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Information technology — Digital compression and coding of continuous-tone still images: Compliance testing

Technologies de l'information — Compression numérique et codage des images fixes de nature photographique: Test de conformité

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 10918-2 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information,* in collaboration with ITU-T. The identical text is published as ITU-T Recommendation T.83.

ISO/IEC 10918 consists of the following parts, under the general title *Information technology — Digital compression and coding of continuous-tone still images*:

— *Part 1: Requirements and guidelines*

— *Part 2: Compliance testing*

Annexes A to D form an integral part of this part of ISO/IEC 10918. Annexes E to H are for information only.

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Introduction

This Recommendation | International Standard, *Digital Compression and Coding of Continuous-tone Still Images*, is published as two parts:

- ITU-T Rec. T.81 | ISO/IEC 10918-1: *Requirements and guidelines.*
- ITU-T Rec. T.83 | ISO/IEC 10918-2: *Compliance testing.*

ITU-T Rec. T.81 | ISO/IEC 10918-1 sets out requirements and implementation guidelines for continuous-tone still image encoding and decoding processes, and for the coded representation of compressed image data. These processes and representations are intended to be generic, that is, to be applicable to a broad range of applications for colour and grayscale still images within communications and computer systems.

This part, ITU-T Rec. T.83 | ISO/IEC 10918-2, sets out tests for determining whether implementations comply with the requirements for the various encoding and decoding processes specified in ITU-T Rec. T.81 | ISO/IEC 10918-1. ITU-T Rec. T.83 | ISO/IEC 10918-2 also specifies tests for determining whether any specific instance of compressed data complies with the ITU-T Rec. T.81 | ISO/IEC 10918-1 specification for compressed data format.

The committee which has prepared this Specification is the ISO/IEC JTC1/SC29/WG1 Sub Group on JPEG, also known as the Joint Photographic Experts Group (JPEG). Both the committee and the two parts of this Specification continue to be known informally by the name JPEG.

The "joint" in JPEG refers to the committee's collaboration with the ITU-T SG8 Rapporteur's Group on Recommendation Q.16. In this collaboration, WG1 has performed the work of selecting, developing, documenting, and testing the generic compression processes.

ITU-T SG8 has provided the requirements which these processes must satisfy to be useful for specific image communications applications such as facsimile, videotex, and audiographic conferencing.

This Specification is presented in accordance with the rules of ITU-T and ISO/IEC JTC1 established by "Rules for presentation of ITU-T | ISO/IEC common text".

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ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – DIGITAL COMPRESSION AND CODING OF CONTINUOUS-TONE STILL IMAGES: COMPLIANCE TESTING

1 Scope

This Recommendation | International Standard is concerned with compliance tests for the continuous-tone still image encoding processes, decoding processes, and compressed data formats specified in ITU-T Rec. T.81 | ISO/IEC 10918-1.

This Specification:

- specifies compliance tests for the ITU-T Rec. T.81 | ISO/IEC 10918-1 compressed data formats;
- specifies compliance tests for the ITU-T Rec. T.81 | ISO/IEC 10918-1 encoding processes;
- specifies compliance tests for the ITU-T Rec. T.81 | ISO/IEC 10918-1 decoding processes;
- specifies a method for constructing application-specific compliance tests;
- gives guidance and examples on how to implement these tests in practice.

This Specification specifies normative generic compliance tests for the ITU-T Rec. T.81 | ISO/IEC 10918-1 encoding and decoding processes. These compliance tests are applicable to "stand-alone" generic implementations of one or more of the encoding and decoding processes specified in ITU-T Rec. T.81 | ISO/IEC 10918-1. Among the purposes of these tests is to ensure that generic encoder (and decoder) implementations compute the discrete cosine transform (DCT) and quantization functions with sufficient accuracy.

2 Normative references

The following ITU-T Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent editions of the Recommendations and Standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU-T maintains a list of the currently valid ITU-T Recommendations.

2.1 Additional references

- ISO 5807:1985, *Information processing – Documentation symbols and conventions for data, program and system flowcharts, program network charts and system resources charts.*

3 Definitions, abbreviations, symbols, and conventions

3.1 Definitions

For the purposes of this Specification, the following definitions apply.

3.1.1 **(coding) process 1:** Coding process with baseline sequential DCT, 8-bit sample precision.

3.1.2 **(coding) process 2:** Coding process with extended sequential DCT, Huffman coding, 8-bit sample precision.

3.1.3 **(coding) process 3:** Coding process with extended sequential DCT, arithmetic coding, 8-bit sample precision.

3.1.4 **(coding) process 4:** Coding process with extended sequential DCT, Huffman coding, 12-bit sample precision.

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3.1.5 (coding) process 5: Coding process with extended sequential DCT, arithmetic coding, 12-bit sample precision.

3.1.6 (coding) process 6: Coding process with spectral selection only, Huffman coding, 8-bit sample precision.

3.1.7 (coding) process 7: Coding process with spectral selection only, arithmetic coding, 8-bit sample precision.

3.1.8 (coding) process 8: Coding process with spectral selection only, Huffman coding, 12-bit sample precision.

3.1.9 (coding) process 9: Coding process with spectral selection only, arithmetic coding, 12-bit sample precision.

3.1.10 (coding) process 10: Coding process with full progression, Huffman coding, 8-bit sample precision.

3.1.11 (coding) process 11: Coding process with full progression, arithmetic coding, 8-bit sample precision.

3.1.12 (coding) process 12: Coding process with full progression, Huffman coding, 12-bit sample precision.

3.1.13 (coding) process 13: Coding process with full progression, arithmetic coding, 12-bit sample precision.

3.1.14 (coding) process 14: Coding process with lossless, Huffman coding, 2- through 16-bit sample precision.

3.1.15 (coding) process 15: Coding process with lossless, arithmetic coding, 2- through 16-bit sample precision.

3.1.16 (coding) process 16: Coding process with extended sequential DCT, Huffman coding, 8-bit sample precision in hierarchical mode.

3.1.17 (coding) process 17: Coding process with extended sequential DCT, arithmetic coding, 8-bit sample precision in hierarchical mode.

3.1.18 (coding) process 18: Coding process with extended sequential DCT, Huffman coding, 12-bit sample precision in hierarchical mode.

3.1.19 (coding) process 19: Coding process with extended sequential DCT, arithmetic coding, 12-bit sample precision in hierarchical mode.

3.1.20 (coding) process 20: Coding process with spectral selection only, Huffman coding, 8-bit sample precision in hierarchical mode.

3.1.21 (coding) process 21: Coding process with spectral selection only, arithmetic coding, 8-bit sample precision in hierarchical mode.

3.1.22 (coding) process 22: Coding process with spectral selection only, Huffman coding, 12-bit sample precision in hierarchical mode.

3.1.23 (coding) process 23: Coding process with spectral selection only, arithmetic coding, 12-bit sample precision in hierarchical mode.

