NOTICE OF CHANGE

NOT MEASUREMENT SENSITIVE

MIL-STD-188-198A
NOTICE 2
14 March 1997

DEPARTMENT OF DEFENSE
INTERFACE STANDARD

JOINT PHOTOGRAPHIC EXPERTS GROUP (JPEG) IMAGE COMPRESSION FOR THE NATIONAL IMAGERY TRANSMISSION FORMAT STANDARD

TO ALL HOLDERS OF MIL-STD-188-198A:

1. THE FOLLOWING PAGES OF MIL-STD-188-198A HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
cover	14 March 1997	cover	12 October 1994
ii	14 March 1997	ii	12 October 1994
v	14 March 1997	v	12 October 1994
vi	14 March 1997	vi	12 October 1994
vii	14 March 1997	vii	12 October 1994
viii	12 October 1994	viii	reprinted without change
61	14 March 1997	61	12 October 1994
61a	14 March 1997	not applicable	new page
61b	14 March 1997	not applicable	new page
61c	14 March 1997	not applicable	new page
61d	14 March 1997	not applicable	new page
61e	14 March 1997	not applicable	new page
61f	14 March 1997	not applicable	new page
62	14 March 1997	62	12 October 1994
101	14 March 1997	101	15 December 1993
102	15 December 1993	102	reprinted without change
DD1426	14 March 1997	DD1426	12 October 1994

2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-STD-188-198A will verify that the page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the military standard is completely revised or canceled.

Custodians:

Army - SC

Navy - OM

Air Force - 90

Misc - DC4

Preparing Activity:

NIMA - MP

(Project TCSS 198002)

NOTE: The cover page of this standard has been changed for administrative reasons. There are no other changes to this document.

NOT MEASUREMENT SENSITIVE
MIL-STD-188-198A
15 December 1993
SUPERSEDING
MIL-STD-188-198A
18 June 1993

DEPARTMENT OF DEFENSE INTERFACE STANDARD

JOINT PHOTOGRAPHIC EXPERTS GROUP (JPEG) IMAGE COMPRESSION FOR THE NATIONAL IMAGERY TRANSMISSION FORMAT STANDARD

AMSC N/A **AREA TCSS**

SUPERSEDES COVER OF MIL-STD-188-198A, NOTICE 1.

FOREWORD

1. The National Imagery Transmission Format Standard (NITFS) is the standard for formatting digital imagery and imagery-related products and exchanging them among members of the Intelligence Community (IC) as defined by Executive Order 12333, the Department of Defense (DOD), and other departments and agencies of the United States Government, as governed by Memoranda of Agreement (MOA) with those departments and agencies.

2. The National Imagery Transmission Format Standard Technical Board (NTB) developed this standard based upon currently available technical information.

3. The DOD and other IC members are committed to interoperability of systems used for formatting, transmitting, receiving, and processing imagery and imagery-related information. This standard describes the Joint Photographic Experts Group (JPEG) compression algorithm and establishes its application within the NITFS.

4. Beneficial comments (recommendations, additions, deletions) and other pertinent data which may be of use in improving this document should be addressed the National Imagery and Mapping Agency, SEII, 4600 Sangamore Road, Bethesda, MD 20816-5003 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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APPENDIX

REPRINTED WITHOUT CHANGE.

TABLE XV. NITF APP_6 application data segment - Continued.

Offset	Field Value	Field Name	length (bytes)	comments
21	0-2	Stream Color	1	Compressed color representation. Three values are defined at this time. 0 - monochrome 1 - RGB 2 - YCbCr601
22	8 or 12	Stream Bits	1	Compressed image sample precision.
23	1	Horizontal Filtering	1	This field specifies the filtering used in the horizontal direction prior to subsampling the chrominance samples. One value is defined at this time. 1 - Centered samples, [1/2, 1/2] filter
24	1	Vertical Filtering	1	This field specifies the filtering used in the vertical direction prior to subsampling the chrominance samples. One value is defined at this time. 1 - Centered samples, [1/2, 1/2] filter
25	0	Flags	2	Reserved for future use.

