sysmex

CT-90
ASTM Host Interface Specifications

Revision 1.01

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Sysmex Corporation

Content

1 Scope

This document is intended to supply the information that the CT-90 communicates with the host computer using ASTM protocol.

ASTM (the American Society for Testing and Materials), one of the world largest volunteer non-profit organizations, founded in 1898 for the purpose of creating standard regulations for materials, products and system services.

This specification conforms to the following two standards:

ASTM E1381-02

   Specifications for low-level protocols to transfer data between clinical laboratory instruments and computer systems.

ASTM E1394-97

   Standard specifications for transferring data between clinical instruments and computer systems.

> Note:
>   The CT-90 supports only the Ethernet connection.
>   As for the CT-90, only the presentation layer conforms to ASTM1394-97 and the other layers conform to IEEE 802.3u.

2　General

By communicating with the host computer, the CT-90 will perform the followings.

(1)　CT-90 can realize that samples are arriving at BT and notifies host computer of the arriving.

(2)　CT-90 can receive order inquiry from the host computer to transport sample racks to appropriate analyzer instruments.

(3)　CT-90 can notify pool information of all tubes transported to Stock yard to the host computer.

3　Terminology

(1)　Numerics:
Indicates ASCII codes "0" (30h) through "9" (39h)

(2)　Alphabet:
Indicates ASCII codes "A" (41h) through "Z" (5Ah) and "a" (61h) through "z" (7Ah)

(3)　"*"
Indicates ASCII codes "*" (2Ah)

(4)　"　"
Indicates ASCII codes " " (20h)

(5)　"-"
Indicates ASCII codes "-" (2Dh)

4 Communication Specifications

Communication specifications are based on a layer protocol.

   (1)   Physical layer (It conforms to IEEE 802.3u.)
Specifies the sending and receiving of signals between the IPU and the host computer through mechanical and electrical connections.   See the section "4.1 Physical layer (hardware)".

   (2)   Data link layer (It conforms to ASTM E1381-02.)
Specifies the sending and receiving of data by link connections and for each frame between the CP-90 and the host computer.   See the section "4.2 Data Link Layer (Transmission Protocol)".

   (3)   Presentation layer (It conforms to ASTM E1394-97.)
Specifies the messages that are sent and received by the IPU and the host computer.   See the section "4.3 Presentation layer".

Presentation layer	⟵ Specifies message specifications.
Data link layer	⟵ Specifies link connection and frame specifications.
Physical layer	⟵ Specifies mechanical and electrical specifications.

Note:
The CT-90 of the S90M supports connection by the TCP/IP.

4.1   Physical Layer (Hardware)

4.1.1   TCP/IP Connection

TCP/IP connection conforms to IEEE802.3u. The communication cable uses the UTP category 5 cable.
Prepare the connector and cable which apply to the TCP/IP connector of the CT-90.

4.2   Data Link Layer (Transmission Protocol)

The data link layer transfers data between systems using a character-based protocol in accordance with ASTM E1381-02 "6. Data Link Layers".   This section briefly describes communication control procedures.   For details, refer to ASTM E1381-02.
When the ASTM E1381-02 mode is intended to use, the TCP connection is established in prior to the communication.   To establish the TCP connection, the host computer acts as a server and the CT-90 acts as a client.   The CT-90 establishes a connection by requesting a connection for the IP address and the port number that are provided by the host computer.

4.2.1   Communication Status

The data link layer is consisted of following two state.
(1) Neutral Status
(2) Linked Status

Transition to each status is accomplished through the following three phases.
(1) Establishment Phase
   Establishes a communication line, and determines the direction of data transfer.   In this way, the sender and the receiver are identified, and the change is made from neutral status to linked status.
(2) Transfer Phase
   The sender transmits messages to the receiver until all messages are transferred.
(3) Termination Phase
   Releases the communication line.   Changes both the sender and the receiver from linked status to neutral status.

6
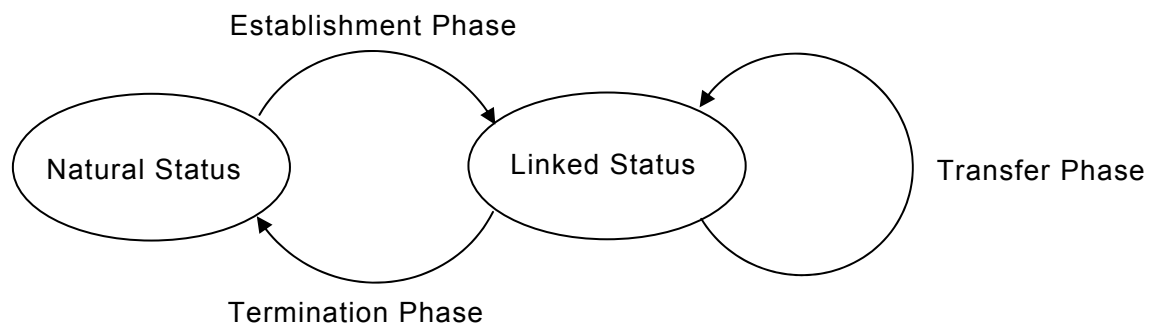
4.2.2   Establishment Phase

(1) The sender (CT-90) sends an [ENQ] signal to the receiver (host computer).   To respond to the
    sender, the receiver performs the following action:
 - Returns an [ACK] signal when the communication is enabled.
 - Returns a [NAK] signal when the communication is disabled.

