



DPC: 23 / 30454994 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

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Part 5: Business to manufacturing transactions

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Responsible Committee Secretary: Ms Charmaine Mukherjee (BSI)

Direct tel:

E-mail: charmaine.mukherjee@bsigroup.com

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

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SECRETARIAT:

United States of America

SECRETARY:

Mr Donald (Bob) Lattimer

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



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TITLE:

Enterprise-control system integration - Part 5: Business to manufacturing transactions

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ENTERPRISE-CONTROL SYSTEM INTEGRATION –

IEC 62264-5: Business to Manufacturing Transactions

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440 The text is based on the following documents:

CD	Report on voting
65E/xxx/CD	65E/xxx/RVC

441
442 Full information on the voting for the approval can be found in the report on voting indicated in
443 the above table.

444 This publication has been drafted in accordance with the ISO/IEC Directives.

445 The list of all the parts of the IEC 62264 series, under the general title *Enterprise-Control*
446 *system integration*, can be found on the IEC website.

447 At this date, the publication will be replaced by a revised edition.

INTRODUCTION

This part of 62264 is based on the use of 62264 abstract models previously defined in 62264-2 and 62264-4 combined with verbs to define a transaction model for information exchange. It is recognized that other non-62264-5 transaction protocols are possible and are not deemed invalid as a result. Transactions occur at all levels within the enterprise and between enterprise partners, and are related to both required and actual activities, but the focus of this 62264-5 is the interface between enterprise/business systems and manufacturing systems.

This standard defines transactions that are exchanged between Level 4 and Level 3, and within Level 3 as defined in the object models of 62264-2 and 62264-4. Models are introduced which provide descriptions of the transactions and explanations of the required transaction processing behaviour.

Technology specific implementations to provide this behaviour are not defined in this standard. This part of 62264 has the intent of providing insight into the level of work required to construct transactional exchanges.

ENTERPRISE-CONTROL SYSTEM INTEGRATION

IEC 62264-5: Business to Manufacturing Transactions

Scope

This part of 62264 defines transactions in terms of information exchanges between applications performing business and manufacturing activities associated with Levels 3 and 4. The exchanges are intended to enable information collection, retrieval, transfer and storage in support of Enterprise-Control system integration. This part of 62264 is consistent with the 62264.00.02 and 62264.00.04 object models attributes. This standard also defines transactions that specify how to exchange the objects defined in 62264.00.02, 62264.00.04 and this standard. Other uses of the transaction model are not defined in this part.

The models covered in this standard are:

- Hierarchy Scope Model
- Personnel Model
- Equipment Model
- Physical Asset Mode
- Material Model
- Process Segment Model
- Operational Location Model
- Operations Event Model
- Operations Capability Model
- Operations Definition Model
- Operations Schedule Model
- Operations Performance Model
- Resource Relationship Network Model
- Work Capability Model
- Work Definition Model
- Work Schedule Model
- Job List Model
- Work Performance Model
- Workflow Specification Model
- Work Calendar Model
- Work Record Model
- Work Alert Model

Normative references

The following normative documents contain provisions, which through reference in this text constitute provisions of this part. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid normative documents.

ISO/IEC 19501-1, *Information Technology – Unified Modeling Language (UML)—Part 1: Specification*

62264.00.01, *Enterprise-control system integration – Part 1: Models and terminology*

62264.00.02, *Enterprise-control system integration – Part 2: Object modes and attributes*

62264.00.03, *Enterprise-control system integration – Part 3: Activity models of manufacturing operations management*

62264.00.04, *Enterprise-control system integration – Part 4: Object models and attributes for manufacturing operations management integration*

ISO 8601, *Data elements and interchange formats – Information interchange – Representation of dates and times*

Definitions, abbreviations, and conventions

3.1 Terms and definitions

3.1.1 application

an ordered set of physical and logical system processes, performed by a set of resources that conduct a set of transactions intended to accomplish a definite objective; information provider or information user performing the activity that is involved in a transaction

EXAMPLE HMIs, Data Historians, MES and LIMs software are examples of applications.

3.1.2 ID

information to identify an object or a property of an object

3.1.3 message

structured information unit conveyed in a one-way transfer of data between one sending application to one or more receiving applications

3.1.4 noun

one of two parts in the content of a message and represents one or more objects, as defined in the Parts 2 and 4 object models

3.1.5 transaction

sequence of related messages that are exchanged among applications performing Level 3 or Level 4 activities

3.1.6 verb

one of two parts in the content of a message and defines the action to be performed, or the response to a request

3.1.7 wildcard

information to identify a collection of objects or properties of objects

3.2 Abbreviations

EDA Event Driven Architecture

ERP Enterprise Resource Planning

MEP Message Exchange Pattern

MOM Manufacturing Operations Management

OAGIS Open Applications Group Interface Standard

SYNC Synchronized data

UTC Universal Coordinated Time

3.3 Conventions

Uppercase words are used to identify the verbs in a transaction message, to differentiate them from verbs in the sentences.

EXAMPLE 1 GET for the get verb used in a transaction message.

Italics and uppercase letters are used, beyond the use defined in ISO/IEC Directives Part2, to emphasize the 62264 specific meaning of terms. They are used for the following cases:

- Names of objects used in exchanged data
- Parts of messages
- Verb/noun message examples

EXAMPLE 1 *GET Equipment* for the get verb used in with an equipment object.

Uppercase words are used to identify transaction models.

EXAMPLE 2 PUSH transaction for PROCESS, CHANGE, and CANCEL verbs

Transaction messages and verbs

4.1 Introduction

This clause defines a common set of transactions, messages and verbs that should be used between Level 4 and Level 3, and among Level 3, applications to exchange the data defined in the object models of 62264.00.02 and 62264.00.04.

A transaction shall consist of a sequence of messages, where each message shall have a structure as defined in Clause 4.3.

Messages shall contain both a noun and a verb area. The information conveyed in a message shall be contained in the noun area of a message while the actions associated with the information shall be contained in the verb area.

The role of an application initiating a transaction shall determine the set of verbs to be used in conducting the transaction. These transaction models are described in Clause 4.2.

Three different transaction models are defined:

- 1) A PULL model where a user of data requests the data from a provider of the data.
- 2) A PUSH model where a provider of data requests an action (processing, changing, or cancelling) on the data by another user.
- 3) A PUBLISH model where the owner of data publishes it to users (subscribers) of the data.

NOTE 1 The phrase “owner of data” is used to identify the application that has responsibility for enforcing the consistency of data.

NOTE 2 This standard does not address the case where there may be multiple systems that can act as the owner of data. In these situations, configuration should be set up so that one master owner of the data should be designated, with other systems performing the role of data users.

4.2 Transaction models

There are three classes of actions provided by the verb set:

- query/reporting for data sharing, and
- transaction processing, and
- data synchronization and event notification.

Each is defined in a different transaction model:

- 1) A PULL model where a user of data requests information from an information provider. This model is used for query/reporting.

Information provider applications listen for GET messages and respond with SHOW messages to complete the transaction.

Information user applications send GET messages.

a) Requests for information are sent through GET messages.

b) A GET message describes the scope of the requested information.

c) A SHOW message returns the information.

- 2) A PUSH model where a sender of information sends new or changed information to the receiver to process requests. This model is used for transaction processing.

Receiver applications listen for PROCESS, CHANGE, or CANCEL messages.

Sender applications send PROCESS, CHANGE, and CANCEL messages..

a) New information is pushed to the receiver through a PROCESS message. Responses may be returned to the sender through an ACKNOWLEDGE message.

b) Changes to information are pushed to the receiver through a CHANGE message. Responses may be returned to the sender through a RESPOND message.

c) Information to be removed is pushed to the receiver through a CANCEL message.

- 3) A PUBLISH model where the provider of data publishes it to users (subscribers) of the data. This model is used for both data synchronization and event notification.

The timing of the publication and scope of the published information is not defined in a message. It is determined by an out-of-band agreement between the publisher and subscriber, therefore there is no SUBSCRIBE message defined in this standard.

NOTE 1 An out-of-band agreement means that the agreement is not defined in the transaction protocol.

Example An agreement between a publisher and subscriber may be setup through configuration parameters in the applications, or an agreement may be setup dynamically through a web service agreement, or an agreement may be setup through a third party application.

a) Data Synchronization is used to inform non-owners of data that data has been added , changed, or deleted by the owner:

Subscriber applications receive SYNC messages.

Publisher applications send SYNC messages.

i) A publisher sends SYNC messages containing new, changed, or deleted information.

ii) A subscriber receives SYNC messages containing new, changed, or deleted information.

b) Event Notification is used to notify of an event that occurred or that data that has been created:

Subscriber applications receive NOTIFY messages.

Publisher applications send NOTIFY messages.

i) A publisher sends NOTIFY messages containing events.

ii) A publisher sends NOTIFY messages containing new information.

iii) A subscriber receives NOTIFY messages containing events or new information.

Information providers (publishers) applications publish NOTIFY transactions.

Information users (subscribers) applications receive NOTIFY transactions to which they have subscribed.

There is no acknowledgement or response to a notification, if an acknowledgement response is required, it is processed as a separate notification.