3.1.24 (coding) process 24: Coding process with full progression, Huffman coding, 8-bit sample precision in hierarchical mode.

3.1.25 (coding) process 25: Coding process with full progression, arithmetic coding, 8-bit sample precision in hierarchical mode.

3.1.26 (coding) process 26: Coding process with full progression, Huffman coding, 12-bit sample precision in hierarchical mode.

3.1.27 (coding) process 27: Coding process with full progression, arithmetic coding, 12-bit sample precision in hierarchical mode.

3.1.28 (coding) process 28: Coding process with lossless, Huffman coding, 2- through 16-bit sample precision in hierarchical mode.

3.1.29 (coding) process 29: Coding process with lossless, arithmetic coding, 2- through 16-bit sample precision in hierarchical mode.

3.1.30 compliance test: The procedures specified in this Specification which determine whether or not an embodiment of an encoding process, compressed data stream, or decoding process complies with ITU-T Rec. T.81 | ISO/IEC 10918-1.

3.1.31 compressed image test data (stream): Compressed image data generated to test a particular coding process. (Distributed as part of the compliance test data.)

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3.1.32 compressed image validation data (stream): Compressed image data generated for validation of a particular coding process. (Distributed as part of the compliance test data.)

3.1.33 compressed test data (stream): Either compressed image test data or table specification test data or both.

3.1.34 decoder reference test data: Quantized DCT coefficient data generated by the reference FDCT and reference quantizer from the reconstructed image data output by the reference decoder, the input to which is the compressed image test data to be used in the DCT-based decoder compliance tests. The format of the quantized DCT coefficient data is a file for each component; each component is a two dimensional array of 8 × 8 blocks stored left-to-right, top-to-bottom order; each 8 × 8 block has 64 coefficients stored in zigzag order; and each coefficient is represented by two bytes, the most significant byte first. This data includes the blocks which are padded to complete an MCU on the right and bottom of the image. (Distributed as part of the compliance test data.)

3.1.35 encoder reference test data: Quantized DCT coefficient data generated by the reference FDCT and reference quantizer from the source image test data to be used in the DCT-based encoder compliance tests. (Distributed as part of the compliance test data.).

3.1.36 generic: Applicable to a broad range of applications, i.e. application independent.

3.1.37 orthogonal representation: The 2-dimensional row-column format illustrated in Figure A.5 in ITU-T Rec. T.81 | ISO/IEC 10918-1.

3.1.38 quantized coefficient validation data: Quantized DCT coefficient data generated from the source image validation test data to be used in the DCT-based encoder validation tests. (Distributed as part of the compliance test data.).

3.1.39 reference DCT-based decoder: An embodiment of the DCT-based decoding processes which generates the decoder reference test data. It consists of an entropy decoder, a dequantizer, and the reference IDCT.

3.1.40 reference DCT-based encoder: An embodiment of the DCT-based encoding processes which generated the DCT-based compressed image test data streams. It consists of the reference FDCT, the reference quantizer, and an entropy encoder.

3.1.41 reference forward discrete cosine transform; reference FDCT: A double precision (64-bit) floating point embodiment of the FDCT described in A.3.3 of ITU-T Rec. T.81 | ISO/IEC 10918-1.

3.1.42 reference inverse discrete cosine transform; reference IDCT: A double precision (64-bit) floating point embodiment of the IDCT described in A.3.3 of ITU-T Rec. T.81 | ISO/IEC 10918-1.

3.1.43 reference quantizer: An embodiment of the quantization described in A.3.4 in ITU-T Rec. T.81 | ISO/IEC 10918-1.

3.1.44 source image test data: The data sets to be used as input to the encoder compliance tests. This data is a sequence of pseudo-random numbers generated with uniform distribution over the range from 0 to 255. The algorithm used to generate this data is described in Annex A of CCITT Recommendation H.261. (This data is distributed as part of the compliance test data.).

3.1.45 table specification test data (stream): Table specification data generated to test decoder compliance with abbreviated format compressed data. (Distributed as part of the compliance test data.)

3.2 Abbreviations

The abbreviations used in this Specification are listed below.

3.2.1 arith.: An abbreviation for arithmetic coding.

3.2.2 Huff.: An abbreviation for Huffman coding.

3.3 Symbols

The symbols used in this Specification are listed below.

3.3.1 $\mathbf{B_{ij}}$**:** quantization value at the *i*th row and *j*th column in the quantization tables defined in Annex B, appears in Annex E.

3.3.2 DF: differential frame flag, appears in flow charts in clause 5.

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3.3.3 **E_{ij}:** quantization value at the ith row and jth column in the quantization tables used in testing for greater accuracy defined in Annex E.

3.3.4 **F:** the scale factor used to generate E_{ij} from B_{ij} as defined in E.1.

3.3.5 **FS:** first scan in frame flag, appears in flow charts in clause 5.

3.3.6 **G:** guaranteed in compressed data, appears in Tables 1 to 5 in clause 5.

3.3.7 **H-L:** hierarchical lossless processes, appears in Table G.1.

3.3.8 **H-S:** hierarchical sequential DCT-based processes without final lossless scans, appears in Table G.1.

3.3.9 **HP:** hierarchical progression flag, appears in flow charts in clause 5.

3.3.10 **LL:** lossless processes, appears in Table G.1.

3.3.11 **o:** optional in compressed data, appears in tables in clause 5.

3.3.12 **P(FULL):** full progressive DCT-based processes with both spectral selection and successive approximation, appears in Table G.1.

3.3.13 **P(SA):** progressive DCT-based successive approximation processes, appears in Table G.1.

3.3.14 **P(SS):** progressive DCT-based spectral selection processes, appears in Table G.1.

3.3.15 **RI:** restart interval flag, appears in flow charts in clause 5.

3.3.16 **S(B):** baseline sequential DCT-based process, appears in Table G.1.

3.3.17 **S(E):** extended sequential DCT-based processes, appears in Table G.1.

3.4 Conventions

The flowcharts use the conventions given in ISO 5807. One of the conventions is that arrows are not needed when the flow is from left-to-right and from top-to-bottom. Arrows are sometimes used in such cases to increase clarity.

4 General

The purpose of this clause is to give an informative overview of this Specification and the principles underlying it. Another purpose is to introduce some of the terms which are defined in clause 3. (Terms defined in clause 3 of ITU-T Rec. T.81 | ISO/IEC 10918-1 continue to apply in this Specification.)

ITU-T Rec. T.83 | ISO/IEC 10918-2 concerns compliance testing for embodiments of the elements specified in ITU-T Rec. T.81 | ISO/IEC 10918-1. For encoders and decoders – embodiments of the ITU-T Rec. T.81 | ISO/IEC 10918-1 encoding and decoding processes – this document makes a distinction between GENERIC embodiments and APPLICATION-SPECIFIC embodiments. For the former, compliance tests themselves are specified herein; for the latter, this document specifies a method for defining compliance tests. Compliance tests are also specified for compressed data streams – embodiments of the ITU-T Rec. T.81 | ISO/IEC 10918-1 compressed data formats.