   If the receiver responded [NAK] signal, the sender waits for at least 10 seconds before
   attempting to send an another [ENQ] signal.
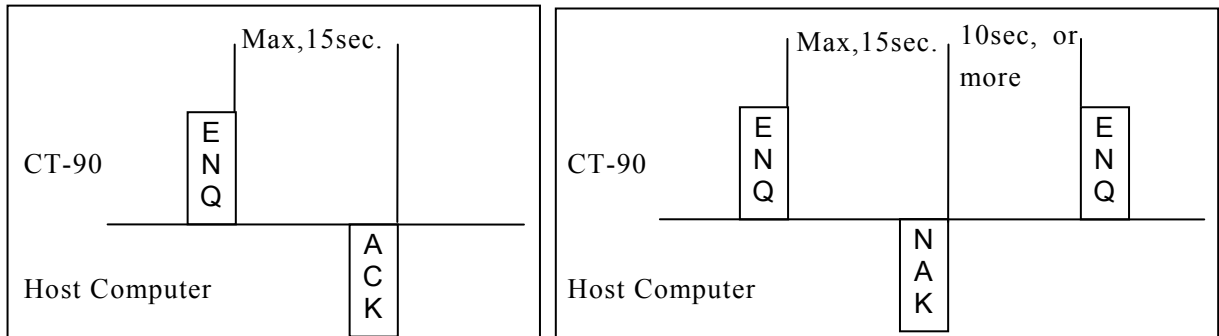
(2) When both sender and receiver send [ENQ] signals, the host computer Must yield control authority
    to the IPU.
  - The IPU sends [ENQ] signal again after 1 second.
  - The host computer Must wait for 20 seconds before sending [ENQ] signal again.
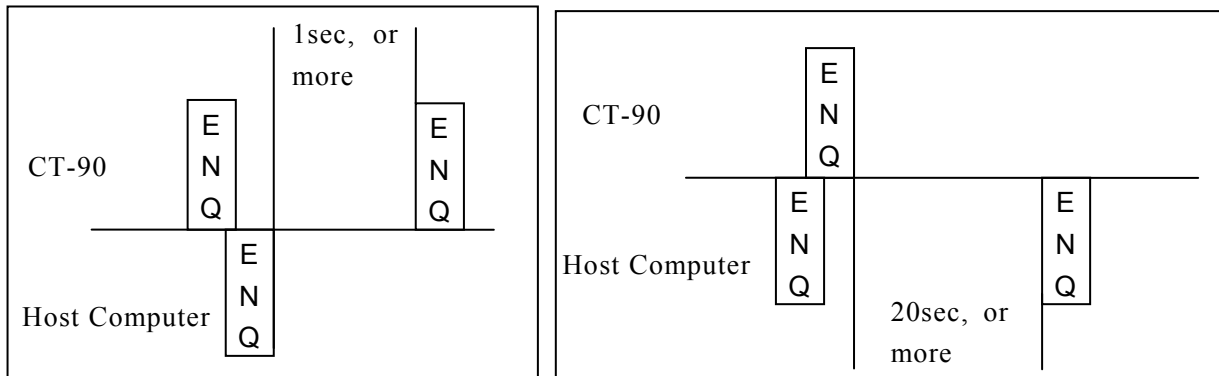
4.2.3   Transfer Phase

During the transfer phase, the sender sends messages to the receiver.   The transfer phase continues until all messages have been sent.

(1) Messages are sent in each record with multiple frames.   Each frame contains a maximum of 64000 characters (including frame overhead).   If the record is longer than 63993 characters, it is divided into two or more frames.

(2) Multiple records cannot be included in a single frame.

(3) If the record contains the maximum number of characters or less, a frame with the following structure will be transferred.
[STX] [F#] [Text] [ETX] [CHK1] [CHK2] [CR] [LF]

If the record is longer than the maximum number of characters, it is divided into 2 or more frames. The intermediate frame text termination code is [ETB], and the final frame text termination code is [ETX], as shown below.

[STX] [F#] [Text] [ETB] [CHK1] [CHK2] [CR] [LF]
[STX] [F#] [Text] [ETB] [CHK1] [CHK2] [CR] [LF]
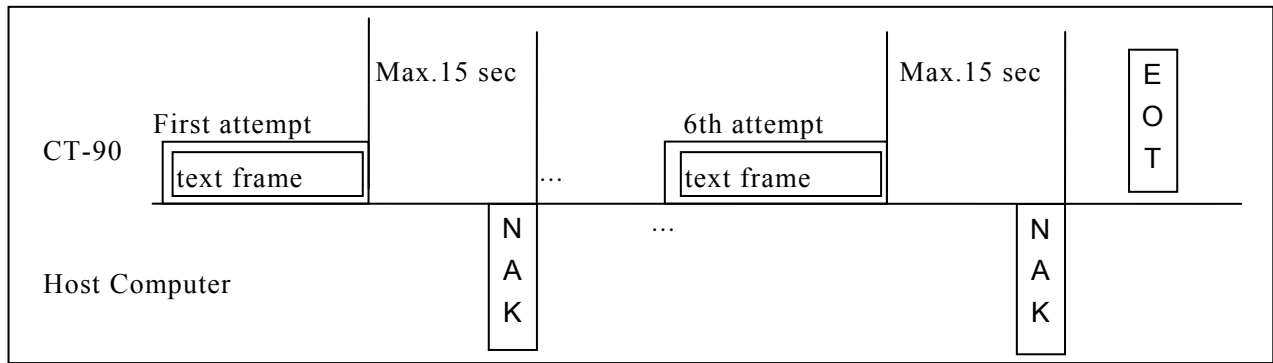   ... ...
[STX] [F#] [Text] [ETX] [CHK1] [CHK2] [CR] [LF]

Symbol	Explanation
[STX]	Start of a frame
[F#]	Frame number. One of the numbers 0 to 7 is used, starting with 1 and repeating 2, 3, 4, 5, 6, 7, 0. In case of retransmission, the same frame number is sent.
[Text]	ASTM E1394-97 records are used. For this reason the codes below will not be used. 0x00 - 0x06, 0x08, 0x0A, 0x0E - 0x1F, 0x7F, 0xFF
[ETB]	Control code indicating end of text (for intermediate frame)
[ETX]	Control code indicating end of text (for the final frame)
[CHK1] [CHK2]	Expressed by characters "0" - "9" and "A" - "F". Characters beginning from the character following [STX] and until [ETB] or [ETX] (including [ETB] or [ETX]) are added in binary. The 2-digit numbers, which represent the least significant 8 bits in hexadecimal code, are converted to ASCII characters "0" - "9" and "A" - "F". The most significant digit is stored in CHK1 and the least significant digit in CHK2.
[CR] [LF]	Control codes indicating end of frame

(4) If the receiver has successfully received the frame, and is prepared to receive the next frame, the receiver responds with [ACK].   After the sender receives [ACK], the sender advances the frame number and either sends a new frame or transitions to the termination phase.

(5) If the receiver fails to receive the frame and is prepared to receive the same frame again, the receiver responds with [NAK].   After the sender receives [NAK], the sender sends the most recent frame again, using the same frame number.   If a total of 6 attempts to send the frame failed, the sender transitions to the termination phase and Must end sending of the message.

