INTERNATIONAL STANDARD

ISO 16284

Second edition
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Ophthalmic optics — Information interchange for ophthalmic optical equipment

Optique ophtalmique — Échange d'informations pour l'équipement d'optique ophtalmique

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16284 was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 7, *Ophthalmic optics and instruments* and by Technical Committee CEN/TC 170, *Ophthalmic optics* in collaboration.

This second edition cancels and replaces the first edition (ISO 16284:2001), which has been technically revised. Since the publication of the first edition in the year 2001, there have been a number of industry developments. Specifically, surface coater, front surface generator, lens measuring, inspection and lap feeder devices have all been developed. In order to communicate with these devices and to support new features on existing device types, the maintenance committee has proposed a number of new labels and device types. This revised International Standard also proposes a way of dealing with file-based data transfers between devices and hosts. In addition, a number of clarifications has been made to further explain certain requirements of the standard and deprecating several requirements because they have proved difficult to manage in practice.

Introduction

This International Standard is the result of a desire shared by manufacturers of optical laboratory equipment and producers of software used in optical laboratories to simplify the interconnection of their products.

The International Standard defined herein provides:

— a method by which machines and computer systems conduct their exchanges of data;

— a method by which computer systems can initialize such parameters on machines as the manufacturers thereof allow;

— a method by which machines can initialize computer systems with information that the systems can use for various purposes;

— a method by which a machine can inform a computer system as to what information it wants to receive, thus allowing machines to define new interfaces dynamically;

— a standard set of records and device types that are used to communicate agreed upon sets of information.

The last feature listed above requires that this International Standard be amended on a regular basis, as the need for new data elements is inevitable.

Ophthalmic optics — Information interchange for ophthalmic optical equipment

1 Scope

This International Standard establishes a method by which machines and computer software systems used in the fabrication of ophthalmic lenses can exchange information.

2 Normative reference

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 13666:1998, *Ophthalmic optics — Spectacle lenses — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13666 and the following apply.

3.1 General terms

3.1.1
device
machine or instrument used in the fabrication of ophthalmic lenses that communicates with a computer system to send or receive job information

3.1.2
host
computer system providing information to or receiving information from a device

3.1.3
job
order for prescription ophthalmic lenses or spectacles

3.1.4
download
communication session in which the host system transmits data to the device

3.1.5
upload
communication session in which the device transmits data to the host

3.2 Special characters

3.2.1
code separator
reserved character used to delimit codes in a device record

3.2.2
CRC position character
reserved character marking the location of the end of the data records and the start of the optional CRC record within a packet

3.2.3
end character
reserved character marking the end of a packet

3.2.4
field separator
reserved character delimiting the fields in a record

3.2.5
label separator
reserved character separating the record label from the field(s) within a record

3.2.6
mandatory record flag
reserved character marking certain records as mandatory

3.2.7
start character
reserved character marking the beginning of a packet

3.2.8
record separator
reserved character which delimits records

3.2.9
unknown data indicator
reserved character indicating that data required for a particular field is unknown to the host

3.2.10
ACK character
reserved character indicating successful transmission of a packet

3.2.11
NAK character
reserved character indicating failed transmission of a packet

3.2.12
control character
character having an ASCII value of less than 32

3.3 Data types

3.3.1
limited data
text data limited to a maximum length

3.3.2
literal data
text data limited to a maximum length and specified in this International Standard

3.3.3
numeric data
floating-point and integer numbers

3.3.4
text data
strings of characters that have no pre-defined meaning

3.3.5
integer data
data represented in whole number form

3.3.6
binary data
data presented in a form usable by computer software with little or no translation

NOTE It requires special handling to avoid introduction of control characters.