NOTE – Like many compliance tests, those described in this Specification for generic encoders and decoders are not exhaustive tests of their respective functional specifications. Therefore, passing these tests does not guarantee complete functional correctness. This observation has two implications:

1) the tests do not fully guarantee complete interoperability between independently-implemented encoders and decoders; and

2) the tests for embodiments of the DCT-based processes do not guarantee that encoders or decoders will have some well defined image-quality-producing capability. These limitations are discussed in more detail below.

4.1 Purpose of the compliance tests

The purpose of compliance tests is to provide designers, manufacturers, or users of a product with a set of procedures for determining whether the product meets a specified set of requirements with some confidence. In addition, the compliance tests specified herein are intended to achieve the following specific goals:

- increase the likelihood of compressed data interchange;
- decrease the likelihood that DCT-based encoders or decoders will yield reduced image quality as a result of computing the DCT or quantization procedures with insufficient accuracy;
- help implementors to meet the ITU-T Rec. T.81 | ISO/IEC 10918-1 requirements for encoders and decoders as fully as possible.

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4.2 Compressed data compliance tests

The aim of the compliance tests specified in clause 5 is to determine whether a particular compressed image data stream or table-specification data stream meets the interchange format or abbreviated format requirements specified in ITU-T Rec. T.81 | ISO/IEC 10918-1. These tests are performed on the compressed data.

4.3 Encoder and decoder compliance tests

This subclause summarizes the considerations which have led to the encoder and decoder compliance tests set out in this Specification.

4.3.1 Encoder versus decoder requirements

ITU-T Rec. T.81 | ISO/IEC 10918-1 imposes more requirements on decoders than on encoders. This difference is based on the philosophy that any encoder should be allowed to produce only compressed images with a limited range of parameter values, but that decoders must handle images with broad ranges of parameters in order to facilitate interchange. Specifically, a decoder is required to handle either

a) the full range and combination of the parameter values specified by its coding process (in which case it qualifies as a generic decoder); or

b) a subset of the same defined by some application (in which case it is an application-specific decoder – see 4.3.2).

4.3.2 Generic versus application-specific decoders

Each coding process specified in ITU-T Rec. T.81 | ISO/IEC 10918-1 is defined for a fairly broad range of parameters. It is recognized, however, that many applications may require only a limited subset of these. For example, a simple picture database might use only grayscale images of fixed dimensions.

Consequently, the committee which prepared this Specification has defined a distinction between generic and application-specific decoders. The former concept is important to facilitate interchange as applications become increasingly inter-connected, and for hardware or software decoder products which can be embedded within many different applications. The latter concept allows application-oriented standards bodies to define a subset of a ITU-T Rec. T.81 | ISO/IEC 10918-1 coding process as its requirements.

This distinction, along with the decoder requirements philosophy in 4.3.1, means that the compliance test for generic decoders should exercise, as much as possible, the full range and combination of the parameter values specified by its coding process. It also means that a compliance test for application-specific decoders should exercise only the combination and range specified by the application.

Although comprehensive in many ways, the compliance tests for generic decoders do not test the full allowed range of all parameters. Many parameters have larger allowed ranges than it is feasible to test. Also, for some parameters, e.g. Number of samples per line (X) and Number of lines (Y), it is not desirable to test their full allowed range since few applications require functionality over the entire range.

According to the encoder requirements philosophy, any encoder may operate on limited ranges of parameter values only, suggesting that encoders are by nature application-specific. Therefore, there is no concept of a generic encoder, and no defined encoder compliance test intended to exercise different parameter values. (The only generic aspect of encoder compliance concerns DCT accuracy, as explained in 4.3.3.)

4.3.3 Computational accuracy of DCT and quantization

In ITU-T Rec. T.81 | ISO/IEC 10918-1, the FDCT, quantizer, and IDCT are defined as ideal mathematical formulae. Because these formulae imply infinite precision, implementors must decide how to approximate them. Efficiency or cost considerations may encourage lower-accuracy approximations, but it is the combination of the DCT and the table-based method of quantization – which accommodates psychovisual thresholding – that gives the DCT-based processes their excellent image-quality-producing capability. This capability may be degraded if the DCT and quantization procedures are computed with insufficient accuracy. Therefore, this Specification provides a method of compliance testing aimed at discouraging such degradation.

Because there is no point in requiring that the FDCT be computed with greater accuracy than necessary for the subsequent quantization procedure, the compliance testing method for DCT-based encoders is concerned with the accuracy of the quantized DCT coefficients. (Basing the test on quantized coefficients also meets the practical constraint that, for product implementations, unquantized coefficients are typically not externally observable.) For symmetry, the method of decoder compliance testing imposes IDCT/dequantization accuracy requirements which are consistent with those imposed on the FDCT/quantization.

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It is important to note that required accuracy is a function of the quantization tables used in these tests. A table with larger (coarser) quantization values will make for a less stringent test than one with smaller (finer) values. Therefore, passing the accuracy test means that the encoder or decoder is likely to perform comparably to an encoder or decoder with an ideal FDCT or IDCT, but only when using the specific quantization table employed in the test. An encoder which passes the test with a moderately coarse quantization table will not be guaranteed to perform as well, with a finer quantization table, as an ideal encoder.

For the generic DCT-based compliance tests specified herein, a set of quantization tables requiring moderate accuracy is specified. Encoders and decoders which achieve this accuracy will yield image quality sufficient for many applications, without incurring undue computational burden. Applications requiring greater or lesser accuracy may specify different quantization tables for application-specific compliance tests.

4.3.4 Summary – Generic compliance test considerations

The compliance tests for generic decoders have been defined to exercise the full range and combination of parameter values specified by the coding process being tested. The compliance tests for generic decoders have been designed so that decoders which satisfy the requirements of these tests are likely to be suitable for use within many different applications or for interchanging data between applications.

The generic compliance tests for DCT-based encoders and decoders define quantization tables requiring a level of computational accuracy which will yield image quality sufficient for many applications.

4.3.5 Procedures for constructing application-specific compliance tests

Application-specific compliance tests are used for testing compliance of application-specific decoders, i.e. decoders which implement a subset of a coding process, or for testing the accuracy of encoders and decoders for use in applications which have greater or lesser accuracy requirements than specified by the generic compliance tests. Application-specific compliance tests are constructed by applications standards bodies to satisfy the requirements of a particular application. This Specification contains the procedures for constructing application-specific compliance tests.

Two different procedures are defined for construction of application-specific compliance tests: one for DCT-based processes and one for lossless processes. Application-specific compliance tests for DCT-based processes may specify quantization tables which are selected according to the accuracy requirements of the application.