5.2.3.3.5.5.2 NITF APP_7 directory segments. The NITF APP_7 directory segments are used to provide random access to the variable length compressed data segments. APP_7 segments contain a directory of offset information for a series of scans or restart intervals depending on the directory type. In all cases, offsets are measured from the beginning of the Image Data Field in the NITF file to the beginning of the element. The number of entries depends on the directory type and is the number of (restart intervals per scan) or (scans per block) for directory types: 'R' and 'S', respectively. The format for APP_7 is shown in table XVI where all integers are stored in big endian format. The number of directory entries can be very large for restart interval directories. In these cases it is possible for a directory to exceed the, approximately 64 kbyte, segment limitation fixed by the 2 byte L_p field at offset 2 in any JPEG application data segment. Since each element requires 4 bytes in the directory, this translates to a maximum of 16,382 entries. When a logical directory contains more that 16,382 elements, they must be split between more that one physical directory. In this case, multiple APP_7 directory segments must follow each other with no other intervening data and they must be of the same directory type (restart interval). Each additional APP_7 directory contains those elements, in the same order, that would have been present in the directory had there been no size limitation.

TABLE XVI. NITF APP_7 directory segments.

Offset	Field Value	Field Name	length (bytes)	comments
0	0xFFE7	APP_7	2	NITF directory segment marker.
2	4N+5	L_p	2	Segment length (2+length of application data).
4	0x52, 0x53	Directory Type	1	Directory type. Two values are defined at this time. 'R' - Restart Interval Directory 'S' - Scan Directory
5		N	2	Number of directory entries. Note 0 is not allowed. Maximum value of N (16,382) maximizes L_p at 65533.
7		1st Offset	4	Offset to first element in this directory. (restart interval, scan).
11		2nd Offset	4	Offset to second element in this directory.
4N+3		Last Offset	4	Offset to last element in this directory.

5.2.3.3.5.5.3 NITF APP6/(Extension NITF0001) image block minimum value. The NITF APP6 application data segment with an ID string "NITF0001.A" contains the minimum value for each scan of an original uncompressed image block before any preprocessing or compression steps are performed. The ID string follows the form NITFxxxx.V, where xxxx is the extension number and V is the version number. The extension number is 0001 and the current version identifier is A.

This application segment also stores the image block index values which specify the relative image block row and image block column position of the frame. The index values are 1 based, with the first FAF at position (1,1).

When the NITF tag for the amplitude re-mapping process is used, (IOMAPA), the minimum values stored in APP6/(Extension NITF0001) are utilized by the amplitude re-mapping process described in paragraph 30.2.3 of MIL-STD-2500A. When the NITF amplitude re-mapping tag is used, an APP6/(Extension NITF0001) application data segment must exist for each image block or frame compressed with the 12-bit JPEG algorithm. When using the 12 bit JPEG DCT extended sequential transmission mode with monochrome imagery, the NScan field shall be fixed at 1.

Table XVII contains the format for the APP6/(Extension NITF0001) segment.

TABLE XVII. NITF JPEG APP6/(Extension NITF0001) segment format for image block minimum values

Offset	Field Value	Field Name	Length	Comments
0	0xFFE6	APP6	2	NITF APP Data Marker
2	Variable	Lp	2	Seg Length (See Note 4)
4	0x4E495446 0x30303031 0x2E41 0x00	ID_STRING	11	Null terminated ID string used to identify the APP6 tag as the minimum pixel amplitude storage extension "NITF0001.A"
15	Generated (see note 1)	Image Block Row No.	4	(See Note 3)
19	Generated (see note 1)	Image Block Col No.	4	(See Note 3)
23	Generated (see note 2)	NScan	2	Number of Scans per Frame
25	Generated (see note 2)	Min_Value_1	2	Min. value of Scan #1 in Image Block
...	...	...	...	...
C	Generated (see note 2)	Min_Value_NScan	2	Min. value of Scan #Nscan in Image Block
C	0x0000 (see note 5)	Flags	2	Reserved for Future Use

Notes:
1) Value is 4 byte unsigned binary integer representation
2) Value is 2 byte unsigned binary integer representation
3) Image block index relative to the transmitted image. The top left image block is indexed (row, column) -> (1,1)
4) Length Lp = 25 + (2*NScan)
5) The offset label of C is used for the conditional offsets dependent on the value of the NScan field.

Figures 22 and 23 show the location of the APP6/(Extension NITF0001) application data segments relative to other NITF components.