3.4 Messages

3.4.1
message
structured stream of data transmitted from a host to a device or from a device to a host

3.4.2
confirmation message
message sent by the receiver of a packet and comprised of a single character indicating that the transmission was successful

3.4.3
positive acknowledgement
single character message indicating successful reception of a sender's message

3.4.4
negative acknowledgement
single character message indicating unsuccessful reception of a sender's message

3.4.5
packet
structured message consisting of a start character and a series of records and terminated by an end character

3.4.5.1
data packet
packet sent from a device to a host or a host to a device, and containing requested information

3.4.5.2
request packet
packet sent from a device to a host to initiate a session

3.4.5.3
response packet
packet containing status information

3.5 Records

3.5.1
record
structured stream of characters including a record label, a label separator, zero or more data fields separated by field separators and a terminating record separator

3.5.2
data field
single data element within a record

3.5.3
record label
means of identifying data contained in a record, limited in length to 8 characters and not including spaces or reserved characters defined in this International Standard

NOTE A list of device record labels is in Annex A.

3.5.4
ASCII record
record comprised of ASCII characters and conforming to the structures defined herein

3.5.5
binary record
record comprised of bytes encoded using the binary number system

3.5.6
chiral record
record with two fields, one for a data element for a right lens or eye, and one for a left, arranged in the order right then left

3.5.7
CRC record
record at the end of any packet containing a CCITT[1] CRC-16 cyclical redundancy check value calculated on the characters transmitted

3.5.8
device record
record containing job specific data elements conveyed between devices and hosts

3.5.9
interface record
record supporting the operation of the host-device interface and not containing job-specific data

3.6 Sessions

3.6.1
session
sequence of messages passed between a device and a host that serves to exchange information related to a single order or task

3.6.2
initialization session
specialized session allowing devices to provide hosts with information that would otherwise be included with each request, such as machine model, software version and operator ID

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1) Comité Consultatif International Téléphonique et Télégraphique

3.6.2.1
auto-format initialization
initialization session allowing devices to define sets of device records to be requested from hosts

3.6.2.2
preset initialization
initialization session allowing devices to transmit sets of identifying data to hosts

3.6.3
download session
session in which information is passed from a host to a device

3.6.4
upload session
session in which information is passed from a device to a host

3.6.5
INFO session
upload request packet containing job status information used to indicate the completion of a job by a device

3.6.6
MNT session
upload request packet containing vendor specific device information

3.7 Timeout

3.7.1
timeout
numeric value representing that period of time that a host or device shall wait for the arrival of data, after which it assumes that such data will not be forthcoming

3.7.1.1
confirmation timeout
timeout which applies to the reception of the confirmation message

3.7.1.2
intercharacter timeout
timeout which applies to the interval between successive characters in a stream of data

3.7.1.3
packet timeout
timeout which applies to the reception of a packet

4 Overview

The strategy used in this International Standard for the exchange of data between devices and hosts can be expressed as follows.

A machine used in the fabrication of ophthalmic lenses (a device) sends a request to a computer system (a host), indicating a need to do one of the following:

— initialize information to identify the device, software versions, model numbers, etc.;

— upload to the host, information for it to store and/or use in the processing of ophthalmic prescription orders;

— download from the host, information required by the device for it to perform its tasks.

Communication can be initialized in two ways. The device may begin an initialization session or the host can force the device to do so by refusing to accept a normal request and asking for initialization via a special error response. For upload requests, the host acknowledges the request and the device sends its data, the receipt of which the host acknowledges. For download requests, the host responds to the request with the data requested.

The variable-length packets of data that comprise this exchange consist of a series of records, each of which contains data and a label identifying the data. This International Standard defines a set of labels and characterizes the data associated with each. This set of labels shall be expanded as needed in the future.

An exchange of packets related to a single job is called a session. The structure of these sessions and the packets of records of which they are comprised is the subject of this International Standard.

Although this International Standard was conceived as being implemented on point-to-point RS-232 serial links, it could be implemented on other hardware platforms. As this is done, specifications shall be incorporated into this International Standard so as to maximize interconnectability amongst diverse hosts and devices.

In the examples given in this International Standard, in the interests of legibility, the RECORD SEPARATORS may be omitted, the START CHARACTER may be placed on a separate line and CRC RECORDS may be excluded. Remarks have been included as REM records. Comments are enclosed in square brackets (**[…]**) and are not part of the data stream. Ellipses ("…") are used to indicate more data of the same type as precedes and follows the ellipses. SPACES have been inserted around record and field separators for readability; in practice these should not be included in packets as this needlessly decreases the efficiency of expression. In the descriptions of Clause 5, REQUEST, RESPONSE and DATA refer to packets. Since encoded data are always expressed using the point as the decimal sign, to avoid confusion the decimal sign is used throughout this document although the ISO decimal sign is the comma. Furthermore, the space representing the thousandths separator is not given in the encoded data.