NOTE 2 The notification of events allows for use of an event driven architecture (EDA) pattern. EDA is an integration architecture for a message exchange pattern promoting the dissemination of published events to subscribers in a loosely coupled environment. The event publisher only knows the event has transpired and has no knowledge of the subsequent processing subscribing may perform.

A single application may support one or more transaction models and the application may take on multiple roles (sender, receiver, provider, and user).

NOTE 3 The transactions are based on the assumption that the exchanged information (noun) is contained in a message of some form. The exact form of the messages is undefined in this specification; for example, *learn messages*.

could be tab delimited files, XML files, electronic mail messages, or data in a named pipe. The exact form of the transport mechanism for the sending, receiving, listening, and publishing of messages is not defined in this specification.

NOTE 4 The transaction message models do not imply any specific architecture or mechanism for transporting the messages.

The transactions assume the ability to send an empty or nearly empty message that identifies either a specific object (typically by ID), a list of specific objects (by a list of IDs), or a class of objects (by wildcard or property value definition).

Figure 1 illustrates the exchange of messages in a typical transaction, where a message (*GET Equipment*) is sent from an information user with an identification of an object (*Equipment*), and a message (*SHOW Equipment*) is returned from the information provider with the object's information (*Equipment*).

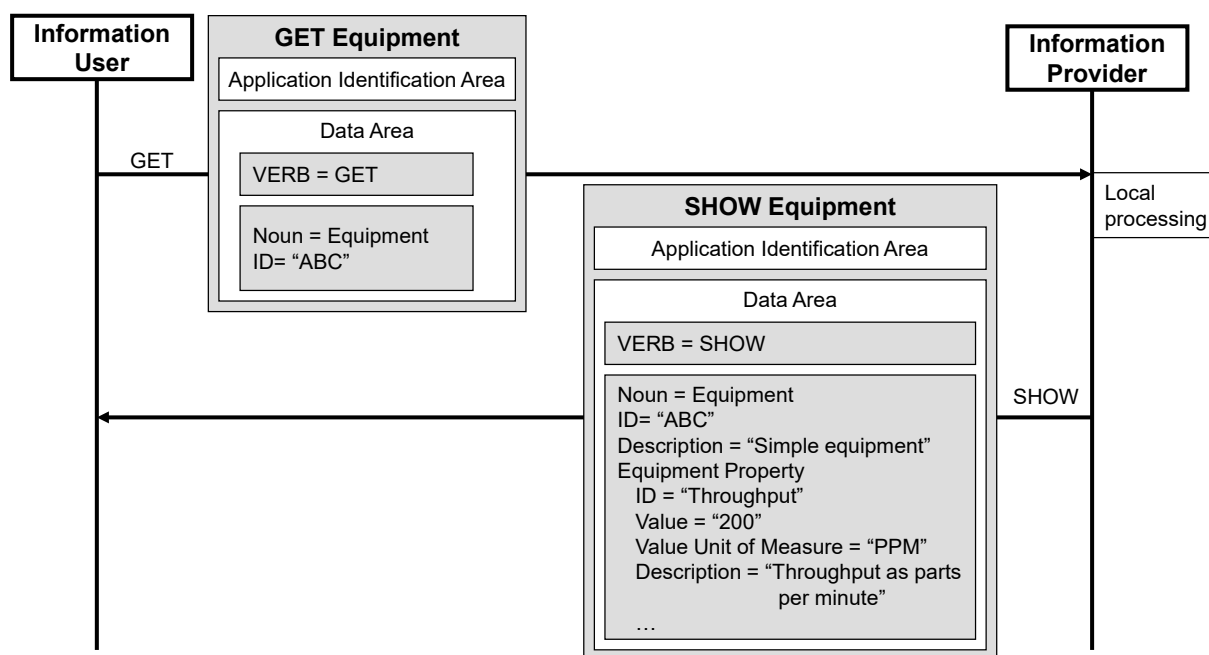


Figure 1 – Typical exchanged messages in a transaction

4.3 Message structure

4.3.1 General Structure

Every message shall contain the information required to identify the source of the message and the type of the message. There shall be two main areas in a message, as shown in Figure 2, an *application identification area* and a *data area*. Within the *data area* there shall be a *verb area* and a *noun area*.

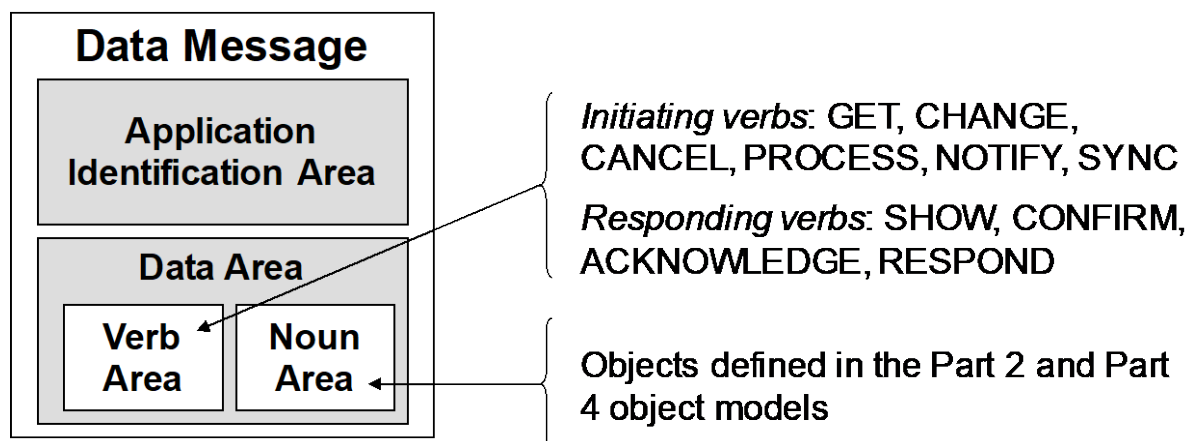


Figure 2 – Typical exchanged data set

4.3.2 Application identification area

The *application identification area* shall carry information that a receiving application uses to handle a message. The *application identification area* is used for the application layer of communication, such as indicating a required confirmation of message processing. This information typically includes the electronic address of the sender, an indication of the confirmation requirement, and the date and time the message was created. The *application identification area* may also include other information required for identification and authentication of the messages, such as a transaction ID. Figure 4 illustrates a typical layout for an application identification area.

NOTE See the OAGIS (Open Applications Group Integration Specification) 9.0 specification for a format for the application identification area. The data exchange model defined in this document is consistent with the OAGIS specification; such that an implementation of OAGIS, using the objects defined in 62264.00.02 and 62264.00.04, can conform to this part of the standard.

Dates and times shall include time information in order to unambiguously identify times, such as coordinated universal time or ISO 8601 CE (Common Era) calendar extended format. A time zone specification of the time is optional, and if missing the time shall be represented as UTC.

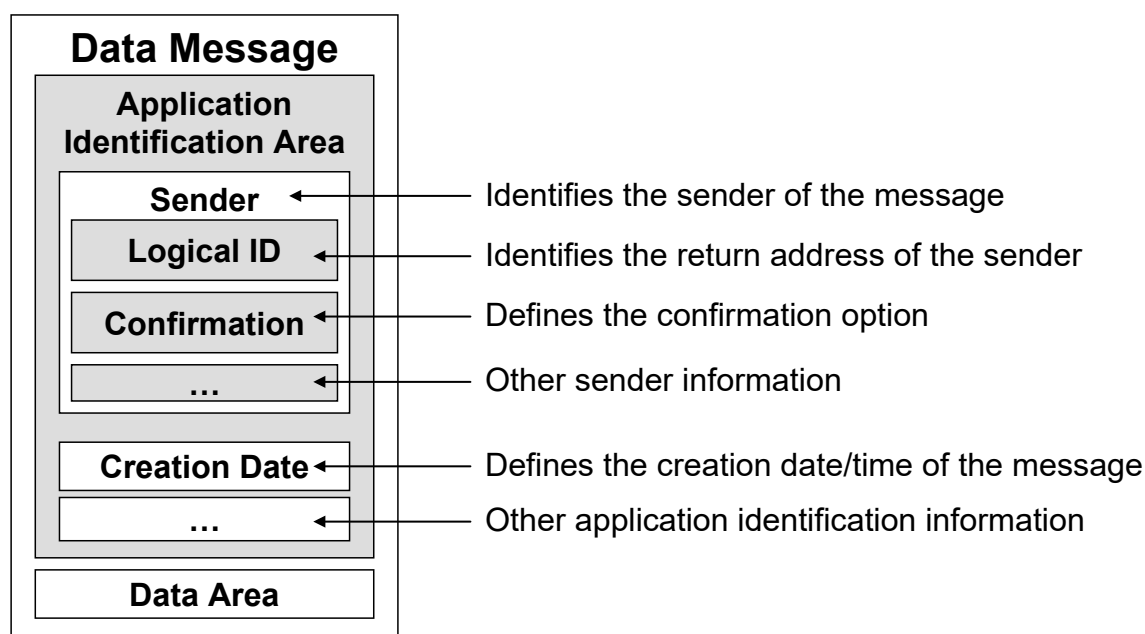


Figure 3 – Typical layout of an application identification area

4.3.3 Data Area

The data area in a message shall contain a *verb area* and a *noun area*.