4.4 Availability of compliance test data

Standardized compliance test data is used to perform the encoder and decoder compliance tests. There are two types of compliance test data which are used by the encoder compliance tests: source image test data and encoder reference test data. Similarly, there are two types of compliance test data which are used by the decoder compliance tests: compressed test data and decoder reference test data.

The compliance test data for the encoder compliance tests and the generic decoder compliance tests are available on 3 diskettes and are included with the copy of this ITU-T Recommendation | ISO/IEC International Standard for parties who wish to determine compliance of an encoder or decoder. The diskettes were created under MS-DOS operating system (version 3.0 or newer), and are of the 1.4 M-byte high-density double-sided 96 tracks per inch MS-DOS format.

5 Compressed data format compliance testing

In order to determine compressed data format compliance, the test procedures in 5.1, 5.2 or 5.3 shall be performed. These test procedures utilize the common additional procedures in 5.4.

There are separate tests for the following compressed data streams:

a) Compressed image data encoded by non-hierarchical processes in interchange format (see 5.1.1);

b) Compressed image data encoded by hierarchical processes in interchange format (see 5.1.2);

c) Compressed image data encoded by non-hierarchical processes in abbreviated format (see 5.2.1);

d) Compressed image data encoded by hierarchical processes in abbreviated format (see 5.2.2);

e) Compressed data in abbreviated format for table specifications (see 5.3).

Twenty-nine coding processes are defined in each of the first paragraphs of ITU-T Rec. T.81 | ISO/IEC 10918-1, Annexes F, G, H, and J. They are assigned numbers in ITU-T T.83 | ISO/IEC 10918-2, clause 3 (Definitions) as "(coding) process *n*" where *n* is an integer from 1 to 29.

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ITU-T Rec. T.81 | ISO/IEC 10918-1, Annex B, contains the syntax requirements for the compressed data. ITU-T Rec. T.81 | ISO/IEC 10918-1, B.1.3 and Figure B.1, give the conventions for the syntax figures. The markers are identified by the marker assignments in ITU-T Rec. T.81 | ISO/IEC 10918-1, Table B.1.

Tables 1, 3, and 5 in this clause give specific references to syntax requirements for markers. Markers and marker segments which are required in the compressed data are denoted 'G'. Those that may optionally be present in the compressed data are denoted 'o'. A dash (–) indicates non-compliance if the particular marker or marker segment is present in the compressed data for that coding process.

If a marker is present, its parameters are required and not optional.

The ITU-T Rec. T.81 | ISO/IEC 10918-1 references in the left-most columns of Tables 1, 3 and 5 indicate where the syntax requirements for each marker segment are stated.

There is no significance to the order of markers in the tables.

NOTES

1 The tests are partial as they check mainly the syntactical correctness of the data. Passing the test does not ensure that the compressed data comply with all the requirements of ITU-T Rec. T.81 | ISO/IEC 10918-1.

2 The flow charts do not use most values of the parameters. Future extensions may include more elaborate test procedures based on parameters' values.

3 There is no requirement in this Specification that any tester shall implement the procedures in precisely the manner specified by the flow charts in this clause. It is necessary only that a tester implement the equivalent function specified in this clause.

4 For simplicity of exposition, the buffer holding the compressed data is assumed to be large enough to contain the entire compressed data stream.

5 In any case that there is conflict between this clause and ITU-T Rec. T.81 | ISO/IEC 10918-1, ITU-T Rec. T.81 | ISO/IEC 10918-1 shall take precedence.

5.1 Interchange Compressed Image Data Format Syntax Compliance Tests

5.1.1 Non-hierarchical coding processes syntax compliance test

Figure 1 gives the non-hierarchical coding processes syntax compliance test main procedure.

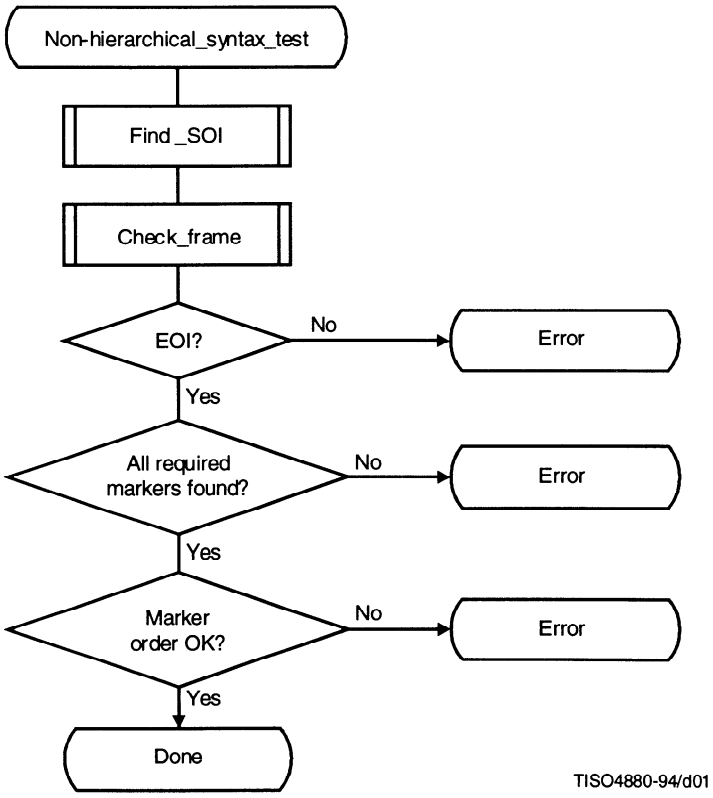

Figure 1 – Non-hierarchical syntax test procedure

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"All required makers found" means that all markers designated with 'G' in the Table 1 column of the process under test were found. A missing required marker makes the compressed data under test non-compliant with the syntax. All other markers found should have an 'o' in the column for the corresponding process. A marker found in the compressed data which has a (–) in the column for the corresponding process or is missing from the table makes the compressed data under test non-compliant with the syntax.

The high-level syntax in ITU-T Rec. T.81 | ISO/IEC 10918-1 B.2.1 and ITU-T Rec. T.81 | ISO/IEC 10918-1, Figure B.2 specifies the required order for the "Marker order OK?" test for non-hierarchical coding processes.

Table 2 specifies the parameter column in ITU-T Rec. T.81 | ISO/IEC 10918-1, Tables B.2 through B.11 that should be used to determine the allowed range of parameter values in marker segments for non-hierarchical processes.