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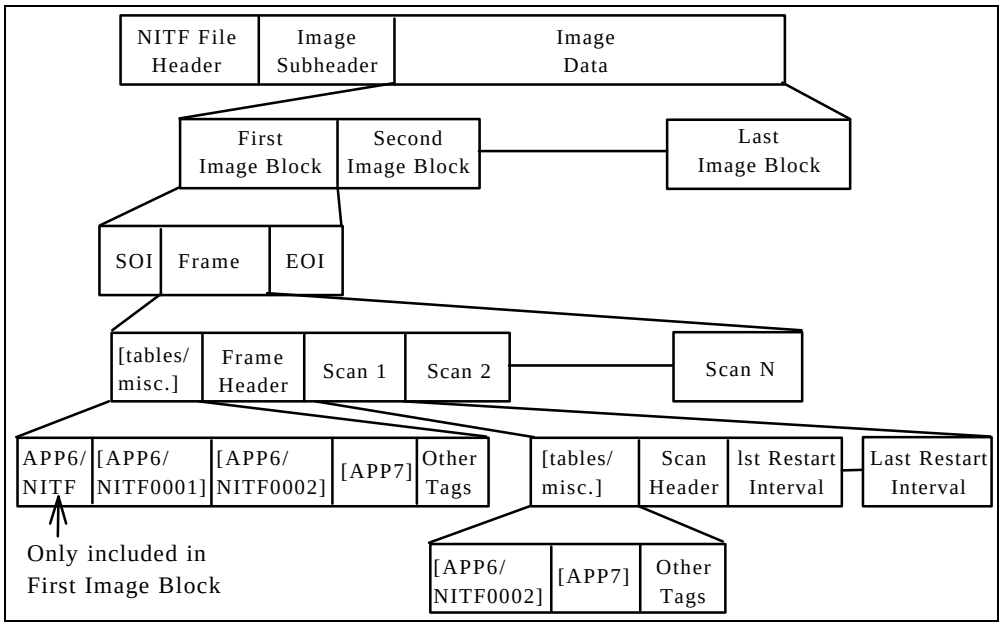

FIGURE 22. NITF 12 bit JPEG/DCT multiple block file structure (IMODE=BorP)

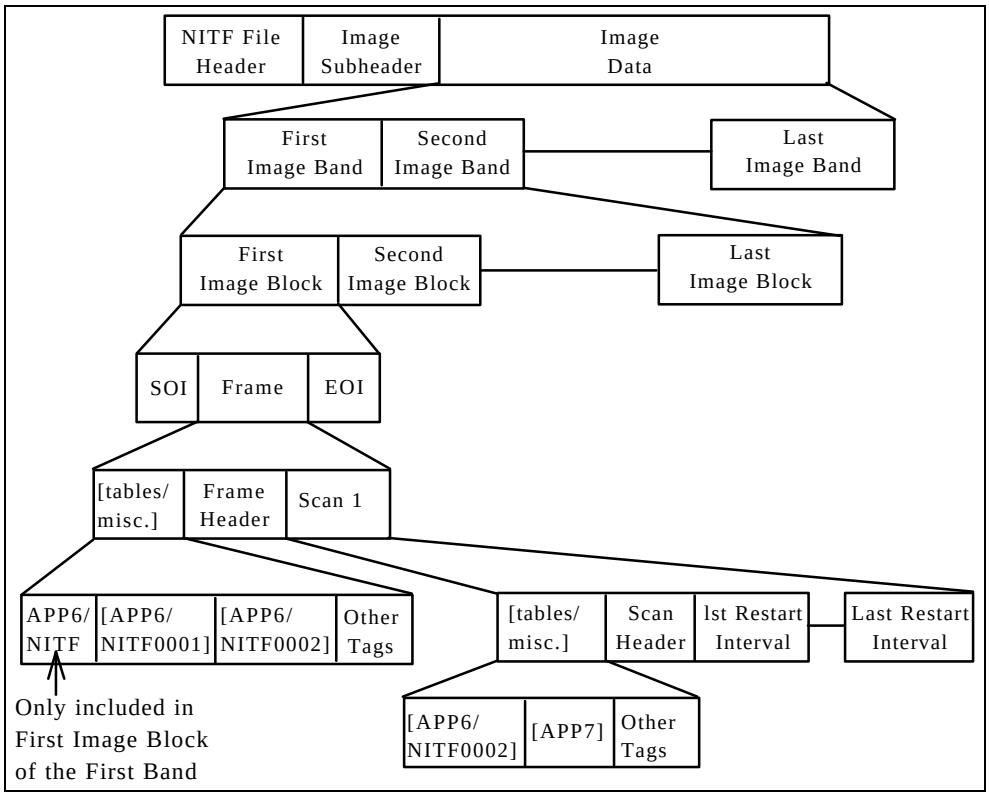

FIGURE 23. NITF 12 bit JPEG/DCT multiple block file strucutre (IMODE=S)