The *verb area* shall contain verbs and associated elements that represent the actions to be performed by the receiving application, or the response to a request by the sending application. The verbs defined in this part of the standard are listed in Clause 5.

The *noun area* shall contain nouns and associated elements that represent one or more objects defined in the 62264.00.02 and 62264.00.04 object models. The nouns defined in this part of the standard are listed in Clause 6.

The verb-noun combinations define messages that are intended to have a unique and unambiguous meaning.

4.3.4 Message nouns

Nouns represent one or more objects from the object models defined in 62264.00.02 and 62264.00.04 that have been grouped together for use with messages.

704 Example A *Material Definition* noun is a composition of a *Material Definition* object instance with its *Material*
 705 *Definition Property* object instances.

706 4.3.5 Wildcard

707 The noun may contain a wildcard string used to identify multiple objects.

708 NOTE 1 Wildcards apply to the ID of a property, not to the value of the properties.

709 NOTE 2 Wildcards should be used with care if combined with lists of object IDs or property IDs. In the case of
 710 errors a confirmation message may not have sufficient information to determine the exact error.

711 NOTE 3 A common convention for specifying wildcards in text strings are as regular expressions (as defined in
 712 ISO/IEC 9945-2:2003 Information technology – Portable Operating System Interface (POSIX) – Part 2:
 713 System Interfaces). Regular expressions are widely supported in programming languages, text
 714 processing programs, advanced text editors, and some other programs. Regular expression support is
 715 part of the standard library of many programming languages, including Java and Python, is built into
 716 the syntax of others, including Perl and ECMAScript, and is supported by many commonly available
 717 libraries.

718 NOTE 4 Wildcards could also be implemented using limited regular expressions. In a limited regular
 719 expression a wildcard string can have the following special characters:

720 a) “*” – Indicates zero or more characters, any character is acceptable

721 b) Example 1 The wildcard “ABC*” would match “ABC”, “ABCD”, “ABCDEF”, “ABC@4!*”, but
 722 not “ABDDEF”

723 c) “%” – Indicates one or more characters, any character is acceptable

724 d) Example 2 The wildcard “ABC%” would match “ABCD”, “ABCDEF”, “ABC^4^”, but not
 725 “ABC”

726 e) “?” – Indicates zero or one characters at the specified position, any character is acceptable

727 f) Example 3 The wildcard “ABC?” would match “ABCX”, “ABCD”, “ABC!”, “ABC”, but not
 728 “ABCDE” or “ABDC”

729 g) The character following a “\” is considered a literal character, not a wildcard character.

730 h) Example 4 An object ID of “ABC*” defines the object ID as “ABC*”.

731 i) Example 5 A property ID of “\\USM 123” defines the property ID “\USM 123”.

732 NOTE 4 Two consecutive backslash characters, i.e. “\\” are interpreted to be a single backslash
 733 character “\”.

734 Figure 4 illustrates a GET/SHOW transaction with a wildcard specified. The provider of the
 735 information returns a list of objects matching the wildcard specification.

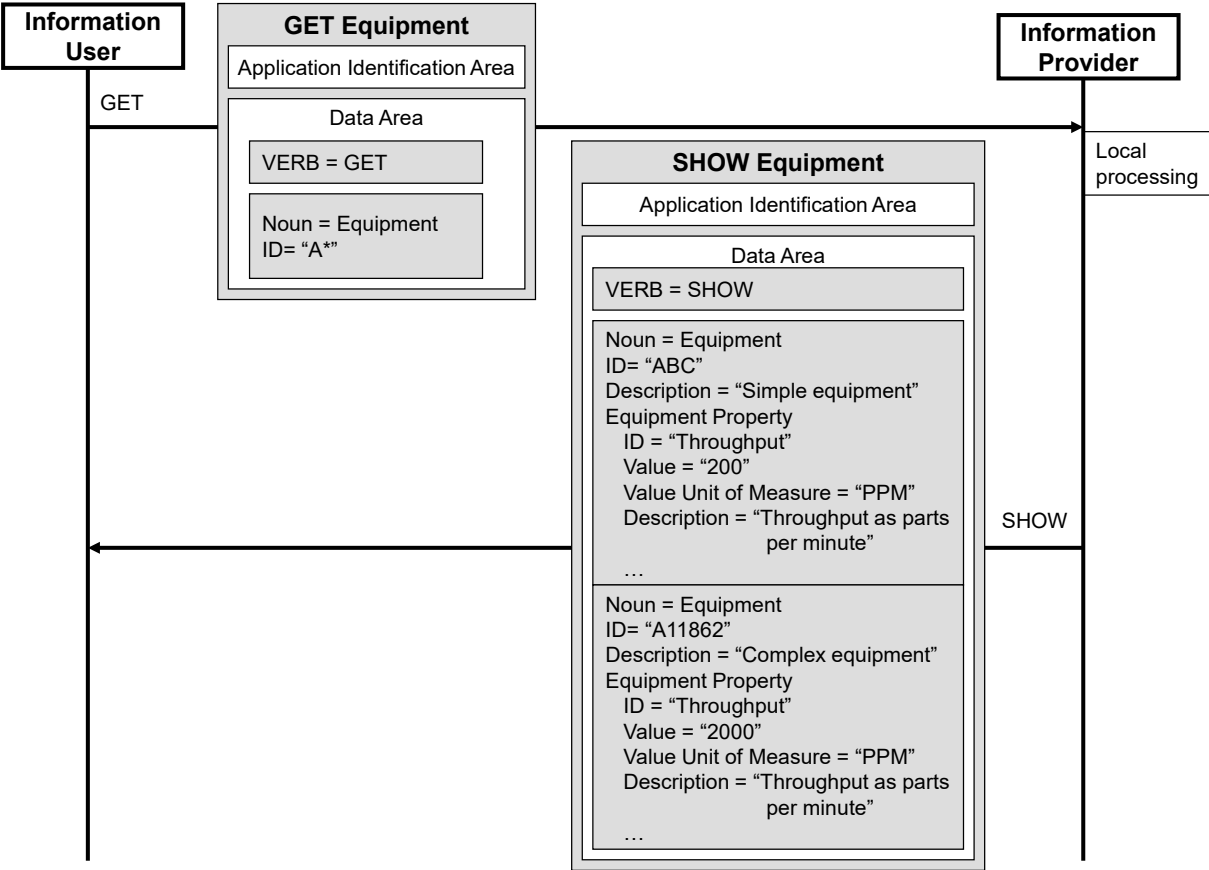


Figure 4 – GET with wildcard and SHOW response

Message verbs

5.1 Verbs and transaction models

The verb area of a message shall contain a verb, defined in this clause and listed in Table 1.

Table 1 – Defined verbs

Verb	Description	Transaction Model
ACKNOWLEDGE	Acknowledgement of a PROCESS request. The noun may contain assigned IDs and other information to inform the sender of the PROCESS message of the IDs of any created objects. Example 1 A PROCESS message sent with a Material Lot may return the ID assigned to the lot by the receiving system.	PUSH

CANCEL	Request to a receiver to remove information. The specified noun's information shall be cancelled. If contained elements IDs are specified, then only the specified contained elements for the specified noun shall be cancelled, not the noun itself. NOTE 1 This does not indicate that the information is deleted, just that it is no longer available for GET, CHANGE and SYNC messages. NOTE 2 Not all objects have contained elements. Examples of contained elements are properties, specifications, actuals, etc. Example 2 A property object for a Material Class noun is a contained element.	PUSH
CHANGE	Request to a receiver to change information. The specified attributes and contained elements of the noun shall be changed. If no IDs of contained elements are specified, only the specified attributes of the noun shall be changed. NOTE 3 See Part 2 and Part 4 for definitions of object attributes.	PUSH
CONFIRM	Confirmation response to a request.	PUSH, PULL, PUBLISH
GET	Request to an information provider for information on one or more objects. The information provider shall return a SHOW message containing each of the specified attributes and each of the specified contained elements of the specified nouns. If no attribute or contained element is specified in the noun area, then all attributes and/or contained elements shall be returned. When wildcards are applied to the noun and property IDs, it shall be possible to further filter the information to be returned by specifying a value for one or more attributes of the noun. Only objects whose attributes match the specified value (out of the list of objects matching the wildcards applied to noun and property IDs) shall be returned. Example 3 To get all the <i>Material Lots</i> with Status = "New", the wildcard "*" would be specified for the <i>Material Lot</i> ID and the "New" value would be specified for the Status attribute.	PULL
PROCESS	Request to a receiver to process new information. A new noun shall be added. If the specified noun already exists, only the specified contained elements shall be added.	PUSH
RESPOND	Response to a CHANGE message request. The noun may contain proposed or alternate information that was used in place of the CHANGE noun information. Example 4 A CHANGE message sent with an updated Material Lot status of "OK" may return a RESPOND with a different status of "OUT OF SPEC" because of business rules in the receiver of the CHANGE message.	PUSH
SHOW	Response to a GET message.	PULL

SYNC ADD	Request from the owner of the object to add information. A new noun shall be added. If the specified noun already exists, only the specified contained elements shall be added.	PUBLISH
SYNC CHANGE	Request from the owner of the object to change information. The specified attributes and contained elements of the noun shall be changed. If no IDs of contained elements are specified, only the specified attributes of the noun shall be changed.	PUBLISH
SYNC DELETE	Request from the owner of the object to delete information. The specified noun shall be cancelled. If contained elements IDs are specified, then only the specified contained elements for the specified noun shall be cancelled.	PUBLISH
NOTIFY	Notification of the occurrence of an event or information creation, by an information provider (publisher) for consumption by zero or more information users (subscribers). There is no expectation of acknowledgement or response to a notification.	PUBLISH

742

743 NOTE 1 The processes on either side of the messages are not defined in this technical specification.

744 NOTE 2 The mechanism to set up the one-to-one association of the PUSH model is not included in this Part.
745 Configuration and set up are implementation specific and would be defined in conforming
746 specifications.