CT-90   First attempt   Max.15 sec   6th attempt   Max.15 sec   E O T
         text frame   ...   text frame

Host Computer   N A K   ...   N A K

(6) The CT-90 processes the response of [EOT] from the host computer as [ACK].   (Response of [EOT] from the receiver is usually a request to suspend a transmission to the sender.   However, the CT-90 does not support this function.)

4.2.4   Termination Phase

During the termination phase, the status returns to neutral.
The sender sends the [EOT] to inform the receiver that the message transmission has been completed.   When the sender sends [EOT], the sender transitions to neutral status.   When the receiver receives [EOT], the receiver transitions to neutral status.

4.2.5   Timeout

The timer is used to detect a failure to coordinate between the sender and the receiver.   The timer is used as a mean of recovery for communication line and communication destination device failures.

(1) During the establishment phase, the timer is set when the sender sends [ENQ].   Time out results if a response of [ACK], [NAK], or [ENQ] is not received within 15seconds.   After time out, the sender transitions to the termination phase.

(2) During the transfer phase, the 15-second timer is set when the sender sends the final character of a frame.   Time out results if no response is received within 15 seconds.   After time out, the sender transitions to the termination phase.
The receiver sets a 30-second timer when first entering the transfer phase or when responding (either [ACK] or [NAK]) to a frame.   Time out results if the receiver does not receive a frame or [EOT] from the sender within 30 seconds.   After time out, the receiver discards the latest incomplete message and transitions to the termination phase.

4.3   Presentation Layer

4.3.1   Messages, Records and Fields

4.3.1.1   Messages

In the presentation layer, all data is transmitted using messages.   Messages are composed of record arrays that start with the message header record (H) and end with message termination record (L).

4.3.1.2   Records

A record is a series of text, beginning with an ASCII alphabet character referred to as the identifier, and ending with [CR].

Record Type	Record Identifier	Level	Contents
Header Record	H	0	Contains the sender and the receiver information
Patient Information Record	P	1	Contains the patient information
Inquiry Record	Q	1	Contains test order inquiry information requesting to the host computer
Test Order Record	O	2	Contains the test order information
Test Result Record	R	3	Contains analysis result information
Comment Record	C	1-4	Contains the specimen comment and the patient comment information
Manufacturer Information Record	M	1-4	Not used
Scientific Information Record	S	N/A	Not used
Message Terminator Record	L	0	Indicates the end of the message

•A smaller level number indicates a higher level.

•A higher-level record contains information that is common to all lower-level records.

•All levels other than 0 Must be located after higher levels.   However, the comment record can be inserted at any level.   They are considered to be one level lower than the preceding record.   However, a consecutive comment records are not allowed.

•Example of transmission

   H->P->O->R->L .... Correct

   H->R->L .... Incorrect, because P and O Must be transmitted in prior to R.

4.3.1.3   Fields

A record is further divided into multiple fields by field delimiters.

A field is identified by its position within a record, and has a variable length.

The followings are used as delimiters.

Type	Code	Description
Field Delimiter	Vertical bar (|) [7Ch]	Separates adjacent fields in a record.
Repeat Delimiter	Backslash (¥) [5Ch]	Used when there are plural components of the same type in one field, and repeats the same field.
Component Delimiter	Caret (^) [5Eh]	Separates data elements within a field that has a hierarchical or qualifier nature.
Escape Delimiter	Ampersand (&) [26h]	Is used within a text field to identify special case operations.
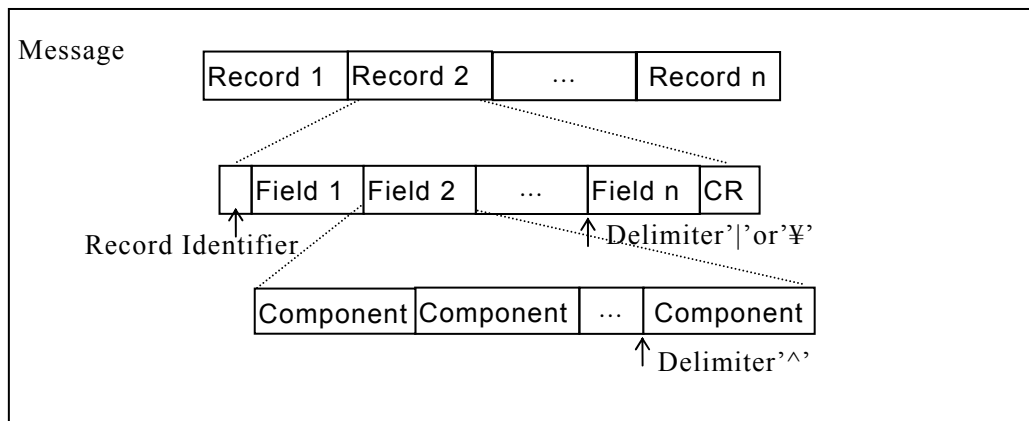
4.3.2   Communication Protocol

4.3.2.1   Transportation Order Inquiry (CT-90->Host computer)

This protocol is used for CT-90 to inquire to the host computer transportation order information to obtain the sample order information. Inquiry can be made with keyword of the sample ID Number.

Table 1: Transportation Order Inquiry

CT-90	Direction	Host Computer
ENQ	→	
	←	ACK
H: Header Record	→	
	←	ACK
Q: Inquiry Record	→	
	←	ACK
L: Message Terminator Record	→	
	←	ACK
EOT	→	

4.3.2.2 Transportation Order Information (Host Computer->CT-90)

This protocol is used for the host computer to respond a transportation order information against the inquiry made by the CT-90.

'P' and 'O' are transmitted by the pair for the number of the specimen material when the inquiry was generated by 'Inquiry Record (Q)' of the4.3.2.1Transportation Order Inquiry.

'P' and 'O' are transmitted by the pair by 5 records when 5 samples are inquired, and when 10 samples are inquired, it transmits by 10 records.

Table 2: Refer to Transportation Order Information.