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5.2.3.3.5.5.4 NITF APP6/(Extension NITF0002) Forward Error Correction (FEC) code The NITF APP6/(Extension NITF0002) application data segment with an ID string "NITF0002.A" contains the FEC (Forward Error Correction) codes which are used to protect the NITF/JPEG header and misc. table data from bit errors. The ID string follows the form NITFxxxx.V, where xxxx is the extension number and V is the version number. The extension number is 0002 and the current version identifier is A.

The FEC codes are applied to:

a. NITF/JPEG Frame Header and Misc. Tables
b. NITF/JPEG Scan Header and Misc. Tables

Two different forms of the APP6/(Extension NITF0002) application data segment shall be used for each image block, one for the frame overhead data and one for the scan overhead data. The two forms are conditional based on the value of the APP6/(Extension NITF0002) Mode_Type field which discriminates the frame and scan forms of the extension. The frame mode version of the tag is placed in the tag region before the Start of Frame marker code, and the scan version of the tag falls in the tag area preceding each Start of Scan marker in an image block.

The two forms are very similar with the exception of the values contained in the Mode_Type field and the 8 byte ASCII formatted SYNC Code inserted before the Reed-Solomon FEC bytes.

The placement of the APP6/(Extension NITF0002) application segments is shown in figures 24 and 25.

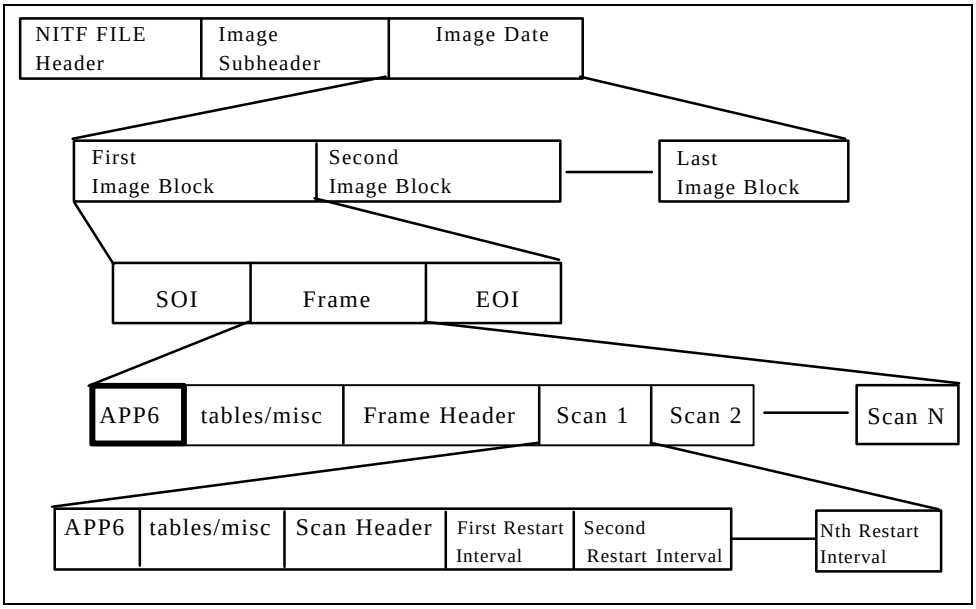

FIGURE 24. NITF 12 bit JPEG/DCT multiple block file structure with FEC (TRANSMISSION MODE = B or P) .

NEW PAGE.