747 NOTE 3 The mechanism to set up the one-to-one association of the PULL model is not included in this Part.
748 Configuration and set up are implementation specific and would be defined in conforming
749 specifications.

750 NOTE 4 The mechanism used for subscribing in the PUBLISH model is not included in this Part. Subscribing
751 mechanisms are implementation specific and would be defined in conforming specifications.

752 NOTE 5 Contained elements are object properties or other contained elements as described in Clause 6.2.

753 NOTE 6 Different methods are possible to specify objects. Such methods depend on the specific noun as well
754 as on the specific verb used, and are specified in the sections for each object type.

755 NOTE 7 The entity receiving the PROCESS message may perform further processing of the added information.

756 NOTE 8 There is no ability defined in this part of the standard to add or remove object attributes; 62264.00.02
757 and 62264.00.04 define the object attributes.

758 NOTE 9 Additional information returned in a SHOW message (as a response to a GET message) (e.g. IDs of
759 referenced objects) is specified in the sections for each object type.

760 NOTE 10 Additional information changed by the CHANGE and SYNC CHANGE messages (e.g. IDs of
761 referenced objects) is specified in the sections for each object type.

762 NOTE 11 Objects can be specified by specific values of their ID or by using wildcards.

763 5.2 GET verb

764 The GET verb shall be used in a GET message to communicate a request for information on an
765 object or list of objects.

766 The response to the GET message is a SHOW message. Figure 6 illustrates the GET/SHOW
767 transaction.

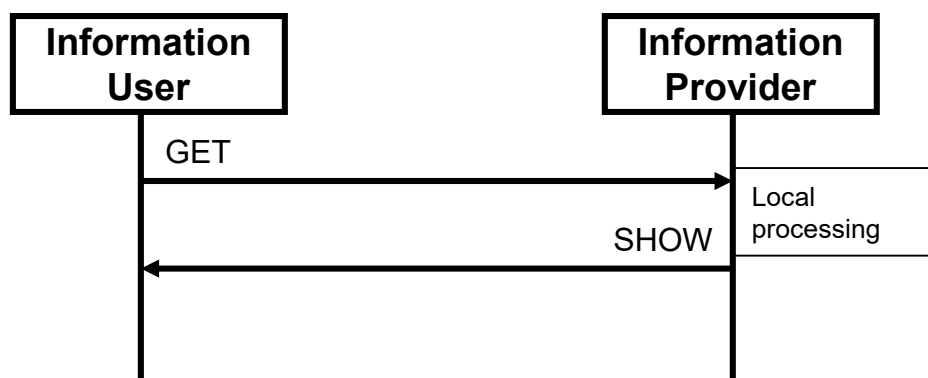


Figure 5 – GET and SHOW transaction

The GET is designed to retrieve one or more objects and any contained elements by using the ID attribute.

Within a GET message, the ID of the requested object is passed to the provider of the information. Where a single ID is not sufficient identification to identify the subset of information requested, such as when only a property of an object is needed, then the ID of the top level object, and the ID or value of the encapsulated object (the property) is passed to the provider of the data. The identifying IDs are specified in the ID sections for each object type.

When a wildcard definition is used in the ID, then the GET returns a list of objects matching the wildcard specification.

Example The GET may retrieve multiple objects such as all of the personnel classes.

NOTE A GET with a wildcard provides a very limited query capability. The transactions are not intended to provide a complete query/reporting capability as normally seen in a database system. If additional query capability is needed, then the GET/SHOW transaction can be used to create copies of all data, and then that copy can be queried locally.

5.3 SHOW verb

The SHOW verb shall be used in a SHOW message when responding to a GET message.

5.4 PROCESS verb

The PROCESS verb shall be used in a PROCESS message to request processing of the associated noun by the receiving application. A PROCESS message is sent to an entity that can process the object. In a typical exchange scenario a PROCESS message is considered to be the equivalent of a formal command.

NOTE A PROCESS verb is often the equivalent of a command to add an object, but usually the receiving entity does further processing of the information. The PROCESS verb is sent to the owner of the information. A SYNC ADD message is usually sent out by the receiver of the PROCESS message, after processing, to inform any other users of the information that there has been new information added.

Example 1 The sending of a *PROCESS Operations Schedule* message to a site indicates that the schedule is to be executed.

Example 2 The sending of a *PROCESS Equipment* message indicates that a new equipment item is to be added to a master equipment database. The receiver of the PROCESS message may then send out a *SYNC ADD Equipment* message to indicate that the master equipment database was updated.

A PROCESS verb area contains an optional element with one of the following additional definitions: Never or Always. (See Table 2) If the optional element is not specified, then it defaults to Never.

Table 2 – Acknowledge request options

Name	Description
Never	No ACKNOWLEDGE message requested.

Always	Always send an ACKNOWLEDGE message.
--------	-------------------------------------

5.5 ACKNOWLEDGE verb

The ACKNOWLEDGE verb shall be used in an ACKNOWLEDGE message to indicate an application's receipt of a PROCESS request. The response to a PROCESS message is an ACKNOWLEDGE message. The ACKNOWLEDGE message may return the original or modified data. Figure 6 illustrates a PROCESS message with the *acknowledge always* option, and with a response ACKNOWLEDGE message.

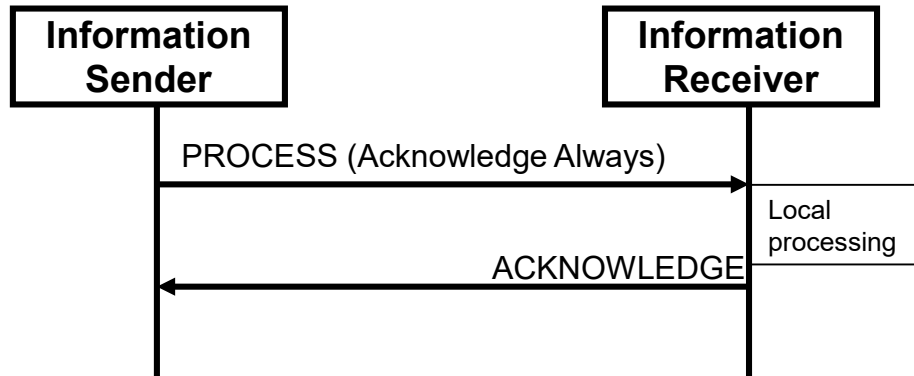


Figure 6 – PROCESS/ACKNOWLEDGE transaction with an acknowledge always option

Example 1 Sending of an *ACKNOWLEDGE Operations Schedule* message, where a *PROCESS Operations Schedule* message has been received and the corresponding business application acknowledges the receipt of the Operations Schedule and responds with an acceptance.

An ACKNOWLEDGE verb area contains an element with one of the following additional definitions: Accepted, Rejected, or Modified. (See Table 3)

Table 3 – Acknowledge element

Acknowledge Element Value	Definition
ACCEPTED	The information was accepted by the receiver of the information and was processed according to the business rules of the receiver.
REJECTED	The information was rejected by the receiver of the information and was not processed by the receiver. The message data area shall contain an identification of the reason for rejection.
MODIFIED	The information was accepted by the receiver of the information but was modified for correct processing, the modified data shall be returned with the ACKNOWLEDGE. The message data area shall contain an identification of the type of modification.

Example 2 Figure 7 shows a message sequence from a scheduling system to an execution system. The initial PROCESS message with an operations schedule is received and an ACKNOWLEDGE message with a MODIFIED flag was returned with a new proposed schedule. The scheduling system re-generates a schedule and resends to the execution system. The execution system accepts the operations schedule and returns an ACKNOWLEDGE message with an ACCEPTED flag.

