CA IPAT 4.)
0090      CALL TONE(0. 0. 440 0)
0091      CALL TONE(V V M2 1)
0092      CALL DRAW(0. 0. 1 9000)
0093      CALL DRAW(0 0 0 9999)
0094      CALL EXEC(3 1106B -1)
0095      80 STOP
0096      END
0097      ENDS
**** LIST END ****

```

Program WDT to Create a Visible Image Using a Line Printer

```

0001 FTN L T
0002 PROGRAM WDMT
0003 C CREATE A VISIBLE RECORD OF IMAGE STORED IN DISK FILE DATA1
0004 C BY USING THE LINE PRINTER
0005 C B.D. GUENTHER 12/27/76
0006 DIMENSION JBUF(128) IFILE(3)
0007 IFILE(1)=2BDA
0008 IFILE(2)=2HTA
0009 IFILE(3)=1R1
0010 WRITE(1 1)
0011 1 FORMAT('INPUT # OF SECTORS')
0012 READ(1 90) ISEC
0013 90 FORMAT(13)
0014 WRITE(1 4)
0015 4 FORMAT('INPUT # OF COLUMNS')
0016 READ(1 90) ICOL
0017 WRITE(1 91)
0018 91 FORMAT('INPUT OFFSET')
0019 READ(1 6) IOF
0020 6 FORMAT(14)
0021 WRITE(1 92)
0022 92 FORMAT('INPUT NORMALIZATION')
0023 READ(1 6) INOR
0024 IC1=ICOL/2
0025 IC2=ICOL-IC1
0026 IC1=IC2
0027 C CONVERT LEFT 1/2 IMAGE DATA TO INTEGERS 0-9
0028 DO 2 J=1 ISEC 2
0029 CALL EVEC(14 103B JBUF IC1 IFILE J)
0030 DO 10 JK=1 IC1
0031 JBUF(JK)=(JBUF(JK)-IOF)/INOR
0032 IF (JBUF(JK))20 20 21
0033 20 JBUF(JK)=0
0034 21 IF(10-JBUF(JK))30 30 10
0035 30 JBUF(JK)=9
0036 10 CONTINUE
0037 C WRITE LEFT 1/2 OF ALL ROWS
0038 2 WRITE(6 5)(JBUF(JC) JC=1 IC1)
0039 5 FORMAT(69(11))
0040 C SKIP A PAGE
0041 CALL EVEC(3 1106B 63)
0042 C CONVERT RIGHT 1/2 IMAGE DATA TO INTEGERS 0-9
0043 DO 3 K=2 ISEC 2
0044 CALL EVEC(14 103B JBUF IC2 IFILE K)
0045 DO 40 KL=1 IC2
0046 JBUF(KL)=(JBUF(KL)-IOF)/INOR
0047 IF(JBUF(KL))50 50 51
0048 50 JBUF(KL)=0
0049 51 IF(10-JBUF(KL))60 60 40
0050 60 JBUF(KL)=9
0051 40 CONTINUE
0052 C WRITE RIGHT 1/2 OF ALL ROWS
0053 3 WRITE(6 5)(JBUF(JC) JC=1 IC2)
0054 CALL EVEC(3 1106B -1)
0055 END
0056 ENDS
**** LIST END ****

```

Program BIWT to Create a Visible Image