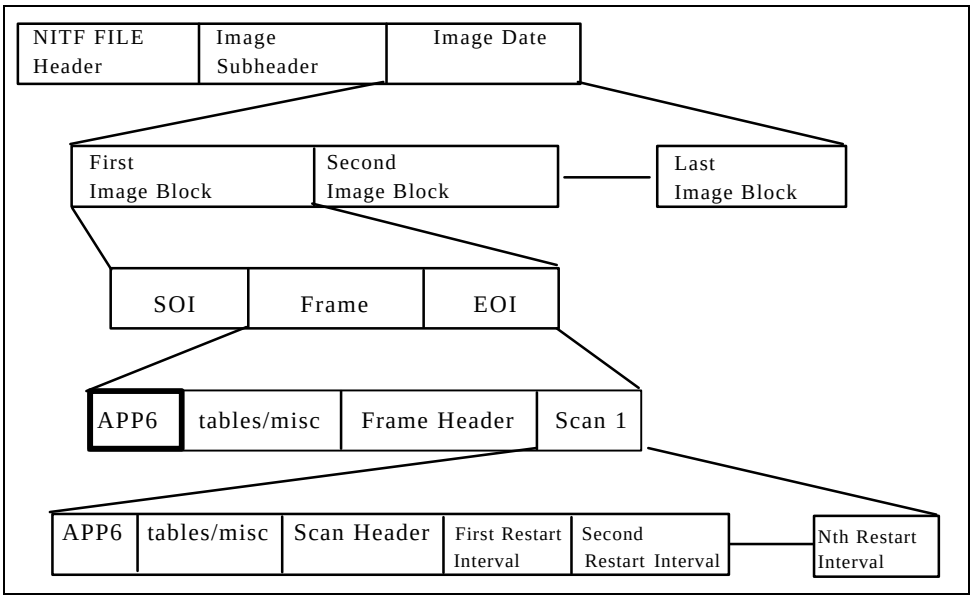

FIGURE 25. NITF 12 Bit JPEG/DCT multiple block file structure with FEC (TRANSMISSION MODE = S)

The FEC code utilized to error protect the JPEG header and misc. tables is based upon the MIL-STD-2045-44500 (TACO2), paragraph 5.4.2.1, and is termed the FEC-1 code. For purposes of applying the FEC-1 code, the JPEG header and tables shall be logically separated into virtual datagrams of 152 bytes or less in length. For example, to build the datagrams for the Frame level APP6/(Extension NITF0002), the bytes from the SOI marker to the last byte of the Start of Frame (SOF) marker segment shall be used to fill the datagram stream. This includes any other allowed JPEG marker segments or APPs, other than APP6/(Extension NITF0002), present in the tables/misc. area before the SOF marker. The end of the SOF marker segment is the end of the Frame portion of the overhead for the image block. If the number of bytes in the virtual datagram stream is less than or equal to 152 bytes, there will be only 1 datagram. Otherwise, the datagram stream will be divided into 152 byte sections until the last datagram is less than or equal to 152 bytes. Each datagram section of 1 to 152 bytes will produce a 10 byte FEC code from the Reed-Solomon algorithm.

To build the datagram stream for the Scan level APP6/(Extension NITF0002), the bytes following the last byte of the SOF marker segment to the last byte of the Start of Scan (SOS) marker segment shall be included. This includes any other allowed JPEG marker segments or APPs, other than APP6/(Extension NITF0002), present in the tables/misc. area before the SOS marker. The end of the SOS marker segment is the end of the Scan portion of the overhead for the image block. The datagram stream for the Scan overhead is sectioned and processed identically to the Frame overhead stream.

Unlike the TACO2 FEC-1 protocol, the 10 byte FEC codes from all of the datagrams are concatenated within the APP6/(Extension NITF0002) tag, and are not interleaved within the data stream as stated in paragraph 5.4.2.1 of the FEC-1 code in MIL-STD-2045-44500 (TACO2).

The resulting length of the APP6/(Extension NITF0002) application segment will vary dependent upon the number of 10 byte FEC codes in the APP6/(Extension NITF0002) field, which is dependent on the length of the JPEG marker segments and misc. tables present in the overhead.

If the ECC type is set to zero, only the block sizes, SOI offsets, and ASCII SYNC codes are included in the APP6/(Extension NITF0002) extension, and Lp will have a fixed length of 35 bytes.

Table XVIII contains the formats for the APP6/(Extension NITF0002) segment in the Frame and Scan modes.