5 Requirements

5.1 Records

5.1.1 Interface records

This International Standard defines a set of interface records. These records contain information which the host and device use to communicate. They do not contain job-specific data. These records are enumerated in A.2.

5.1.2 Device records

This International Standard defines a set of device records which identify the data elements that might be required by any of the devices that might be required for the fabrication of a job. These records are enumerated in A.1.

5.1.3 Preset device types

This International Standard further identifies subsets of device records that are deemed to be appropriate for specific types of devices. These preset records are enumerated in A.3.

5.1.4 Records with unknown values

If the host is requested to send any record for which it has no information or partial information, it shall send the record with a question mark "?" in all the unknown data fields in order to indicate that the information is not available. Such records shall be properly formatted according to the rules for chiral records.

5.1.5 Ignored records

Whenever a host or device receives a record with a label it does not recognize, it shall ignore the record.

5.1.6 Experimental records

When a machine vendor wishes to test new records prior to submitting them for inclusion in this International Standard, such records should use labels that begin with an underscore character (ASCII "_", decimal 95). Record labels are limited in length to 8 characters and may not include spaces or reserved characters defined in this International Standard.

5.1.7 Reserved characters

5.1.7.1 Control characters and the additional characters specified may not appear in transmitted data streams except as specified. The set of reserved characters is specified in Table 1.

5.1.7.2 Reserved characters shall appear in ASCII records only to provide the functionality that they are assigned, as in the case of record and field separators. Reserved characters which conform to the definition of text data may also appear in text fields.

5.1.7.3 When a reserved character with a decimal value less than 32 appears in a binary record, it shall be "escaped" in the following manner. In place of such a character, two characters shall be sent. The first character shall be an ESC character followed by the original character with its high bit set, i.e. the character is OR'd with decimal 128, hex 0×80. The receiver, on receipt of an ESC character, shall discard the ESC character and clear the high bit of the following character. The CRC value, if present, shall be determined after such reserved characters are escaped, so that a receiver need not process packets prior to validating a received packet's CRC.

NOTE In other words, the transmitter encodes control characters before calculating the CRC, and the receiver calculates the CRC before decoding them.

EXAMPLE A stream of bytes (a short tracing record in absolute binary form) before and after having been "escaped" as described above.

```
Before:
   R=175  9  23  10  45  10 223  9  90  9 205  8  89  8 252   7 183   7 143   7
     130  7 147   7 197   7  24  8 136  8  18  9 167  9  39  10  85  10  19  10
     213  9 146   9  75   9  14  9 199  8 120  8  38  8 222   7 166   7 131   7
     117  7 122   7 149   7 191  7 241  7  41  8  92  8 152   8 229   8  67   9 <CR/LF>

After:
   R=175  9  23 27 138 45 27 138 223 9 90 9 205 8 89  8 252   7 183   7 143   7
     130  7 147  7  197   7  24  8 136  8  18  9 167  9  39 27 138 85 27 138 27 147 27 138
     213  9 146  9   75   9  14  9 199  8 120  8  38  8 222   7 166   7 131   7
     117  7 122  7  149   7  191 7 241  7  41  8  92  8 152   8 229   8  67   9 <CR/LF>
```

5.1.7.4 Limited data are a string of ASCII characters in the range 32 to 127 decimals excluding 59 (semi-colon). The length of this string is limited to 12 characters.

5.1.7.5 Text data are a string of ASCII characters in the range 32 to 127 decimals excluding 59 (semi-colon) and having no predefined meaning. The length is limited to 80 characters.

5.1.7.6 Literal data is a string of ASCII characters in the range 32 to 127 whose meaning is implied by the record type and specified in this International Standard. Length is limited to 12 characters unless otherwise noted in the record definition. Literal data shall not contain reserved characters defined by the interface (see Table 1). Literal data is case sensitive.