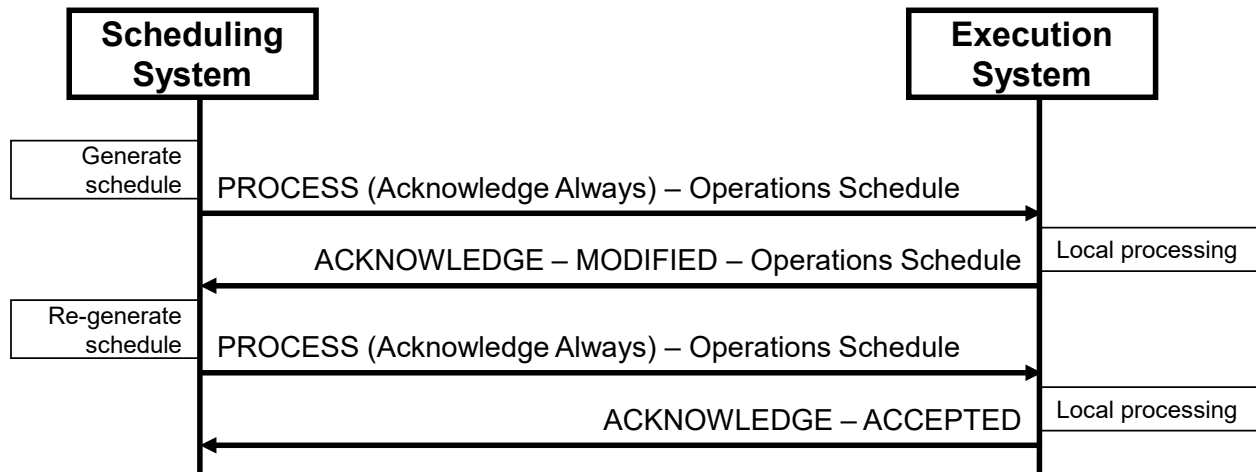


Figure 7 – Example of acknowledge to a process message

5.6 CHANGE verb

The CHANGE verb shall be used in a CHANGE message when the sender of the message is sending a request for the data to be changed. The noun area contains the new data. Figure 8 illustrates a CHANGE message with a *respond always* option and with a RESPOND message.

Example Sending of a *CHANGE Person* message, where the personnel information, such as a qualification test, is changed by a system that is not the owner of the personnel model data.

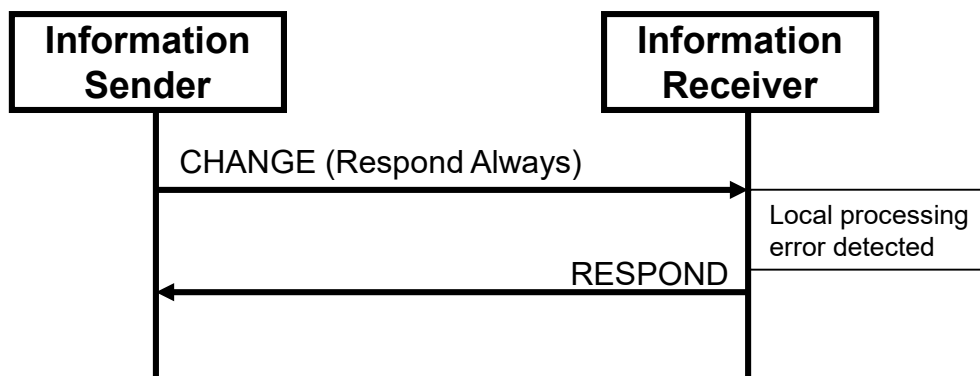


Figure 8 – CHANGE/RESPOND transaction with a respond always option

A CHANGE verb area contains an optional element with one of the following additional definitions: Never or Always. (See Table 4) If the optional element is not specified, then it defaults to Never.

Table 4 – Respond options

Name	Description
Never	No RESPOND message requested.
Always	Always send a RESPOND message.

5.7 CANCEL verb

The CANCEL verb shall be used in a CANCEL message when the sender of the CANCEL message is sending a request for the data to be cancelled.

Example Sending of a *CANCEL Material Lot* message, where an application indicates that a material lot is no longer valid (or available), but the application that is sending the CANCEL message is not the owner of the material model data.

NOTE Because the CANCEL is not sent by the owner of the data, the data are not necessarily deleted. The sender is indicating that the sender no longer needs the data.

5.8 CONFIRM verb

A CONFIRM verb shall be used in a CONFIRM message for confirmation of receipt and processing of any message other than the CONFIRM, RESPOND, or ACKNOWLEDGE messages. See Figure 11 for an example of confirmation with detected errors.

Figure 9 illustrates a transaction with a GET message followed by a SHOW message and a CONFIRM message (because of the “Confirm Always” option specified with the GET message).

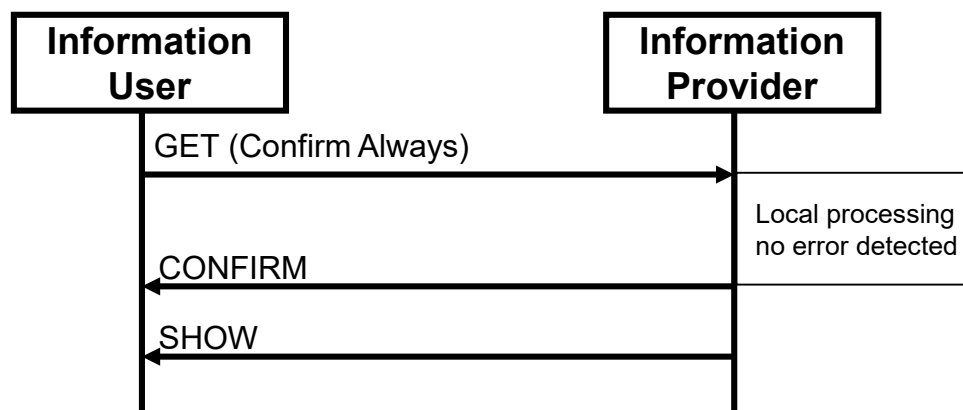


Figure 9 – GET and SHOW transaction with a CONFIRM always

NOTE The order of arrival of the CONFIRM message, SHOW message, and any other response message is not defined in this standard.

Confirmation is an option controlled by the sending business application. It is a request to the receiving application to send back a confirmation message to the sender of the initiating message. If the optional element is not specified, then it defaults to Never.

A confirmation request, specified in the application identification area, has the values defined in Table 5.

Table 5 – Confirmation request options

Name	Description
Never	No confirmation requested.
OnError	Send back a confirmation only if an error has occurred.
Always	Always send a confirmation regardless of the local processing.

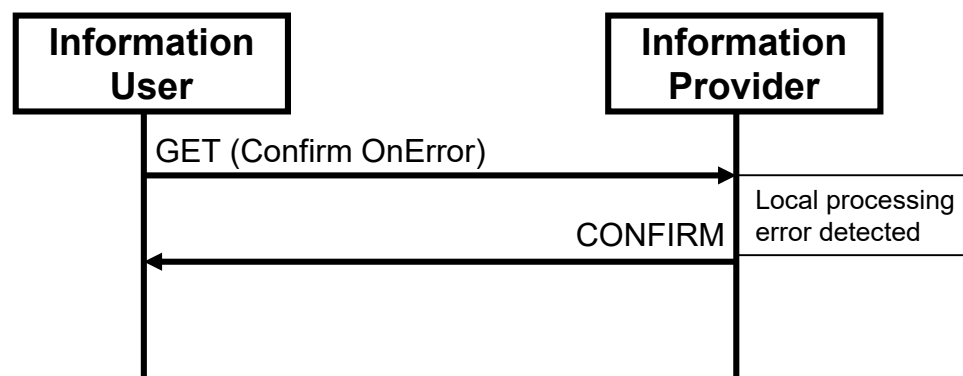


Figure 10 – Example of a GET message with Confirm OnError

NOTE The order of arrival of the CONFIRM message and any other response message is not defined in this standard.

The CONFIRM message:

- 1) Identifies the initiating message being confirmed.
 - 2) Indicates the status of the processing of the message.
 - 3) Includes a description of the error if the status indicates a processing error if requested.
- If an error occurs in the processing of the initiating message by the receiving application and the sender set the confirmation element to either *OnError* or *Always*, then the receiving application shall provide a CONFIRM message.
- Error handling at the application layer is through the confirmation element in the application identification area. Specific error codes or error text are not defined in this part and are implementation specific.
- The application error handling is in addition to any communication layer error handling that may be provided by the infrastructure framework, web service, or middleware.
- Additional error description, code, or text associated with objects in the noun area may be contained in the noun area, as shown in Figure 11.

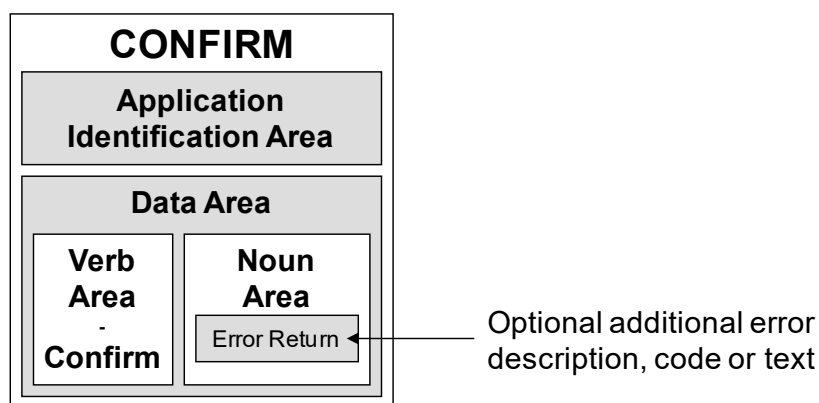


Figure 11 – Confirm Message

5.9 RESPOND verb

The RESPOND verb shall be used in a RESPOND message to signify the application receipt and processing of a CHANGE message. The RESPOND message is used when responding to a CHANGE message. The RESPOND message may return the original or modified data.