Table 1 – Marker syntax requirements for non-hierarchical coding processes

ITU-T Rec. T.81 | ISO/IEC 10918-1				Process														
	Reference	Figure	Table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SOI	B.2.1	B.2		G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
EOI	B.2.1	B.2		G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
RST_m	B.2.1	B.2		o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
SOS	B.2.3	B.4	B.3	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
DNL	B.2.5	B.12	B.10	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Non-differential frames																		
SOF_0	B.2.2	B.3	B.2	G	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SOF_1	B.2.2	B.3	B.2	–	G	–	G	–	–	–	–	–	–	–	–	–	–	–
SOF_2	B.2.2	B.3	B.2	–	–	–	–	–	G	–	G	–	G	–	G	–	–	–
SOF_3	B.2.2	B.3	B.2	–	–	–	–	–	–	–	–	–	–	–	–	–	G	–
SOF_9	B.2.2	B.3	B.2	–	–	G	–	G	–	–	–	–	–	–	–	–	–	–
SOF_{10}	B.2.2	B.3	B.2	–	–	–	–	–	–	G	–	G	–	G	–	G	–	–
SOF_{11}	B.2.2	B.3	B.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	G
Tables/miscellaneous																		
DQT	B.2.4.1	B.6	B.4	G	G	G	G	G	G	G	G	G	G	G	G	G	o	o
DHT	B.2.4.2	B.7	B.5	G	G	o	G	o	G	o	G	o	G	o	G	o	G	o
DAC	B.2.4.3	B.8	B.6	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
DRI	B.2.4.4	B.9	B.7	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
COM	B.2.4.5	B.10	B.8	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
APP_n	B.2.4.6	B.11	B.9	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

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Table 2 – Parameter column in ITU-T Rec. T.81 | ISO/IEC 10918-1, Annex B tables for non-hierarchical processes

	Sequential DCT		Progressive	Lossless
	Baseline	Extended	DCT	
Non-differential frames				
SOF_0	G	–	–	–
SOF_1	–	G	–	–
SOF_2	–	–	G	–
SOF_3	–	–	–	G
SOF_9	–	G	–	–
SOF_{10}	–	–	G	–
SOF_{11}	–	–	–	G

5.1.2 Hierarchical coding processes syntax compliance test

Figure 2 gives the hierarchical coding processes syntax compliance test main procedure.

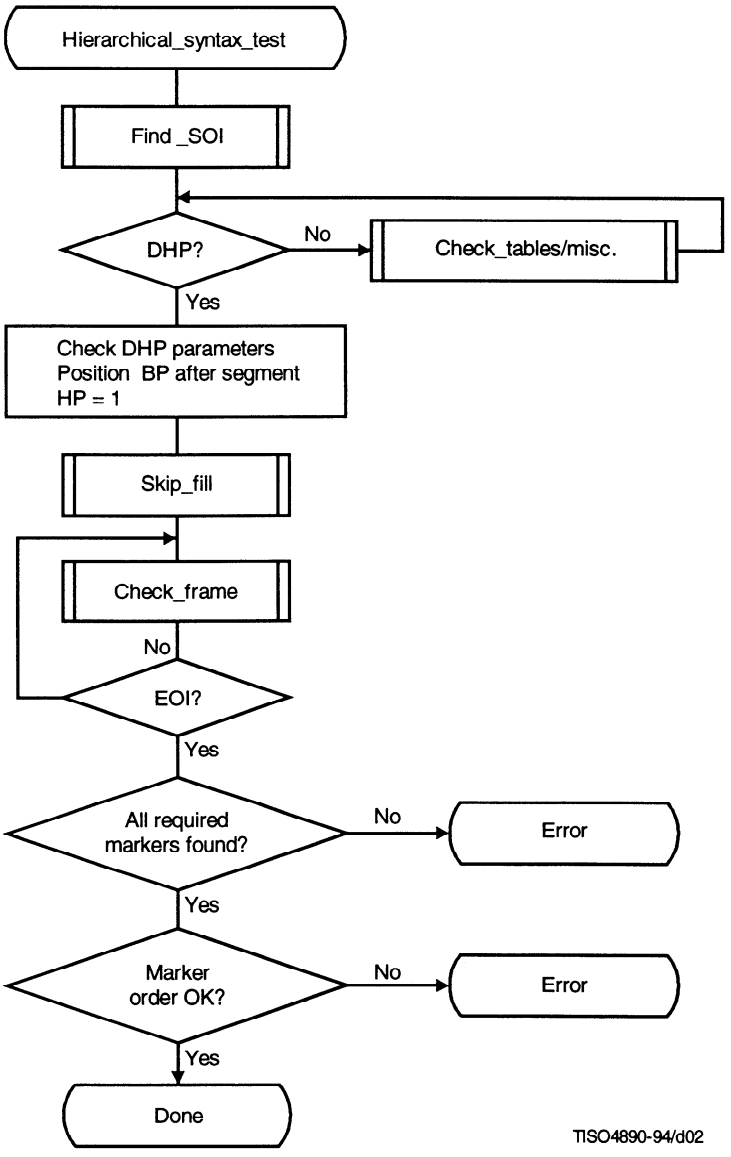

Figure 2 – Hierarchical syntax test procedure

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The "Check DHP parameters" procedure is not specified here and is left to the tester. The tester should use the references given in Table 3 in the line containing DHP. The appropriate column to be used to check that the parameters' values are valid can be found in Table 4.

Table 3 – Marker syntax requirements for hierarchical coding processes

ITU-T Rec. T.81 | ISO/IEC 10918-1				Process													
	Reference	Figure	Table	16	17	18	19	20	21	22	23	24	25	26	27	28	29
SOI	B.3.1	B.13		G	G	G	G	G	G	G	G	G	G	G	G	G	G
EOI	B.3.1	B.13		G	G	G	G	G	G	G	G	G	G	G	G	G	G
RST_m	B.2.1	B.2		o	o	o	o	o	o	o	o	o	o	o	o	o	o
SOS	B.2.3	B.4	B.3	G	G	G	G	G	G	G	G	G	G	G	G	G	G
DNL	B.2.5	B.12	B.10	o	o	o	o	o	o	o	o	o	o	o	o	o	o
DHP	B.3.2	B.13	B.2	G	G	G	G	G	G	G	G	G	G	G	G	G	G
EXP	B.3.3	B.14	B.11	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Non-differential frames																	
SOF_0	B.2.2	B.3	B.2	o	o	–	–	o	o	–	–	o	o	–	–	–	–
SOF_1	B.2.2	B.3	B.2	o	–	G	–	o	–	o	–	o	–	o	–	–	–
SOF_2	B.2.2	B.3	B.2	–	–	–	–	o	–	o	–	o	–	o	–	–	–
SOF_3	B.2.2	B.3	B.2	–	–	–	–	–	–	–	–	–	–	–	–	G	–
SOF_9	B.2.2	B.3	B.2	–	o	–	G	–	o	–	o	–	o	–	o	–	–
SOF_{10}	B.2.2	B.3	B.2	–	–	–	–	–	o	–	o	–	o	–	o	–	–
SOF_{11}	B.2.2	B.3	B.2	–	–	–	–	–	–	–	–	–	–	–	–	–	G
Differential frames																	
SOF_5	B.2.2	B.3	B.2	o	–	o	–	o	–	o	–	o	–	o	–	–	–
SOF_6	B.2.2	B.3	B.2	–	–	–	–	o	–	o	–	o	–	o	–	–	–
SOF_7	B.2.2	B.3	B.2	o	–	o	–	o	–	o	–	o	–	o	–	o	–
SOF_{13}	B.2.2	B.3	B.2	–	o	–	o	–	o	–	o	–	o	–	o	–	–
SOF_{14}	B.2.2	B.3	B.2	–	–	–	–	–	o	–	o	–	o	–	o	–	–
SOF_{15}	B.2.2	B.3	B.2	–	o	–	o	–	o	–	o	–	o	–	o	–	o
Tables/miscellaneous																	
DQT	B.2.4.1	B.6	B.4	G	G	G	G	G	G	G	G	G	G	G	G	o	o
DHT	B.2.4.2	B.7	B.5	G	o	G	o	G	o	G	o	G	o	G	o	G	o
DAC	B.2.4.3	B.8	B.6	o	o	o	o	o	o	o	o	o	o	o	o	o	o
DRI	B.2.4.4	B.9	B.7	o	o	o	o	o	o	o	o	o	o	o	o	o	o
COM	B.2.4.5	B.10	B.8	o	o	o	o	o	o	o	o	o	o	o	o	o	o
APP_n	B.2.4.6	B.11	B.9	o	o	o	o	o	o	o	o	o	o	o	o	o	o