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TABLE XVIII. NITF JPEG APP6/(Extension NITF0002) segment format for NITF JPEG frame and scan level overhead tag

Offset	Field Value	Field Name	Length	Comments
0	0xFFE6	APP6	2	NITF APP Data Marker
2	Variable	Lp	2	Segment Length (See Note 1)
4	0x4E495446 0x30303032 0x2E41 0x00	ID_STRING	11	Null terminated ID string used to identify the APP6 tag as the ECC overhead protection extension "NITF0002.A"
15	0x02 or 0x03	Mode_Type	1	APP6/(Extension NITF0002) Mode Type 0x02 specifies Frame Mode Code 0x03 specifies Scan Mode Code
16	0x00 or 0x01	ECC Type	1	ECC Type Code specifies the ECC Protection Algorithm --- Currently Defined Values: --- 0 = No ECC Codes, only offsets and SYNC Code included 1 = RS ECC Codes, SYNC Code, and offsets included
17	(See note 2)	Offset From SOI	4	Offset in bytes from this APP6/(Extension NITF0002) Marker to the SOI Marker of this block
21	(See note 2) or 0x00000000	Previous Block Size	4	Number of bytes in previous image block (See notes 3 & 7)
25	(See note 2)	Current Block Size	4	Number of bytes in this image block (See note 3)
29	0x46454343 0x5353594E or 0x53454343 0x5353594E	Start ECC SYNC Code	8	Frame Sync Code for Start of ECC codes when Mode_Type=0x02 (ASCII: FECCSSYN) Scan Sync Code for Start of ECC codes when Mode_Type=0x03 (ASCII: SECCSSYN)
37	Generated (See note 4)	First 10 byte Code	10	10 Byte ECC Code from First Datagram Block
...	...	...	...	...
C	Generated (See note 6)	Last 10 byte Code (See note 5)	10	10 Byte ECC Code from Last Datagram Block

Notes:

1) Length Lp = 35 + (10 * (Number_of_datagrams)) If ECC Type = 0, the Number_of_datagrams = 0.
2) Value is unsigned binary integer format of appropriate length
3) Size in bytes for the image blocks can be calculated by the adding 2 to the offset between the EOI and the SOI markers for each image block. Sizes are stored in binary integer format.
4) Each datagram of 152 bytes or less produces a 10 byte ECC code using the RS FEC protection algorithm.
5) The last datagram of 152 bytes or less produces a 10 byte ECC code using the RS FEC protection algorithm.
6) The offset label of C is used for the conditional offsets dependent on the number of ECC code bytes.
7) The code of 0x00000000 uniquely represents the case when the information regarding the previous block is not included in the tag due to one of the following conditions: a) this is the first block, or b) the image blocks in this NITF product were not sequentially processed and the size was unavailable. This information can be possibly be found in the image block offset tag if it is present in the image subheader.

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5.2.4 Encoding procedure with marker codes. Figure 15 illustrates the overall encoding procedure when the marker codes are added to the entropy-coded data segments.

5.2.5 Decoding procedure with marker. Figure 16 illustrates the overall decoding procedure when the marker codes are added to the entropy-coded data segments.

5.2.5.1 Quantization tables. If the DQT marker is not in the compressed data, then information from the COMRAT field in the NITF image subheader (defined in MIL-STD-2500A) shall be interpreted to determine the appropriate default table(s). If the DQT marker is in the compressed data, then this table specification shall take precedence over any defaults specified in the COMRAT field.

5.2.5.2 Huffman tables. If the DHT marker is not in the compressed data, then the default Huffman table, from Appendix B, for this image data type, image sample precision, and image color shall be used. If the DHT marker is in the compressed data, then this table specification shall take precedence over any defaults.

5.3 Progressive DCT-based JPEG mode. (Effectivity 5)

5.4 Hierarchical JPEG mode. (Effectivity 6)

5.5 Lossless JPEG mode. (Effectivity 2)

5.6 Region of interest encoding and decoding processes. (Effectivity 3)

CONCLUDING MATERIAL

Custodians:
Army - SC
Navy - OM
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Misc - DC4

Review activities:
OASD - DO, IR
Army - TM2, IE, ET, AC, PT, SC1, SC2
Air force - 02, 13
DLA - DH
Misc - NS, DC7

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Agent:
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(Project TCSS1980)

SUPERSEDES PAGE 101 OF MIL-STD-188-198A.

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3. DOCUMENT TITLE
Joint Photographic Experts Group (JPEG) Imagey Compression for the National Imagery Transmission Format Standard

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

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a. NAME **SEII**	b. TELEPHONE *(Include Area Code)* (1) Commercial **(301) 227-3554** (2) AUTOVON
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