A RESPOND verb area contains an element with one of the following additional definitions: Accepted, Rejected, or Modified. (See Table 6)

Table 6 – Respond element

Respond element value	Definition
ACCEPTED	The information was accepted by the receiver of the information and was changed according to the business rules of the receiver.
REJECTED	The information was rejected by the receiver of the information and was not changed by the receiver. The message data area shall contain an identification of the reason for rejection.
MODIFIED	The information was accepted by the receiver of the information but was modified for correct processing and the modified data were returned with the RESPOND. The message data area shall contain an identification of the type of modification.

5.10 SYNC verb

The SYNC verb shall be used in a SYNC message when the owner of the data is publishing the information or change in information to subscribers.

NOTE 1 SYNC is short for synchronize, and implies synchronized or aligned data; it does not mean synchronous communications

NOTE 2 There should only be one application that sends SYNC messages for any specific element of information.

Example 1 A human resources system may provide personnel capability information; however, a training system may provide the Specification information pertaining to the personnel capability object.

The owner of the information sends the SYNC message.

The SYNC message shall contain one of the following modifiers in the verb area: ADD, CHANGE, or DELETE.

Example 2 This verb is commonly used when mass changes are necessary, such as when an ERP publishes item master to multiple MES systems, or when a publish and subscribe mechanism is used as a company's integration architecture.

5.11 SYNC ADD verb

A SYNC ADD verb shall be sent by the owner of the information and indicates that the owner of the information has added new information. The SYNC ADD message shall include the object instances added and the values of all attributes of these objects. The specific elements to be added are defined in Clause 6. See Figure 12 for an example of a SYNC ADD with a CONFIRM response.

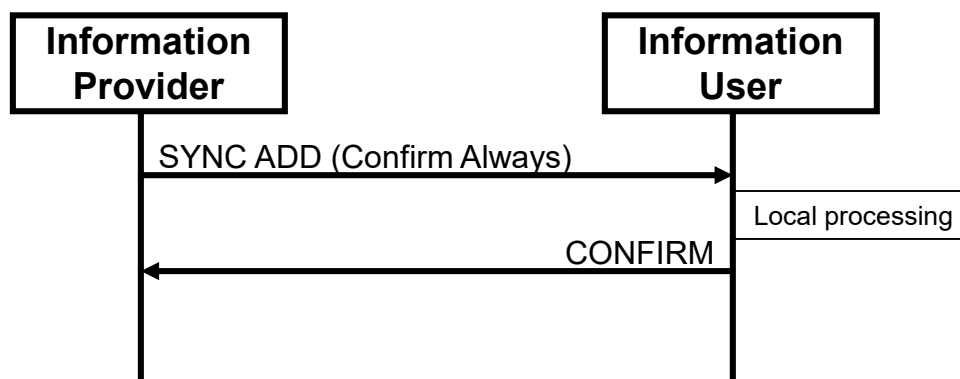


Figure 12 – SYNC ADD transaction with confirmation

Example A SYNC ADD on a *Test Specification* noun indicates the definition of a new *Test Specification* object.

5.12 SYNC CHANGE verb

A SYNC CHANGE verb is sent by the owner of the information and is used to disseminate information on changed objects to subscribed users. The SYNC CHANGE message shall include the object instances changed with the values of the attributes changed. The specific elements to be changed are defined in Clause 6.

Example A SYNC CHANGE message with a *MATERIAL CLASS* object indicates a change in the material class or a property of the material class and the new value.

5.13 SYNC DELETE verb

A SYNC DELETE verb is sent by the owner of the information and indicates that the provider of the information has deleted the information. The SYNC DELETE message shall include the object instances deleted.

See Figure 13 for an example of a SYNC DELETE with no response. The specific elements to be deleted are defined in Clause 6.

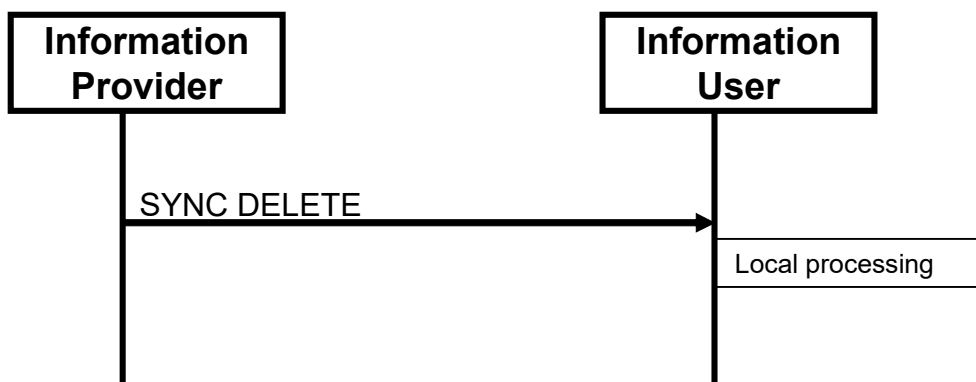


Figure 13 – SYNC DELETE transaction with no confirmation

NOTE A SYNC DELETE message only indicates that the provider has deleted the information from publication. The information may still be archived or retained in accordance with business policies, but just not available for further publishing. The information user has the responsibility to determine the correct action, such as retaining or archiving their information.

5.14 NOTIFY verb

The NOTIFY verb shall be used in a NOTIFY message when an information provider publishes notification of the occurrence of an event or data creation. The noun area contains the event data, as illustrated in Figure 14.

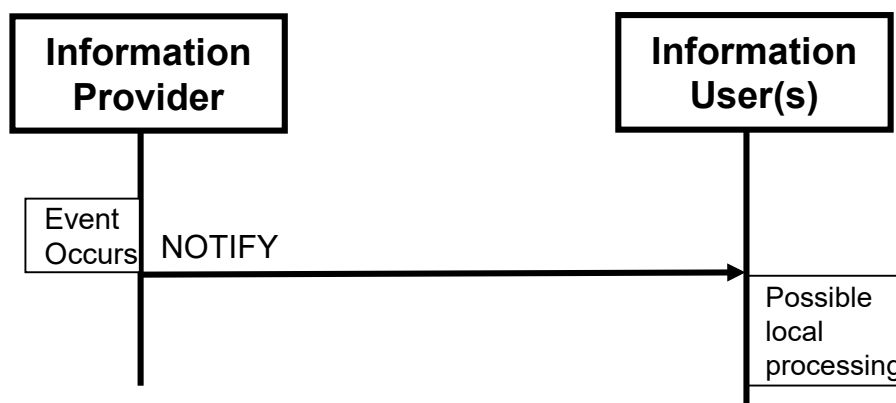


Figure 14 - NOTIFY transaction

The NOTIFY verb does not support acknowledgment or response to a notification. If an implementation requires acknowledgement or response to an event notification, then the responses should be processed as separate event notifications.

NOTE The NOTIFY transaction publication is disconnected from the consumption of the transaction by subscribers. There may be zero or many information users subscribed to receive notifications.

Example Generation of notifications by information providers typically involve the following functions:

1. Monitoring of activities from an enterprise or manufacturing operations management system.
2. Identification when the trigger condition for the notification is met, indicating that an event has occurred or information is created.
3. Assembly of NOTIFY message for notification of the event occurrence or data creation.
4. Publication of the NOTIFY message.

5.15 Verb actions and the use of IDs

The verbs GET, CHANGE, CANCEL, PROCESS, and SYNC, have different meaning and responses based on the values of ID attributes in the noun object. The specific rules for each verb/noun combination are defined in Clause 6. IDs may be specified, not specified, or contain wildcard values. The action is each case is defined in the noun's verb action clause. Where there are multiple IDs in a noun/object, each row in the noun's verb action table defines one valid combination of ID values.

Message nouns

6.1 Introduction

This clause defines the contents of the noun area in a message that shall be used by verbs to identify information exchanged.

6.2 Defined message contents

6.2.1 Object References

An object may be included in a message either to communicate information about that object or to communicate a reference to a preexisting object. Where a message is communicated containing an object only with its ID (and the ID is recognized as a preexisting object), this shall constitute a reference to a preexisting object with the given ID rather than information describing that object.