Table 2: Transportation Order Information

Must/ Skippable	CT-90	Direction	Host Computer
Must		←	ENQ
	ACK	→	
		←	H: Header Record
	ACK	→	
Skippable		←	P: Patient Record (Pos.1)
	ACK	→	
		←	O: Order Record (Pos.1)
	ACK	→	
Skippable		←	P: Patient Record (Pos.2)
	ACK	→	
		←	O: Order Record (Pos.2)
	ACK	→	
Skippable		←	P: Patient Record (Pos.3)
	ACK	→	
		←	O: Order Record (Pos.3)
	ACK	→	
Skippable		←	P: Patient Record (Pos.4)
	ACK	→	
		←	O: Order Record (Pos.4)
	ACK	→	
Skippable		←	P: Patient Record (Pos.5)
	ACK	→	
		←	O: Order Record (Pos.5)
	ACK	→	
Skippable		←	P: Patient Record (Pos.6)
	ACK	→	
		←	O: Order Record (Pos.6)
	ACK	→	
Skippable		←	P: Patient Record (Pos.7)
	ACK	→	
		←	O: Order Record (Pos.7)
	ACK	→	
Skippable		←	P: Patient Record (Pos.8)
	ACK	→	
		←	O: Order Record (Pos.8)
	ACK	→	
Skippable		←	P: Patient Record (Pos.9)
	ACK	→	
		←	O: Order Record (Pos.9)
	ACK	→	
Skippable		←	P: Patient Record (Pos.10)
	ACK	→	
		←	O: Order Record (Pos.10)
	ACK	→	
Must		←	L: Message Terminator Record
	ACK	→	
		←	EOT

4.3.2.3   Pool Information (CT-90 -> Host Computer)

In case the conveyor line is composed of two or more blocks, storage information is transmitted to the Host Computer when the rack arrives at ST that the pool setting type of ST is set to 'Collection'.

Since the transfer unit uses the final sample ID No. read for the pool information, if the final reading is an ID reading error, the pool information will be an error sample No.

This protocol is used for sending pool information to the host computer. Pool information is transmitted to the host computer by each rack unit. 'P', 'O', and 'R' of each sample are transmitted together.

In case of 5 tubes on a rack, 'P', 'O' and 'R' must be transmitted 5 records. In case of 10 tubes on a rack 'P', 'O' and 'R' must be transmitted 10 records.

Table 3: Pool Information

Must/ Skippable	CT-90	Direction	Host Computer
Must	ENQ	→	
		←	ACK
	H: Header Record	→	
		←	ACK
Skippable	P: Patient Record (Pos.1)	→	
		←	ACK
	O: Order Record (Pos.1)	→	
		←	ACK
	R: Result Record(Pos.1)	→	
		←	ACK
Skippable	P: Patient Record (Pos.2)	→	
		←	ACK
	O: Order Record (Pos.2)	→	
		←	ACK
	R: Result Record(Pos.2)	→	
		←	ACK
Skippable	P: Patient Record (Pos.3)	→	
		←	ACK
	O: Order Record (Pos.3)	→	
		←	ACK
	R: Result Record(Pos.3)	→	
		←	ACK
Skippable	P: Patient Record (Pos.4)	→	
		←	ACK
	O: Order Record (Pos.4)	→	
		←	ACK
	R: Result Record(Pos.4)	→	
		←	ACK
Skippable	P: Patient Record (Pos.5)	→	
		←	ACK
	O: Order Record (Pos.5)	→	
		←	ACK
	R: Result Record(Pos.5)	→	
		←	ACK

Skippable	P: Patient Record (Pos.6)	→	
		←	ACK
	O: Order Record (Pos.6)	→	
		←	ACK
	R: Result Record(Pos.6)	→	
		←	ACK
Skippable	P: Patient Record (Pos.7)	→	
		←	ACK
	O: Order Record (Pos.7)	→	
		←	ACK
	R: Result Record(Pos.7)	→	
		←	ACK
Skippable	P: Patient Record (Pos.8)	→	
		←	ACK
	O: Order Record (Pos.8)	→	
		←	ACK
	R: Result Record(Pos.8)	→	
		←	ACK
Skippable	P: Patient Record (Pos.9)	→	
		←	ACK
	O: Order Record (Pos.9)	→	
		←	ACK
	R: Result Record(Pos.9)	→	
		←	ACK
Skippable	P: Patient Record (Pos.10)	→	
		←	ACK
	O: Order Record (Pos.10)	→	
		←	ACK
	R: Result Record(Pos.10)	→	
		←	ACK
Must	L: Message Terminator Record	→	
		←	ACK
	EOT	→	

4.3.3　　Details of Record

4.3.3.1　　　　　Header Record

[Example of transmission]

■　CT-90 -> Host Computer

　　　H|¥^&|||CT-90^00-01^11001^^^^12345678||||||||E1394-97|20100822100525<CR>

■　Host Computer　-> CT-90

　　　H|¥^&|||||||||||E139->4-97|20100822100525<CR>

ASTM Field	Field Name	CT-90 → Host	Host → CT-90	Max. Size (Bytes)	Remarks
7.1.1	Record type	H	H	1	Fixed
7.1.2	Delimiter definition	|¥^&	|¥^&	4	Fixed
7.1.3	Message control ID	Not used	Not used	-	
7.1.4	Access password	Not used	Not used	-	
7.1.5	Sender name or ID	Analyzer name^ Software version^ Analyzer serial No.^^^^ PS code	Not used	5^ 13^ 5^^^^ 8	
7.1.6	Sender street address	Not used	Not used	-	
7.1.7	Reserved field	Not used	Not used	-	
7.1.8	Sender Telephone No.	Not used	Not used	-	
7.1.9	Sender characteristics	Not used	Not used	-	
7.1.10	Receiver ID	Not used	Not used	-	
7.1.11	Comment	Not used	Not used	-	
7.1.12	Processing ID	Not used	Not used	-	
7.1.13	ASTM Version No.	E1394-97	E1394-97	8	Fixed
7.1.14	Date and Time of message	YYYYMMDDHHMMSS	YYYYMMDDHHMMSS	14	

1) 7.1.1　　Record type

　　　"H" is used as a fixed character string.

2) 7.1.2　　Delimiter definition

　　　"|¥^&" is used as a fixed character string. No field delimiter is required between 7.1.1 and 7.1.2

3) 7.1.5   Sender name or ID

Each sub-field such as analyzer name, software version, analyzer serial number and PS code is delimited by "^".

3-1) Analyzer name

Analyzer name is fixed as "CT-90".

3-2) Software version

Software version is fixed with the version of the application program of CT-90.

3-3) Analyzer serial No.

Analyzer serial number is a unique serial number which is consisted of maximum of 5 characters of alphameric character.