5.1.8 Record length

Non-binary records should not exceed 80 characters in length. Binary data may be longer than 80 characters.

Table 1 — Reserved characters

Character	Hexadecimal value	Decimal value	Control key	Use
FS	0×1C	28	^\	Start of message
GS	0×1D	29	^]	End of message
DC1	0×11	17	^Q	Reserved (XOFF)
DC3	0×13	19	^S	Reserved (XON)
ACK	0×06	06	^F	Positive acknowledgement
NAK	0×15	21	^U	Negative acknowledgement
ESC	0×1B	27	^[	Escape
RS	0×1E	30	^^	CRC separator
SUB	0×1A	26	^Z	DOS end-of-file marker
CR	0×0D	13	^M	Record separator
LF	0×0A	10	^J	Record separator
;	0×3B	59	;	Field separator
=	0×3D	61	=	Label separator
,	0×2C	44	,	Code separator
*	0×2A	42	*	Mandatory record flag
?	0×3F	63	?	Unknown data indicator

5.2 Reference point records

5.2.1 Records are defined to indicate the horizontal and vertical distances between two reference points or to indicate an action that a machine should take relative to a reference point. The following naming scheme will clarify all such reference records included in this International Standard and can easily be extended for future ones.

5.2.2 The first two letters of the record label describe the first reference point (see Table 2), the second two letters of the record label describe the second reference point and the last two letters indicate “IN” (horizontal) or “UP” (vertical) directions (see Table 3). The values indicate the position of the second reference point with respect to the first reference point.

5.2.3 A positive IN value indicates that the second reference point is towards the nasal relative to the first.

5.2.4 A negative IN value indicates that the second reference point is towards the temporal relative to the first.

5.2.5 A positive UP value indicates that the second reference point is above the first.

5.2.6 A negative UP value indicates that the second reference point is below the first.

Table 2 — Reference point identifiers

Identifier	Reference point
BC	Blank centre
FB	Finish block
FC	Frame centre
OC	Optical centre/prism reference point
SB	Surface block
SG	Segment/progressive fitting cross (layout reference point)

Table 3 — Reference point records

Label	Meaning
FBFCIN, FBFCUP	Finish block to frame centre (see Table A.1 for use)
FBSGIN, FBSGUP	Finish block to segment
FBOCIN, FBOCUP	Finish block to prism reference point (O.C.)
SBBCIN, SBBCUP	Surface block to blank centre
BCSGIN, BCSGUP	Blank centre to segment
BCOCIN, BCOCUP	Blank centre to prism reference point (O.C.)
SBSGIN, SBSGUP	Surface block to layout reference point (segment)
SBOCIN, SBOCUP	Surface block to prism reference point (see 5.3.11 for use)
SBFCIN, SBFCUP	Surface block to frame centre
SGOCIN/SGOCUP	Segment to O.C.
FCSGIN/FCSGUP	Frame centre to segment (similar to segment height or drop)
FCOCIN/FCOCUP	Frame centre to O.C. (similar to O.C. height or drop)

5.3 Generator records

5.3.1 The surface generator interface includes a number of records used to indicate adjustments that should be applied to the generator machine settings. Because this International Standard provides for a complete data set ("preset packet") to be sent to an "unknown" generator, it is necessary to clarify some of the relationships amongst these records, especially as relates to the "compensation" fields.

The position of a lens in a generator can be determined by the RNGH, RNGD, SAGRD and SAGBD fields (ring height, ring diameter, lens sag at ring diameter and lens sag at blank diameter, respectively). Some generators, especially those with exclusively mechanical components, may presume certain values for some of the above records and may be unable to effect the adjustments required by the mismatch in assumptions. The following compensation fields provide the data required to make these adjustments.

5.3.2 BLKCMP represents the change that is required to be made to the generator thickness setting that arises from a mismatch between the curvature of a block that has a curved contact surface with the lens and the curvature of the lens blocked thereon. The BLKB field contains the curvature of that surface of the block that contacts the lens; the BLKD field contains the diameter of the block.

5.3.3 When the blocks used for a job do not have a curved contact surface, the BLKB field is not necessary. If it is sent in such a case, its value should be equivalent to IFRNT.