6.2.2 Hierarchy Scope

The *Hierarchy Scope* noun contains the following object as defined in 62264.00.02:

- Hierarchy Scope

6.2.3 Equipment

The *Equipment* noun can contain the following objects as defined in 62264.00.02:

- Equipment
- Equipment Property
- Test Result
- Equipment Asset Mapping

6.2.4 Equipment Class

The *Equipment Class* noun can contain the following objects as defined in 62264.00.02:

- Equipment Class
- Equipment Class Property

6.2.5 Job List

The *Job List* noun can contain the following objects as defined in 62264.00.04:

- Job Order
- Job List
- Job Order Parameter
- Personnel Requirement
- Equipment Requirement
- Physical Asset Requirement
- Material Requirement
- Personnel Requirement Property
- Equipment Requirement Property
- Physical Asset Requirement Property
- Material Requirement Property

6.2.6 Job Response

The *Job Response* noun contains the following objects as defined in 62264.00.04:

- Job Response
- Job Response Data
- Personnel Actual

- 1002 – Equipment Actual
- 1003 – Physical Asset Actual
- 1004 – Material Actual
- 1005 – Personnel Actual Property
- 1006 – Equipment Actual Property
- 1007 – Physical Asset Actual Property
- 1008 – Material Actual Property

1009 **6.2.7 Job Response List**

1010 The *Job Response List* noun contains the following objects as defined in 62264.00.04:

- 1011 – Job Response List
- 1012 – Job Response
- 1013 – Job Response Data
- 1014 – Personnel Actual
- 1015 – Equipment Actual
- 1016 – Physical Asset Actual
- 1017 – Material Actual
- 1018 – Personnel Actual Property
- 1019 – Equipment Actual Property
- 1020 – Physical Asset Actual Property
- 1021 – Material Actual Property

1022 **6.2.8 Material Class**

1023 The *Material Class* noun can contain the following objects as defined in 62264.00.02:

- 1024 – Material Class
- 1025 – Material Class Property

1026 **6.2.9 Material Definition**

1027 The *Material Definition* noun can contain the following objects as defined in 62264.00.02:

- 1028 – Material Definition
- 1029 – Material Definition Property

1030 **6.2.10 Material Lot**

1031 The *Material Lot* noun can contain the following objects as defined in 62264.00.02:

- 1032 – Material Lot
- 1033 – Material Lot Property
- 1034 – Test Result

1035 **6.2.11 Material Sublot**

1036 The *Material Sublot* noun can contain the following objects as defined in 62264.00.02:

- 1037 – Material Sublot
- 1038 – Material Lot Property
- 1039 – Test Result

1040 Example Sublot specific properties may be unique RFIDs (Radio Frequency ID) for each sublot or maximum
1041 temperature indicators for each sublot.

1042 **6.2.12 Operational Location**

1043 The *Operational Location* noun contains the following objects as defined in 62264.00.02:

1044 – Operational Location

1045 – Operational Location Property

1046 **6.2.13 Operational Location Class**

1047 The *Operational Location Class* noun contains the following objects as defined in 62264.00.02:

1048 – Operational Location Class

1049 – Operational Location Class Property

1050 **6.2.14 Operations Capability**

1051 The *Operations Capability* noun can contain the following objects as defined in 62264.00.02:

1052 – Operations Capability

1053 – Process Segment Capability

1054 – Personnel Capability

1055 – Equipment Capability

1056 – Physical Asset Capability

1057 – Material Capability

1058 – Personnel Capability Property

1059 – Equipment Capability Property

1060 – Physical Asset Capability Property

1061 – Material Capability Property

1062 **6.2.15 Operations Definition**

1063 The *Operations Definition* noun can contain the following objects as defined in 62264.00.02:

1064 – Operations Definition

1065 – Operations Segment

1066 – Operations Segment Dependency

1067 – Operations Material Bill

1068 – Operations Material Bill Item

1069 – Parameter Specification

1070 – Personnel Specification

1071 – Equipment Specification

1072 – Physical Asset Specification

1073 – Material Specification

1074 – Personnel Specification Property

1075 – Equipment Specification Property

1076 – Physical Asset Specification Property

1077 – Material Specification Property

1078 **6.2.16 Operations Schedule**

1079 The *Operations Schedule* noun can contain the following objects as defined in 62264.00.02:

1080 – Operations Schedule

1081 – Operations Request

1082 – Segment Requirement

1083 – Requested Segment Response

1084 – Segment Parameter

1085 – Personnel Requirement

- 1086 – Equipment Requirement
- 1087 – Physical Asset Requirement
- 1088 – Material Requirement
- 1089 – Personnel Requirement Property
- 1090 – Equipment Requirement Property
- 1091 – Physical Asset Requirement Property
- 1092 – Material Requirement Property

1093 **6.2.17 Operations Performance**

1094 The *Operations Performance* noun can contain the following objects as defined in 62264.00.02:

- 1095 – Operations Performance
- 1096 – Operations Response
- 1097 – Segment Response
- 1098 – Segment Data
- 1099 – Personnel Actual
- 1100 – Equipment Actual
- 1101 – Physical Asset Actual
- 1102 – Material Actual
- 1103 – Personnel Actual Property
- 1104 – Equipment Actual Property
- 1105 – Physical Asset Actual Property
- 1106 – Material Actual Property

1107 **6.2.18 Person**

1108 The *Person* noun can contain the following objects as defined in 62264.00.02:

- 1109 – Person
- 1110 – Person Property
- 1111 – Qualification Test Result

1112 **6.2.19 Personnel Class**

1113 The *Personnel Class* noun can contain the following objects as defined in 62264.00.02:

- 1114 – Personnel Class
- 1115 – Personnel Class Property

1116 **6.2.20 Physical Asset**

1117 The *Physical Asset* noun can contain the following objects as defined in 62264.00.02:

- 1118 – Physical Asset
- 1119 – Physical Asset Property
- 1120 – Test Result
- 1121 – Equipment Asset Mapping

1122 **6.2.21 Physical Asset Class**

1123 The *Physical Asset Class* noun can contain the following objects as defined in 62264.00.02:

- 1124 – Physical Asset Class
- 1125 – Physical Asset Class Property

1126 **6.2.22 Process Segment**

1127 The *Process Segment* noun can contain the following objects as defined in 62264.00.02:

- 1128 – Process Segment
- 1129 – Process Segment Parameter
- 1130 – Personnel Segment Specification
- 1131 – Equipment Segment Specification
- 1132 – Physical Asset Segment Specification
- 1133 – Material Segment Specification
- 1134 – Process Segment Dependency
- 1135 – Personnel Segment Specification Property
- 1136 – Equipment Segment Specification Property
- 1137 – Physical Asset Segment Specification Property
- 1138 – Material Segment Specification Property

1139 **6.2.23 Operations Event**

1140 The *Operations Event* noun can contain the following objects as defined in 62264.00.02:

- 1141 – Operations Event
- 1142 – Operations Event Property
- 1143 – Operations Event Record

1144 **6.2.24 Operations Event Definition**

1145 The *Operations Event Definition* noun can contain the following objects as defined in
1146 62264.00.02:

- 1147 – Operations Event Definition
- 1148 – Operations Event Definition Property
- 1149 – Operations Event Definition Record Specification

1150 **6.2.25 Operations Event Class**

1151 The *Operations Event Class* noun can contain the following objects as defined in 62264.00.02:

- 1152 – Operations Event Class
- 1153 – Operations Event Class Property
- 1154 – Operations Event Class Record Specification

1155 **6.2.26 Resource Relationship Network**

1156 The *Resource Relationship Network* noun can contain the following objects as defined in
1157 62264.00.04:

- 1158 – Resource Relationship Network
- 1159 – Resource Network Connection
- 1160 – Resource Network Connection Property
- 1161 – To Resource Reference
- 1162 – To Resource Reference Property
- 1163 – From Resource Reference
- 1164 – From Resource Reference Property

1165 **6.2.27 Resource Relationship Network Connection Type**

1166 The *Resource Relationship Network Connection Type* noun can contain the following objects
1167 as defined in 62264.00.04:

- 1168 – Resource Network Connection Type
- 1169 – Resource Network Connection Type Property

6.2.28 Transaction Profile

The message contents of a transaction profile returns all supported verb/noun combinations, if the combination is supported as a receiver, if it is supported as a sender, and if wildcards are supported. See Clause 6.22 and Clause 7 for the definition of the object and compliance information.

NOTE The *transaction profile* is a method to interactively determine what verbs and nouns are supported by an application.