3-4) PS code

PS code is fixed with   "BD934079".

4) 7.1.13 ASTM Version No.

ASTM Version number is fixed with "E1394-97".

5) 7.1.14 Date and time of message

Date and time of message format is fixed with "YYYYMMDDHHMMSS".

YYYY: Christian year in 4 digits

MM: Month in 2 digits, right-aligned, with zero padding

DD: Date of the month in 2 digits, right-aligned, with zero padding

HH: Hour in the 24-hour system ("00"-"23") in 2 digits, right-aligned, with zero padding

MM: Minute in 2 digits ("00"-"59"), right-aligned, with zero padding

SS: Second in 2 digits ("00"-"59"), right-aligned, with zero padding

Example:

"20050102090530" means January 2, 2005, 09:05:30.

4.3.3.2   Patient Information Record

[Example of transmission]
- CT-90 -> Host Computer

    P|1<CR>
- Host Computer -> CT-90

    P|1<CR>

ASTM Field	Field Name	CT-90 ↓ Host	Host ↓ CT-90	Max. size (Bytes)	Remarks
8.1.1	Record type	P	P	1	Fixed
8.1.2	Sequence No.	Sequence No.	Sequence No.	4	Sequence No. of records
8.1.3	Practice assigned patient ID	Not used	Not used	-	
8.1.4	Laboratory assigned patient ID	Not used	Not used	-	
8.1.5	Patient ID No.	Not used	Not used	-	
8.1.6	Patient name	Not used	Not used	-	
8.1.7	Mother's maiden name	Not used	Not used	-	
8.1.8	Birth date	Not used	Not used	-	
8.1.9	Patient sex	Not used	Not used	-	
8.1.10	Patient race	Not used	Not used	-	
8.1.11	Patient address	Not used	Not used	-	
8.1.12	Reserved	Not used	Not used	-	
8.1.13	Patient telephone No.	Not used	Not used	-	
8.1.14	Attending doctor ID	Not used	Not used	-	
8.1.15	Special field 1	Not used	Not used	-	
8.1.16	Special field 2	Not used	Not used	-	
8.1.17	Patient height	Not used	Not used	-	
8.1.18	Patient weight	Not used	Not used	-	
8.1.19	Patient's known or suspected diagnosis	Not used	Not used	-	
8.1.20	Patient active medications	Not used	Not used	-	
8.1.21	Patient diet	Not used	Not used	-	
8.1.22	Practice field 1	Not used	Not used	-	
8.1.23	Practice field 2	Not used	Not used	-	
8.1.24	Admission and discharge dates	Not used	Not used	-	
8.1.25	Admission status	Not used	Not used	-	
8.1.26	Location	Not used	Not used	-	
8.1.27	DRG or AVG	Not used	Not used	-	
8.1.28	DRG or AVG 2	Not used	Not used	-	
8.1.29	Patient religion	Not used	Not used	-	
8.1.30	Marital status	Not used	Not used	-	
8.1.31	Isolation status	Not used	Not used	-	
8.1.32	Language	Not used	Not used	-	
8.1.33	Hospital service	Not used	Not used	-	
8.1.34	Hospital institution	Not used	Not used	-	
8.1.35	Dosage category	Not used	Not used	-	

1) 8.1.1   Record type

    "P" is used as a fixed character string.

2) 8.1.2   Sequence No.

The sequence number starts with 1 in a maximum of 4 digits, and indicates the sequence position in which the record appeared in the message. This number is reset to 1 when a higher-level record appears in the message.

4.3.3.3 Request Information Record

[Example of transmission]

- CT-90 -> Host

    Q|1|^^123456^01^123456789012345678901 2^B||||20010905150000||||B| <CR>

- Host -> CT-90

    Not used

ASTM Field	Field Name	CT-90 ↓ Host	Host ↓ CT-90	Max. size (Bytes)	Remarks
12.1.1	Record type	Q	Not used	1	fixed
12.1.2	Sequence No.	Sequence No.	Not used	4	Sequence No. of records
12.1.3	Starting Range ID No.	Rack No.^ Tube Position^ Sample ID number^ Sample No. attribute	Not used	6^ 2^ 22^ 1	Sample No. attribute is one of followings: A: Automatic assignment by analyzer B: Barcode reader input Maximum 10 sample IDs can be specified by using repeat code ¥(5Ch).
12.1.4	Ending Range ID No.	Not used	Not used	-	
12.1.5	Universal test ID	Not used	Not used	-	
12.1.6	Nature of request time limit	Not used	Not used	-	
12.1.7	Beginning request results date and time	YYYYMMDDHHMMSS	Not used	14	
12.1.8	Ending request results date and time	Not used	Not used	-	
12.1.9	Requesting physician name	Not used	Not used	-	
12.1.10	Requesting physician telephone No.	Not used	Not used	-	
12.1.11	User field No. 1	Inquiry type	Not used	1	B: Inquiry at BT C: Inquiry at other than BT (e.g. CVR)
12.1.12	User field No. 2	Not used	Not used	-	

| 12.1.13 | Requested information status code | Not used | Not used | - | |

12.1.13	Requested information status code	Not used	Not used	-	

1) 12.1.1   Record type

    "Q" is used as a fixed character string.

2) 12.1.2   Sequence No.

    The sequence number starts with 1 in a maximum of 4 digits, and indicates the sequence position in which the record appeared in the message. This number is reset to 1 when a higher-level record appears in the message.

12.1.3   Starting Range ID No.
Each sub-fields of Rack No., tube position, sample No., and sample No. attribute are placed by separating with a delimiter "^".

The contents of inquiry messages indicate following 2 patterns according to online setting of CT-90 (ASTM order query type setting)

- When ASTM order query type setting of CT-90 is set as "Inquiry for the Rack unit"
  Maximum 10 sample IDs can be specified by using repeat code ¥(5Ch).
  1 rack is set, minimum 1 sample, maximum 10 samples.

  Ex.) To inquire for 2 samples:
  Rack No.1^Tube Position No.1^Sample ID number1^Sample No. attribute1¥Rack No.2^Tube Position No.2^Sample ID number2^Sample No. attribute2

- When ASTM order query type setting of CT-90 is set as "Inquiry for the Rack unit"
  Using repeat code ¥(5Ch) is prohibited.
  1 sample is set.

1-1) Rack No.