```

0001 FTR L T
0002 PROGRAM BIWT
0003 C POINT PROCESS IMAGE IN DISK FILE CALLED DATA1
0004 C AND WRITE ON VERSATEC IN BINARY FORMAT
0005 C B.D.GUENTHER 12/27/76
0006 DIMENSION JB*(128) IB*(256) IFILE(3) KB*(132)
0007 DATA IFILE/2HDA 2HTA 1H1/
0008 1 FORMAT("INPUT # OF SECTORS")
0009 2 FORMAT("INPUT # OF COLUMNS")
0010 3 FORMAT("INPUT # OF ROWS")
0011 4 FORMAT("INPUT MAX PIXEL VALUE")
0012 5 FORMAT("INPUT MIN PIXEL VALUE")
0013 6 FORMAT("INPUT SPHERE VOLTAGE")
0014 8 FORMAT(5X "MAX PC" = " F4.1 "DB" " ABOVE MAX PC" = " F4.1 "DB")
0015 9 FORMAT(5X "MIN RCS" = " F4.1 "DB" / 5X "RCS" = " F4.1 "DB "REMOVED")
0016 7 FORMAT(13)
0017 99 FORMAT(15X "FILE # = " I3)
0018 98 FORMAT("INPUT FILE #")
0019 97 FORMAT("INPUT 001 FOR 10.6 -01 FOR 3.2 OR 000 FOR VIS")
0020 96 FORMAT("INPUT PIXEL VALUE TO BE REMOVED OR MIN PIXEL VALUE")
0021 95 FORMAT("INPUT PIXEL INTENSITY ABOVE MAX PIXEL")
0022 WRITE(1 98)
0023 READ(1 7) IFV
0024 WRITE(1 1)
0025 READ(1 7) ISEC
0026 WRITE(1 2)
0027 READ(1 7) IC
0028 WRITE(1 3)
0029 READ(1 7) IP
0030 WRITE(1 4)
0031 READ(1 *) VMAX
0032 WRITE(1 95)
0033 READ(1 *) VX1
0034 WRITE(1 5)
0035 READ(1 *) VMIN
0036 WRITE(1 96)
0037 READ(1 *) VX2
0038 WRITE(1 6)
0039 READ(1 *) VS
0040 WRITE(1 97)
0041 READ(1 7) KOD
0042 IC1=IC/2
0043 IC2=IC-IC1
0044 IC1=IC2
0045 IC=2*IC2
0046 WRITE(6 99) IFV
0047 WRITE(6 8) VMAX VX1
0048 WRITE(6 9) VMIN VX2
0049 C POINT PROCESS OF IMAGE
0050 IF(KOD)21 32 31
0051 21 A=6.91
0052 C=26.9
0053 GO TO 33
0054 31 A=5.346
0055 C=26.9
0056 GO TO 33
0057 32 A=6.91
0058 C=0
0059 33 VMAX=409.6*(((VMAX+C)/A)+VS)
0060 VMIN=409.6*(((VMIN+C)/A)+VS)
0061 VX1=409.6*(((VX1+C)/A)+VS)
0062 VX2=409.6*(((VX2+C)/A)+VS)
0063 DO 10 I=1 IP
0064 IO=2*I-1

```