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Table 4 – Parameter column in ITU-T Rec. T.81 | ISO/IEC 10918-1, Annex B tables for hierarchical processes

	Sequential DCT		Progressive	Lossless
	Baseline	Extended	DCT	
Non-differential frames				
SOF_0	G	–	–	–
SOF_1	–	G	–	–
SOF_2	–	–	G	–
SOF_3	–	–	–	G
SOF_9	–	G	–	–
SOF_{10}	–	–	G	–
SOF_{11}	–	–	–	G
Differential frames				
SOF_5	–	G	–	–
SOF_6	–	–	G	–
SOF_7	–	–	–	G
SOF_{13}	–	G	–	–
SOF_{14}	–	–	G	–
SOF_{15}	–	–	–	G

BP is the pointer to the compressed data stream bytes. After checking parameters, BP is positioned after the segment. HP is the hierarchical progression flag.

An EOI marker determines the end of the compressed data stream. If an EOI marker has not been found before BP points outside the compressed data, the compressed data stream under test is non-compliant.

The "All required makers found" test means that all markers designated with 'G' in the column of the process of Table 3 for hierarchical processes were found. A missing required marker makes the compressed data under test non-compliant with the syntax. All other markers found should have an 'o' in the column for the corresponding process. A marker found in the compressed data which has a (–) in the column for the corresponding process makes the compressed data under test non-compliant with the syntax.

The high-level syntax in ITU-T Rec. T.81 | ISO/IEC 10918-1, B.3.1 and ITU-T Rec. T.81 | ISO/IEC 10918-1, Figure B.13 specifies the required order for the "Marker order OK?" test for hierarchical coding processes.

Table 4 specifies the parameter column in ITU-T Rec. T.81 | ISO/IEC 10918-1, Tables B.2 through B.11, that should be used to determine the allowed range of parameter values in marker segments for hierarchical processes.

5.2 Abbreviated Compressed Data Format Syntax Requirements

5.2.1 Abbreviated format non-hierarchical coding processes syntax compliance test

The compliance testing for abbreviated format compressed image data syntax is the same as for the interchange format compressed image data given in 5.1.1 except that some or all of the table specifications may be omitted (see ITU-T Rec. T.81 | ISO/IEC 10918-1 B.4). If all of the tables are removed from a marker segment, the marker and its length parameter are also removed.

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5.2.2 Abbreviated format hierarchical coding processes syntax compliance test

The compliance testing for abbreviated format compressed image data syntax is the same as for the interchange format compressed image data given in 5.1.2 except that some or all of the table specifications may be omitted (see ITU-T Rec. T.81 | ISO/IEC 10918-1, B.4). If all of the tables are removed from a marker segment, the marker and its length parameter are also removed.

5.3 Abbreviated format for table specification data syntax compliance test

Figure 3 gives the abbreviated format for table specification data syntax compliance test main procedure.

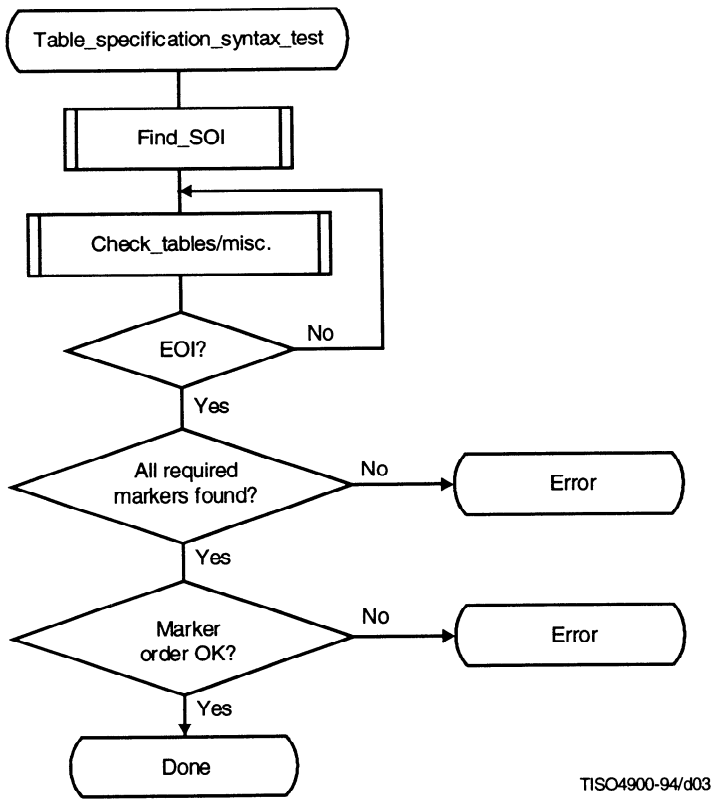

Figure 3 – Table specification syntax test procedure

An EOI marker determines the end of the compressed data stream. If an EOI marker has not been found before BP points outside the compressed data, the compressed data stream under test is non-compliant.

The "All required makers found" test means that all markers designated with 'G' in the column of the process of Table 5 for abbreviated format for table specifications were found. A missing required marker makes the compressed data under test non-compliant with the syntax. All other markers found should have an 'o' in the column for the corresponding process. A marker found in the compressed data which has a (–) in the column for the corresponding process or is missing from Table 5 makes the compressed data under test non-compliant with the syntax.

The high-level syntax in ITU-T Rec. T.81 | ISO/IEC 10918-1 B.5 and ITU-T Rec. T.81 | ISO/IEC 10918-1, Figure B.15, specifies the required order for the "Marker order OK?" test for abbreviated format for table-specification data.