Rack No. that was used to analyze, and is maximum of 6-digit <u>alpha-numeric</u>(alpha-numeral). A hyphen "-" (2Dh) may be inserted between characters. Hyphens are counted in 6 digits. Rack No. is set Right-align and space padding of 6 digits when the Sample No. is less than 6 digits.

1-2) Tube Position

The Tube Position number within a rack used for the analysis, and is maximum 2-digit alpha-numeric(alpha-numeral). Right-align and space padding of 2 digits. Tube position No. is filled with zero in the most significant digit to fill up to 2 digits.

1-3) Sample ID number

Indicates the Sample ID No. of the inquiry, and is the maximum 22-digit of alpha-numeric(alpha-numeral).   And also can insert hyphen "-" (2Dh) between the characters. Hyphens are counted in 22 digits. Sample ID No. is less than 22 digits, the number is aligned to the right and spaces are padded to fill up 22 digits.

1-4) Sample No. attribute

Indicates the way how the sample ID number was determined.
            'B':   Sample ID number was read by the barcode reader.
            'A':   Sample ID number was automatically assigned by the analyzer.
                This is used when barcode reading error occur and put sample ID number starting from ERR" or when sequential sample ID number is put by the analyzer automatically.

12.1.7   Beginning request results date and time

Beginning request results date and time format is fixed with "YYYYMMDDHHMMSS".

Can not change the format.

YYYY: Christian year in 4 digits

MM: Month in 2 digits, right-aligned, with zero padding

DD: Date of the month in 2 digits, right-aligned, with zero padding

HH: Hour in the 24-hour system ("00"-"23") in 2 digits, right-aligned, with zero padding

MM: Minute in 2 digits ("00"-"59"), right-aligned, with zero padding

SS: Second in 2 digits ("00"-"59", right-aligned, with zero padding

Example: "20050102090530" means January 2 2005, 09:05:30

12.1.11   Inquiry type

'B': Inquiry from BT

'C' : Inquiry from the other than BT

4.3.3.4 Test Order Record

[Example of transmission]

- CT-90 -> Host
  O|1||123456^05^123456789012345678 9012^B||20040807101000|||||N|||||||||||||||F<CR>

- Host -> CT-90
  O|1|123456^05^123456789012345678 9012^B^O||^^^^CBC¥^^^^DIFF|20040807101000|||||N|||||||
  00000000|||||||Q<CR>

ASTM Field	Field Name	CT-90 ↓ Host	Host ↓ CT-90	Max. size (Bytes)	Remarks
9.4.1	Record type	O	O	1	Fixed
9.4.2	Sequence No.	Sequence No.	Sequence No.	4	Sequence No. of records
9.4.3	Specimen ID	Not used	Rack No.^ Tube Position No.^ Sample ID number^ Sample No. attribute^ Type of Sample Tube	6^ 2^ 22^ 1^ 1	Sample No. attribute is one of the followings: A: Automatic assignment by the analyzer B: Barcode reader
9.4.4	Instrument specimen ID	Rack No.^ Tube Position No.^ Sample ID number^ Sample No. attribute	Not used	6^ 2^ 22^ 1	
9.4.5	Universal Test ID	^^^^Parameter	^^^^Parameter	^^^^8	Test Order of each analysis parameter
9.4.6	Priority	Not used	Not used	-	
9.4.7	Requested/order date and time	YYYYMMDDHHMMSS	YYYYMMDDHHMMSS	14	
9.4.8	Specimen collection date and time	Not used	Not used	-	
9.4.9	Collection end time	Not used	Not used	-	
9.4.10	Collection volume	Not used	Not used	-	
9.4.11	Collector ID	Not used	Not used	-	
9.4.12	Action Code	N	N	1	N: Normal sample
9.4.13	Danger code	Not used	Not used	-	
9.4.14	Relevant clinical information	Not used	Not used	-	
9.4.15	Date/time specimen received	Not used	Not used	-	
9.4.16	Specimen descriptor	Not used	Not used	-	
9.4.17	Ordering doctor	Not used	Not used	-	
9.4.18	Doctor telephone No.	Not used	Not used	-	
9.4.19	User field No. 1	Not used	Registry No	8	
9.4.20	User field No. 2	Not used	-	-	

9.4.21	Laboratory field No. 1	Not used	Not used	-	
9.4.22	Laboratory field No. 2	Not used	Not used	-	
9.4.23	Date/time results reported or last modified	Not used	Not used	-	
9.4.24	Instrument charge to computer system	Not used	Not used	-	
9.4.25	Instrument section ID	Not used	Not used	-	
9.4.26	Report Type	F	Y,Q	1	F: Final results (Fixed) Y: No test order Q: Response to inquiry
9.4.27	Reserved field	Not used	Not used	-	
9.4.28	Location or ward of specimen collected	Not used	Not used	-	
9.4.29	Nosocomial infection flag	Not used	Not used	-	
9.4.30	Material service	Not used	Not used	-	
9.4.31	Material institution	Not used	Not used	-	

1) 9.4.1   Record type
   "O" is transmitted.

2) 9.4.2   Sequence No.
   The sequence number starts with 1 in a maximum of 4 digits, and indicates the sequence position in which the record appeared in the message. This number is reset to 1 when a higher-level record appears in the message.

3) 9.4.3   Specimen ID
   Sub-fields of Rack No., tube position., sample No., and sample No. attribute are placed by separating with a delimiter "^".

   1-1) Rack No.
        Rack No. that was used to analyze, and is maximum of 6-digit alpha-numeric(alpha-numeral). A hyphen "-" (2Dh) may be inserted between characters. Hyphens are counted in 6 digits. Rack No. is set Right-align and space padding of 6 digits when the Sample No. is less than 6 digits.

   1-2) Tube Position
        The tube position number within a rack used for the analysis, and is maximum 2-digit alpha-numeric(alpha-numeral). Right-align and space padding of 2 digits.
        The tube position number is less than 2 digits, tube position No. is filled with zero in the most significant digit to fill up to 2 digits.

1-3) Sample ID number

Consisted of the maximum 22-digit of alpha-numeric(alpha-numeral).   And also can insert hyphen "-" (2Dh) between the characters. Hyphens are counted in 22 digits. Sample ID No. is less than 22 digits, the number is aligned to the right and spaces are padded to fill up 22 digits.

1-4) Sample No. attribute

Indicates the way how the sample ID number was determined.