```

0065      IE=2*I
0066      CALL EVEC(14 103B JBUF IC1 IFILE IO)
0067      DO 100 J=1 IC1
0068          IF(JBUF(J).GT.VMAX) JBUF(J)=VM1
0069          IF(JBUF(J).EQ.VM2) JBUF(J)=VMIN
0070          IF(JBUF(J).LT.VMIN) JBUF(J)=VMIN
0071          VO=256.*(JBUF(J)-VMIN)/(VMAX-VMIN)
0072      100 IBUF(J)=IFIX(VO)
0073      CALL EVEC(14 103B JBUF IC2 IFILE IE)
0074      DO 200 J=1 IC2
0075          JD=J+IC1
0076          IF(JBUF(J).GT.VMAX) JBUF(J)=VM1
0077          IF(JBUF(J).EQ.VM2) JBUF(J)=VMIN
0078          IF(JBUF(J).LT.VMIN) JBUF(J)=VMIN
0079          VO=256.*(JBUF(J)-VMIN)/(VMAX-VMIN)
0080      200 IBUF(JD)=ABS(VO)
0081          DO 400 J=1 IC
0082              IF(IBUF(J).LT.3)GO TO 20
0083              IF(IBUF(J).LT.5)GO TO 30
0084              IF(IBUF(J).LT.9)GO TO 40
0085              IF(IBUF(J).LT.17)GO TO 50
0086              IF(IBUF(J).LT.33)GO TO 60
0087              IF(IBUF(J).LT.65)GO TO 70
0088              IF(IBUF(J).LT.129)GO TO 80
0089              IBUF(J)=255
0090              GO TO 400
0091      20 IBUF(J)=0
0092              GO TO 400
0093      30 IBUF(J)=3
0094              GO TO 400
0095      40 IBUF(J)=7
0096              GO TO 400
0097      50 IBUF(J)=15
0098              GO TO 400
0099      60 IBUF(J)=31
0100              GO TO 400
0101      70 IBUF(J)=63
0102              GO TO 400
0103      80 IBUF(J)=127
0104      400 CONTINUE
0105      C PACK TWO 8 BIT PIXALS INTO ONE 16 BIT WORD
0106      DO 300 J=1 IC1
0107          JO=2*J-1
0108          JE=2*J
0109          IBUF(JO)=IAND(377B IBUF(JO))
0110          IBUF(JO)=IBUF(JO)*256
0111          IBUF(JO)=IAND(177400B IBUF(JO))
0112          IBUF(JE)=IAND(377B IBUF(JE))
0113      300 KBUF(J)=10*(IBUF(JO)+IBUF(JE))
0114      C PLOT 8 IDENTICAL ROWS FOR EACH IMAGE ROW
0115      DO 10 K=1 8
0116          CALL EVEC(2 106B KBUF IC1)
0117      10 CONTINUE
0118          CALL EVEC(3 1106B -1)
0119          STOP
0120          END
0121          ENDS
**** LIST END ****

```

DISTRIBUTION

	No. of Copies		No. of Copies
Defense Documentation Center Cameron Station Alexandria, Virginia 22314	2	Commander US Army Combined Arms Combat Development Activity Fort Leavenworth, Kansas 66027	1
Commander US Army Research Office Attn: Dr. R. Lontz P. O. Box 12211 Research Triangle Park North Carolina 22709	2	Commander US Army Frankford Arsenal Philadelphia, Pennsylvania 19137	1
US Army Research and Standardization Group (Europe) Attn: DRXSN-E-RX, Dr. Alfred K. Nedoluha Box 65 FPO New York 09510	2	Commander US Army Picatinny Arsenal Dover, New Jersey 07801	1
US Army Materiel Development and Readiness Command Attn: Dr. Gordon Bushy Dr. James Bender Dr. Edward Sedlak 5001 Eisenhower Avenue Alexandria, Virginia 22333	1 1 1	Commander US Army Tank Automotive Development Command Attn: DRDTA-RWL Warren, Michigan 48090	1
Headquarters Hq DA (DAMA-ARZ) Washington, DC 20310	2	Commander US Army Mobility Equipment Research and Development Command Fort Belvoir, Virginia 22060	1
Director of Defense Research and Engineering Attn: Mr. L. Weisberg Washington, DC 20301	2	Commander US Army Harry Diamond Laboratories Attn: Dr. Stan Kulpa 2800 Powder Mill Road Adelphi, Maryland 20783	1
Director Defense Advanced Research Projects Agency 1400 Wilson Boulevard Arlington, Virginia 22209	1	Commander US Army Armament Command Rock Island, Illinois 61202	1
Commander US Army Aviation Systems Command 12th and Spruce Streets St. Louis, Missouri 63166	1	Commander US Army Foreign Science and Technology Center Federal Office Building 220 7th Street, NE Charlottesville, Virginia 22901	1
Director US Army Air Mobility Research and Development Laboratory Ames Research Center Moffett, California 94035	1	Commander US Army Training and Doctrine Command Fort Monroe, Virginia 23351	1
Commander US Army Electronics Command Attn: DRSEL-TL-I, Dr. Jacobs -CT, Dr. R. Buser Fort Monmouth, New Jersey 07703	1 1	Director Ballistic Missile Defense Advanced Technology Center Attn: ATC-D -O -R -T P. O. Box 1500 Huntsville, Alabama 35807	1 1 1 1
Director US Army Night Vision Laboratory Attn: John Johnson Fort Belvoir, Virginia 22060	1	Commander US Naval Air Systems Command Washington, DC 20360	1
George Webber Honeywell Systems and Research Center 2600 Ridgway Minneapolis, Minnesota 55413	1	Chief of Naval Research Department of the Navy Washington, DC 20360	1
Director US Army Ballistic Research Laboratories Attn: Ken Richer Aberdeen Proving Ground, Maryland 21005	1	Commander US Naval Air Development Center Attn: Radar Division Warminster, Pennsylvania 18974	1
		Commander US Naval Electronics Laboratory Center San Diego, California 92152	1
		Commander US Naval Surface Weapons Center Dahlgren, Virginia 22448	1