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Table 5 – Marker syntax requirements for abbreviated format for table specification data

ITU-T Rec. T.81 I ISO/IEC 10918-1				
Marker	Reference	Figure	Table	
SOI	B.5	B.15		G
EOI	B.5	B.15		G
Tables/miscellaneous				
DQT	B.2.4.1	B.6	B.4	o
DHT	B.2.4.2	B.7	B.5	o
COM	B.2.4.5	B.10	B.8	o
APP_n	B.2.4.6	B.11	B.9	o

5.4 Additional procedures

Figure 4 gives the "Find_SOI" procedure in which the SOI marker is identified. This determines the start of the compressed data stream.

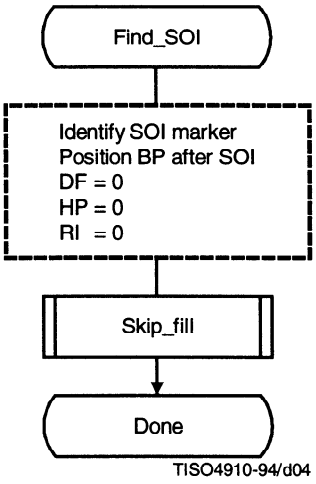

Figure 4 – Procedure to find the SOI marker

The procedure of identifying the SOI marker skips any preceding fill bytes and may require information about where the compressed data starts which is outside of this Specification. A failure to find SOI at the start of the compressed data makes the compressed data under test non-compliant.

The hierarchical-progression flag (HP), the differential-frame flag (DF), and restart-interval flag (RI) are cleared. They will be set by a DHP marker, an EXP marker, and a DRI marker, respectively. The HP and DF flags allow some procedures to be shared for the testing of both non-hierarchical and hierarchical processes.

Figure 5 shows the "Skip_fill" procedure.

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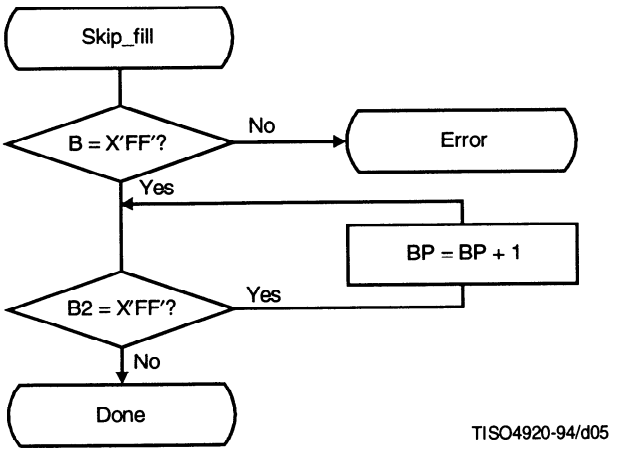

Figure 5 – Skip fill bytes procedure

First, the byte B pointed to by BP shall be an X'FF' byte. Then BP is incremented past any extra "fill" X'FF' bytes so that it will point to last X'FF' byte. Note that B2 is the byte next to B and is pointed to by BP + 1.

Figure 6 gives the "Check_frame" procedure.

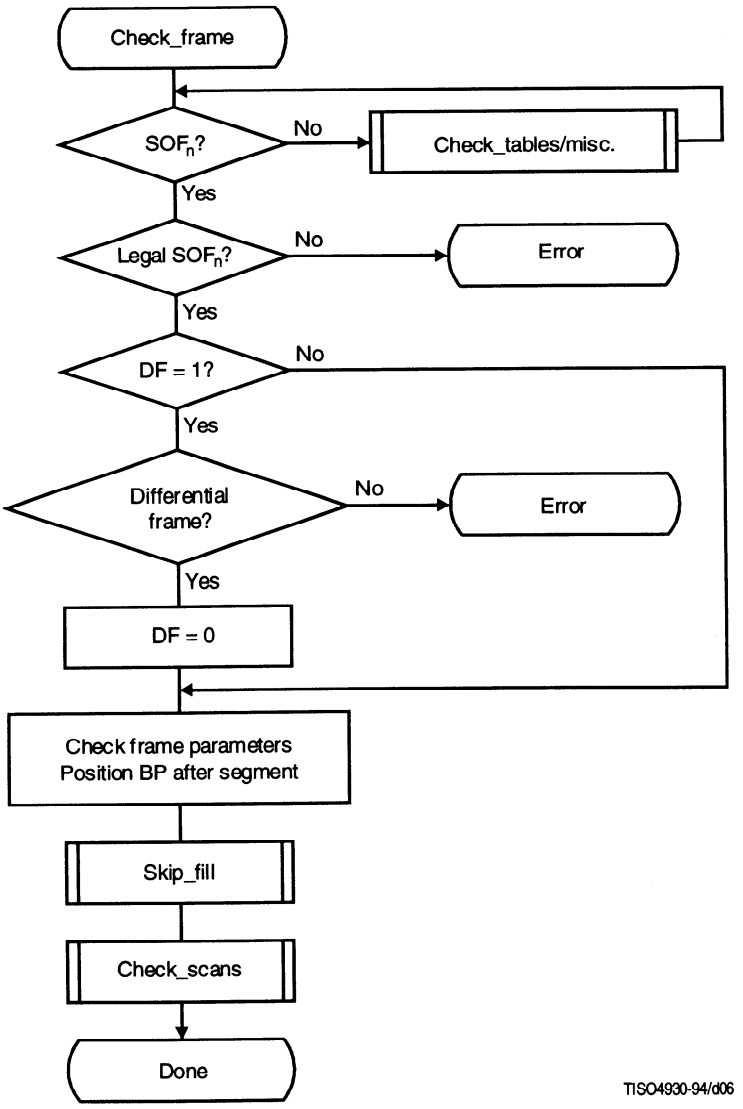

Figure 6 – The procedure for checking a frame for all coding processes

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The "Legal SOFn?" test verifies that, in Table 1 for non-hierarchical processes, and Table 3 for hierarchical processes, the intersection of the column of the given process number and the line of the found SOF_n marker code, is designated by either 'G' or 'o'.

If the EXP marker has set the DF flag to 1 (in hierarchical processes only), a differential frame must follow.

The "Check_frame parameters" procedure is not specified here and is left to the tester. The tester should use the references given in Table 1 in the line containing the found SOF_n for non-hierarchical coding processes. Table 2 gives the column which is used to determine allowed range of parameter values based on the SOF_n marker for non-hierarchical coding processes. The tester should use the references for hierarchical coding processes given in Table 4 in the line containing the SOF_n for hierarchical frames. Table 4 also gives the column which is used to determine allowed range of parameter values based on the SOF_n marker for differential frames.

Figure 7 gives the "Check_tables/misc." procedure for all processes.