'C' : Sample ID number was assigned by the host computer.

1-5) Type of Sample Tube

'S': SARSTEDT Tube

'M': BD MAP Tube

'O': other

4) 9.4.4   Instrument Specimen ID

1-1) Rack No.

9.4.3   Refer to Specimen ID

1-2) Tube Position No.

9.4.3   Refer to Specimen ID

1-3) Sample ID number

9.4.3   Refer to Specimen ID

1-4) Sample No. attribute

Indicates the way how the sample ID number was determined.

'A' : Sample ID number was automatically assigned by the analyzer.

'B' : Sample ID number was read by the barcode reader.

5) 9.4.5　Universal Test ID

　　　When the host computer replies order, please set the parameters which contains necessary measurement order.

　　　example: "^^^^parameter1¥^^^^parameter2¥^^^^parameter3"

Table4: List of order

List of order	
Parameter	Remark
CBC	Order of XN-10/XN-20
DIFF	
RET	
PLT-F	
WPC	
SP	Order of SP-10
A1C	Order of G8 or VIIT
OTHER1	The other order
OTHER2	
OTHER3	
OTHER4	
OTHER5	

6) 9.4.7　Requested/Order date and time

　　　Requested/order date and time format is fixed with "YYYYMMDDHHMMSS".

　　　　YYYY: Christian year in 4 digits

　　　　MM: Month in 2 digits, right-aligned, with zero padding

　　　　DD: Date of the month in 2 digits, right-aligned, with zero padding

　　　　HH: Hour in the 24-hour system ("00"-"23") in 2 digits, right-aligned, with zero padding

　　　　MM: Minute in 2 digits ("00"-"59"), right-aligned, with zero padding

　　　　SS: Second in 2 digits ("00"-"59", right-aligned, with zero padding

　　　　Example: "20050102090530" means January 2, 2005, 09:05:30

7) 9.4.12　Action Code

　　　"N" is used as a fixed character string.

8) 9.4.19　User field No.1

　　　Reception No. is set.

　　　The numbers "0" to "9" can be used.

　　　The reception number is 8 digits. If there are less than 8 digits, "0" is set in the upper digits.

　　　Example: When the reception number is "12345", "00012345" is set.

　　　When a reception number is not used, "0" is set in all digits.

9) 9.4.26　Report Type

　　　Indicates the report type.

　　　F: Final result (Fixed: CT-90 will always output the final results.)

　　　Y: No test order exists. (Use this when no order exists for the inquiry.)

　　　Q: Response to the inquiry (Use this when an order exists for the inquiry.)

4.3.3.5　　　　　　Result record

[Example of transmission]

■ CT-90 -> Host
   R|1|^^^^SMEAR^^^^^|00^OK^12345678901231234567890123 1234567890123|
   |||||||20041116101000<CR>

■ Host-> CT-90
   Not used

ASTM Field	Field Name	CT-90 ↓ Host	Host ↓ CT-90	Max. size (Bytes)	Remarks
10.1.1	Record type	R	Not used	1	fixed
10.1.2	Sequence No.	Sequence No.	Not used	4	Sequence No. of records
10.1.3	Universal Test ID	^^^^Parameter^^^^^	Not used	5	FINAL: Pool information
10.1.4	Data or measurement value	Result	Not used	-	
10.1.5	Units	Not used	Not used	-	
10.1.6	Reference ranges	Not used	Not used	-	
10.1.7	Result abnormal flags	Not used	Not used	-	
10.1.8	Nature of abnormality testing	Not used	Not used	-	
10.1.9	Result status	Not used	Not used	-	
10.1.10	Date of change in instrument normative values	Not used	Not used	-	
10.1.11	Operator identification	Not used	Not used	-	
10.1.12	Date/time test started	Not used	Not used	-	
10.1.13	Date/time test completed	YYYYMMDDHHMMSS	Not used	14	
10.1.14	Instrument identification	Not used	Not used	-	

1) 10.1.1 Record type
   'R' is transmitted.

2) 10.1.2 Sequence No.
   The sequence number starts with 1 maximum 4 digits and indicates the sequence position in which
the
   record appeared in the message. This number is reset to 1 when a higher-level appears in the
message.

3)10.1.3 Universal Test ID
   FINAL: Pool information

4) 10.1.4 Data or measurement value

Table5: Parameter ID list

ID	Data or measurement value	Maximum size(byte)
FINAL	Line ID^ Rack sequence No.^ XN-10/XN-20 Result^ SP-10 Result^ A1C Result	2^ 4^ 2^ 2^ 2^

Line ID:
    Block ID (00-20) which is set on CT-90 setting.
Rack sequence No.:
    Sequential rack number which is put automatically at ST(Stock yard) when the rack is stocked
      into ST.   Note: This is different parameter from Rack ID.
XN-10/XN-20 Result:
    OK: Normal End
    NG: Other than normal End
SP-10 Result:
    OK: Normal End
    NG: Other than normal End
A1C Result:
    OK: Normal End
    NG: Other than normal End

5) 10.1.13 Date/time test completed

Date/time test completed format is fixed with "YYYYMMDDHHMMSS".
        YYYY: Christian year in 4 digits
        MM: Month in 2 digits, right-aligned, with zero padding
        DD: Date of the month in 2 digits, right-aligned, with zero padding
        HH: Hour in the 24-hour system ("00"-"23") in 2 digits, right-aligned, with zero padding
        MM: Minute in 2 digits ("00"-"59"), right-aligned, with zero padding
        SS: Second in 2 digits ("00"-"59", right-aligned, with zero padding
        Example: "20050102090530" means January 2, 2005, 09:05:30

4.3.3.6   Comment Record

[Example of transmission]
- CT-90 -> Host
  C|1||1<CR>
- Host-> CT-90
  C|1||1<CR>

ASTM Field	Field Name	CT-90 ↓ Host	Host ↓ CT-90	Max. Size (Bytes)	Remarks
11.1.1	Record type	C	C	1	Fixed
11.1.2	Sequence No.	Sequence No.	Sequence No.	4	Sequence No. of records
11.1.3	Comment source	Not used	Not used	-	
11.1.4	Comment text	Not used	Not used	-	
11.1.5	Comment type	Not used	Not used	-	

1) 11.1.1 Record type

"C" is used as a fixed character string.

2) 11.1.2 Sequence No.

The sequence number starts with 1 in a maximum of 4 digits, and indicates the sequence position in which the record appeared in the message. This number is reset to 1 when a higher-level record appears in the message.

4.3.3.7　　　　　　　Message Terminator Record

[Example of transmission]
- CT-90 -> Host
    L|1|N<CR>
- Host-> CT-90
    L|1|N<CR>

ASTM FIeld	Field Name	CT-90 ↓ Host	Host ↓ CT-90	Max. Size (Bytes)	Remarks
13.1.1	Record type	L	L	1	Fixed
13.1.2	Sequence No.	1	1	4	Always 1
13.1.3	Terminator code	N	N	1	N: Normal termination

1) 13.1.1　Record type
   "L" is used as a fixed character string.

2) 13.1.2　Sequence No.
   The sequence number starts with 1 in a maximum of 4 digits, and indicates the sequence position in which the record appeared in the message. This number is reset to 1 when a higher-level record appears in the message.

3) 13.1.3　Terminator code
   "N" is usually used as a character string.

5　Examples of Communication

5.1　Transportation Order Inquiry (CT-90->Host computer)

5.1.1　When a Transportation Order Inquiry

CT-90	\<ENQ>
Host	\<ACK>
CT-90	\<STX>H|¥^&|||CT-90^00-01^11001^^^^04303413||||||||E1394-97|20090324100447\<CR> \<ETX>\<CHK1>\<CHK2>\<CR>\<LF>
Host	\<ACK>
CT-90	\<STX>Q|1|^^123456^01^　　　　　1234^B¥^^123456^03^　　　　　1239^B ||||20090324214154||||B\<CR>\<ETX>\<CHK1> \<CHK2>\<CR>\<LF>
Host	\<ACK>
CT-90	\<STX>L|1|N\<CR>\<ETX>\<CHK1>\<CHK2>\<CR>\<LF>
Host	\<ACK>
CT-90	\<EOT>

5.2   Transportation Order Information (Host Computer -> CT-90)

   5.2.1 When a Transportation Order exists

 Host   <ENQ>
 CT-90   <ACK>
 Host   <STX>H|¥^&|||CT-90^00-01^11001^^^^04303413||||||||E1394-97|20090324210847<CR>
             <ETX><CHK1><CHK2><CR><LF>
 CT-90   <ACK>
 Host   <STX>P|1<CR><ETX><CHK1><CHK2><CR><LF>
 CT-90   <ACK>
 Host   <STX>O|1|123456^01^
             1234^B||^^^^CBC¥^^^^DIFF¥^^^^SP¥^^^^A1C¥^^^^OTHER2
             ||20090324210847|||||N|||||||12345678^1234^123456^12345^1^1^1^1234567890123^123456789
             0123^1234567890123|||||||Q<CR><ETX><CHK1><CHK2><CR><LF>

 CT-90   <ACK>
 Host   <STX>P|2<CR><ETX><CHK1><CHK2><CR><LF>
 CT-90   <ACK>
 Host   <STX>O|1|123456^03^
             1239^B||^^^^CBC¥^^^^DIFF¥^^^^SP¥^^^^A1C¥^^^^OTHER2
             ||20090324210847|||||N|||||||12345678^1234^123456^12345^1^1^1^1234567890123^123456789
             0123^1234567890123|||||||Q<CR><ETX><CHK1><CHK2><CR><LF>

 CT-90   <ACK>
 Host   <STX>L|1|N<CR><ETX><CHK1><CHK2><CR><LF>
 CT-90   <ACK>
 Host   <EOT>

5.2.2 When no Transportation Order exists

Host	`<ENQ>`
CT-90	`<ACK>`
Host	`<STX>H|¥^&|||CT-90^00-01^11001^^^^04303413||||||||E1394-97|20090324210847<CR>` `<ETX><CHK1><CHK2><CR><LF>`
CT-90	`<ACK>`
Host	`<STX>P|1<CR><ETX><CHK1><CHK2><CR><LF>`
CT-90	`<ACK>`
Host	`<STX>O|1|123456^01^` `1234^B|^^^^CT-90|` `||20090324210847|||||N|||||||||||||||Y<CR><ETX><CHK1><CHK2><CR><LF>`
CT-90	`<ACK>`
Host	`<STX>P|2<CR><ETX><CHK1><CHK2><CR><LF>`
CT-90	`<ACK>`
Host	`<STX>O|1|123456^03^` `1239^B|^^^^CT-90|` `||20090324210847|||||N|||||||||||||||Y<CR><ETX><CHK1><CHK2><CR><LF>`
CT-90	`<ACK>`
Host	`<STX>L|1|N<CR><ETX><CHK1><CHK2><CR><LF>`
CT-90	`<ACK>`
Host	`<EOT>`

5.3   Analysis Results (CT-90 -> Host Computer)

  5.3.1 Pool Information

CT-90	<ENQ>
Host	<ACK>
CT-90	<STX>H|¥^&|||CT-90^00-01^11001^^^^04303413||||||||E1394-97|20090324210847<CR><ETX><CHK1><CHK2><CR><LF>
Host	<ACK>
CT-90	<STX>P|1<CR><ETX><CHK1><CHK2><CR><LF>
Host	<ACK>
CT-90	<STX>O|1|123456^01^ 1234^B||||20090324213040|||||N|||||| ||||||||F<CR><ETX><CHK1><CHK2><CR><LF>
Host	<ACK>
CT-90	<STX>R|1|^^^^FINAL^^^^^|00^1234^OK^NG^NG||||||||20090324213047<CR><ETX><CHK1><CHK2><CR><LF>
Host	<ACK>
CT-90	<STX>P|2<CR><ETX><CHK1><CHK2><CR><LF>
Host	<ACK>
CT-90	<STX>O|1|123456^03^ 1239^B||||20090324213040|||||N|||||| ||||||||F<CR><ETX><CHK1><CHK2><CR><LF>
Host	<ACK>
CT-90	<STX>R|1|^^^^FINAL^^^^^|00^1239^OK^NG^NG||||||||20090324213047<CR><ETX><CHK1><CHK2><CR><LF>
Host	<ACK>
CT-90	<STX>L|1|N<CR><ETX><CHK1><CHK2><CR><LF>
Host	<ACK>
CT-90	<EOT>

Appendix.A

A.1   Transmission Timing

Indicates the transmission timing of CT-90 in the following picture.