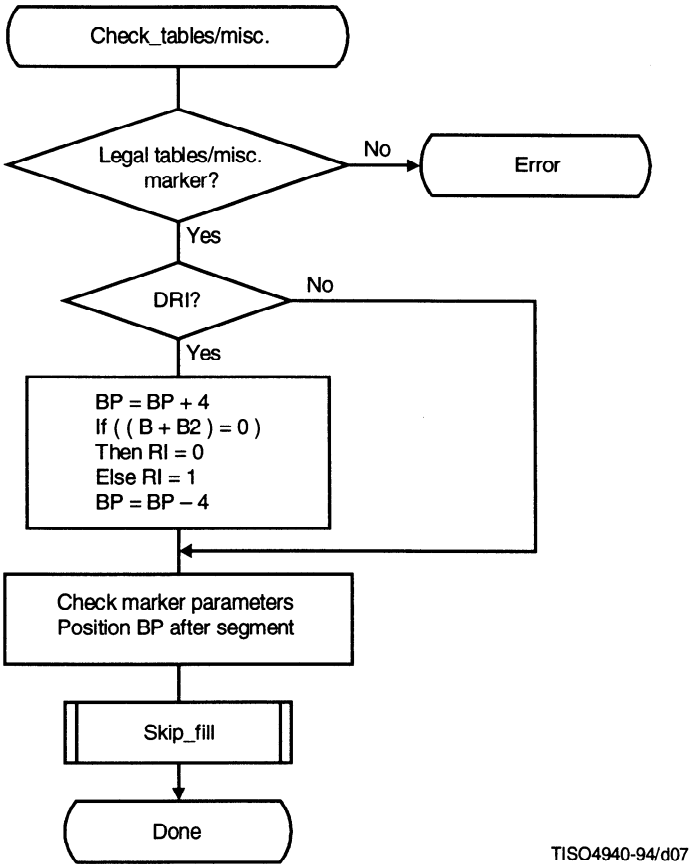

Figure 7 – Procedure to check the tables/miscellaneous markers

The "Legal tables/misc. marker?" test verifies that, in Table 1 for non-hierarchical processes, Table 3 for hierarchical processes, and Table 5 for abbreviated format for table specifications, under the tables/miscellaneous caption, the intersection of the column of the given process number and the line of the marker code to be checked, is designated by either 'G' or 'o'.

If the marker is DRI (Define Restart Interval), four is added to BP so that B points at the most significant byte and B2 at the least significant byte of the parameter Ri in order to use them to set the restart-interval flag RI. Then, four is subtracted from BP to reposition BP at the DRI marker.

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The "Check marker parameters" procedure is not specified here and is left to the tester. The tester should use the references given in Table 1 for non-hierarchical processes, Table 3 for hierarchical processes, and Table 5 for abbreviated format for table specifications, in the line containing the found table/misc. marker. The appropriate column to be used to check that the parameters' values are valid can be found in Table 2 for non-hierarchical processes and Table 4 for hierarchical processes.

Figure 8 gives the "Check_scans" procedure for all coding processes.

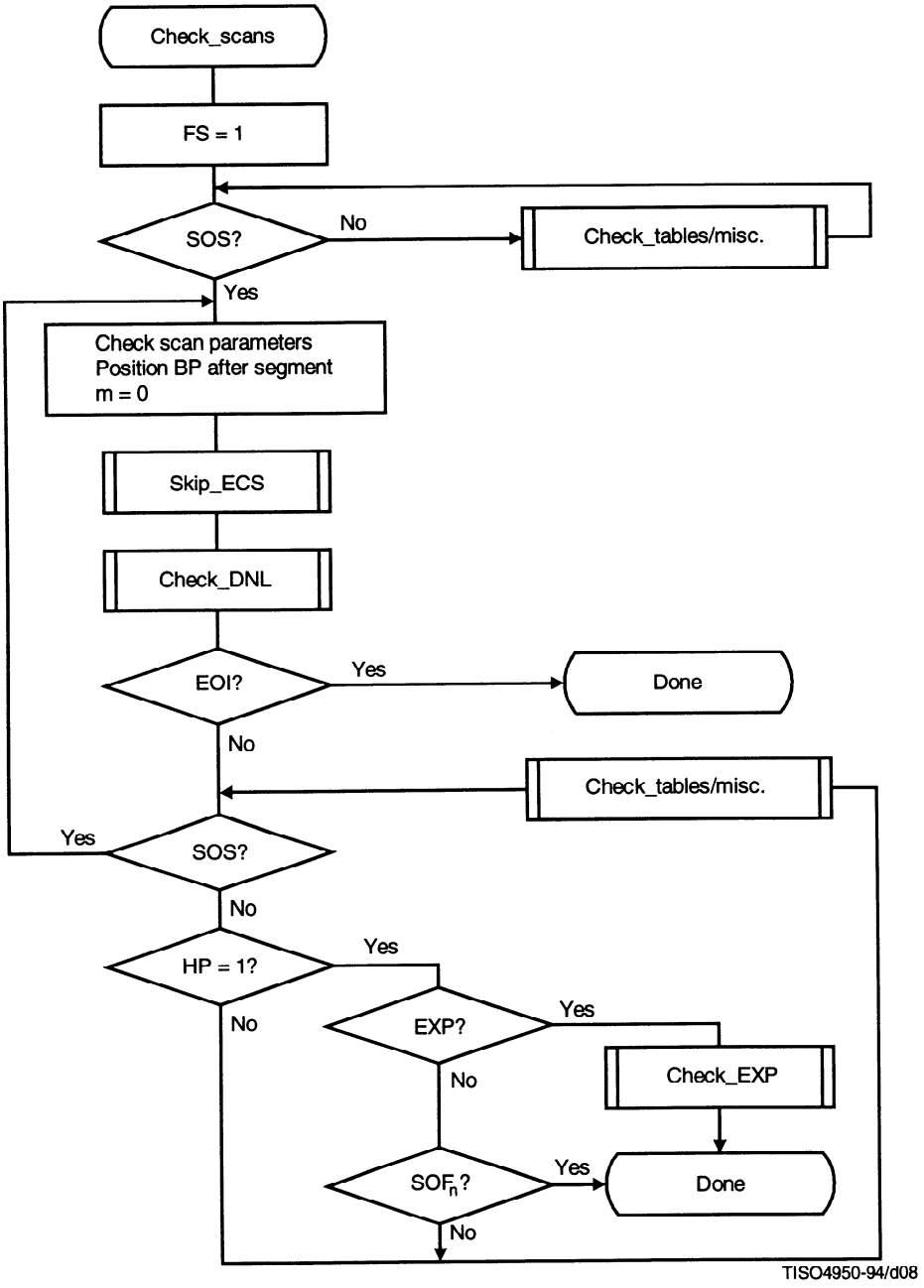

Figure 8 – The procedure for checking scans

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