6.2.29 Test Specification

The *Test Specification* noun contains the following object as defined in 62264.00.02:

- Test Specification

6.2.30 Work Alert Definition

The *Work Alert Definition* noun can contain the following objects as defined in 62264.00.04:

- Work Alert Definition
- Work Alert Definition Property

6.2.31 Work Alert

The *Work Alert* noun can contain the following objects as defined in 62264.00.04:

- Work Alert
- Work Alert Property

6.2.32 Work Calendar Definition

The *Work Calendar Definition* noun can contain the following objects in 62264.00.04:

- Work Calendar Definition
- Work Calendar Definition Entry
- Work Calendar Definition Property

6.2.33 Work Calendar

The *Work Calendar* noun can contain the following objects in 62264.00.04:

- Work Calendar
- Work Calendar Entry
- Work Calendar Property

6.2.34 Work Capability

The *Work Capability* noun contains the following objects as defined in 62264.00.04:

- Work Capability
- Work Master Capability
- Personnel Capability
- Equipment Capability
- Physical Asset Capability
- Material Capability
- Personnel Capability Property
- Equipment Capability Property
- Physical Asset Capability Property
- Material Capability Property

6.2.35 Work Directive

The *Work Directive* noun contains the following objects as defined in 62264.00.04:

- 1212 – Work Directive
- 1213 – Workflow Specification
- 1214 – Parameter Specification
- 1215 – Personnel Specification
- 1216 – Equipment Specification
- 1217 – Physical Asset Specification
- 1218 – Material Specification
- 1219 – Personnel Specification Property
- 1220 – Equipment Specification Property
- 1221 – Physical Asset Specification Property
- 1222 – Material Specification Property

1223 **6.2.36 Work Master**

1224 The *Work Master* noun contains the following objects as defined in 62264.00.04:

- 1225 – Work Master
- 1226 – Workflow Specification
- 1227 – Parameter Specification
- 1228 – Personnel Specification
- 1229 – Equipment Specification
- 1230 – Physical Asset Specification
- 1231 – Material Specification
- 1232 – Personnel Specification Property
- 1233 – Equipment Specification Property
- 1234 – Physical Asset Specification Property
- 1235 – Material Specification Property

1236 **6.2.37 Work Performance**

1237 The *Work Performance* noun contains the following objects as defined in 62264.00.04:

- 1238 – Work Performance
- 1239 – Work Response
- 1240 – Job Response
- 1241 – Job Response Data
- 1242 – Personnel Actual
- 1243 – Equipment Actual
- 1244 – Physical Asset Actual
- 1245 – Material Actual
- 1246 – Personnel Actual Property
- 1247 – Equipment Actual Property
- 1248 – Physical Asset Actual Property
- 1249 – Material Actual Property

1250 **6.2.38 Work Record**

1251 The *Work Record* noun contains the following objects as defined in 62264.00.04:

- 1252 – - Work Record
- 1253 – - All subobjects in a Work Record as defined in 62264.00.04

6.2.39 Work Schedule

The *Work Schedule* noun contains the following objects as defined in 62264.00.04:

- Work Schedule
- Work Request
- Job Order Parameter
- Personnel Requirement
- Equipment Requirement
- Physical Asset Requirement
- Material Requirement
- Personnel Requirement Property
- Equipment Requirement Property
- Physical Asset Requirement Property
- Material Requirement Property

6.2.40 Workflow Specification

The *Workflow Specification* noun contains the following objects as defined in 62264.00.04:

- Workflow Specification
- Workflow Specification Node
- Workflow Specification Node Property
- Workflow Specification Connection
- Workflow Specification Connection Property

6.2.41 Workflow Specification Type

The *Workflow Specification Type* noun contains the following objects as defined in 62264.00.04:

- Workflow Specification Type
- Workflow Specification Node Type
- Workflow Specification Node Type Property
- Workflow Specification Connection Type
- Workflow Specification Connection Type Property

6.3 Hierarchy Scope Model**6.3.1 Hierarchy scope model elements**

The message definitions assume that information may be accessed from one starting point, hierarchy scope, as identified by the dotted collection in Figure 15.

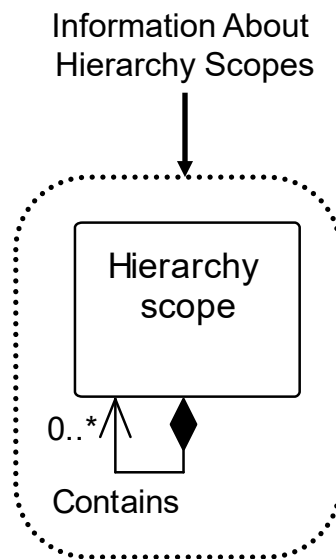


Figure 15 - Object grouping for hierarchy scope model

Example Messages include Get Hierarchy Scope, Show Hierarchy Scope and Process Hierarchy Scope

6.3.2 Hierarchy scope verbs

All verbs shall be valid for a hierarchy scope noun.

6.3.3 Hierarchy scope verb actions

The actions performed on *hierarchy scope* objects are defined in Table 7.

Table 7 – Hierarchy scope verb actions

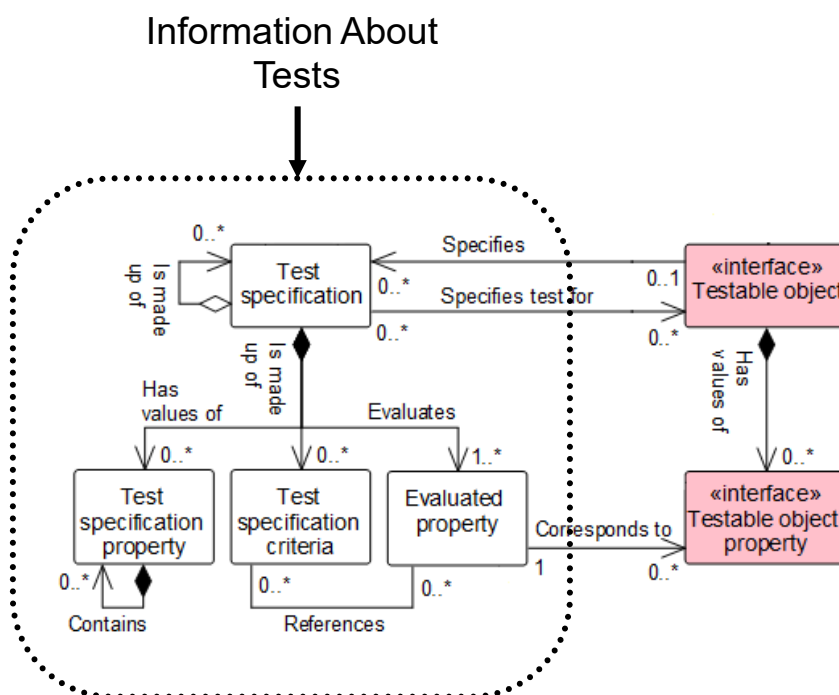
Value of Hierarchy Scope ID	Verb action on noun
IDs specified	GET: Shall define a request that the receiver is to return, in a SHOW message, all attributes about the <i>Hierarchy Scopes</i>. PROCESS: Shall define a request that the receiver is to add <i>Hierarchy Scopes</i>. The message defines suggested IDs for the <i>Hierarchy Scopes</i>. The receiver adds the <i>Hierarchy Scopes</i> and assigns IDs. The assigned IDs shall be returned in the ACKNOWLEDGE message. CHANGE: Shall define a request that the receiver is to change the specified attributes of the <i>Hierarchy Scopes</i>. A RESPOND message may be used to communicate agreement, disagreement, or changes made to the CHANGE message data. CANCEL: Shall define a request that the receiver is to cancel the specified <i>Hierarchy Scopes</i>. SYNC ADD: Shall define a request that the receiver is to add the specified <i>Hierarchy Scopes</i>. SYNC CHANGE: Shall define a request that the receiver is to change the specified attributes of the <i>Hierarchy Scopes</i>. SYNC DELETE: Shall define a request that the receiver is to delete the specified <i>Hierarchy Scopes</i>. NOTIFY: Shall define the creation of a new hierarchy scope.
<not specified>	GET: Error. PROCESS: Error. CHANGE: Error. CANCEL: Error. SYNC ADD: Error. SYNC CHANGE: Error. SYNC DELETE: Error. NOTIFY: Error.
Wildcard specified	GET: Shall define a request that the receiver is to return, in a SHOW message, all attributes of all <i>Hierarchy Scopes</i> identified by the ID wildcard.

Value of Hierarchy Scope ID	Verb action on noun
	Example To return all <i>Hierarchy Scopes</i>, specify a “*” as the wildcard. PROCESS: Error. CHANGE: Error. CANCEL: Shall define a request that the receiver is to cancel all <i>Hierarchy Scopes</i> matching the wildcard. SYNC ADD: Error. SYNC CHANGE: Error. SYNC DELETE: Shall define a request that the receiver is to delete all <i>Hierarchy Scopes</i> matching the wildcard. NOTIFY: Error.

1293

1294 **6.4 Test specification model**

1295 The message definitions assume that test information may be accessed from one starting point,
 1296 test specification, as identified by the dotted collections in Figure 16. *Test Specification* is
 1297 defined for the <<interface>> classes defined in ISA 95.00.02 in the Operations Test Model,
 1298 and for *Personnel Class*, *Person*, *Equipment Class*, *Equipment*, *Physical Asset Class*, *Physical*
 1299 *Asset*, *Material Class*, *Material Definition*, *Material Lot*, and *Material Sublot*.



1300

1301 **Figure 16 – Object Grouping for Test Specification**1302 **6.4.1 Test specification verbs**

1303 All verbs shall be valid for a *test specification* noun.

1304 **6.4.2 Test specification verb actions**

1305 The actions performed on a *Test specification* noun are defined in Table 8.

1306 **Table 8 – Test specification verb actions**

Value of Test ID	Verb action on noun
IDs specified	GET: Shall define a request that the receiver is to return, in a SHOW message, all attributes of the <i>Test Specifications</i> , the IDs of <i>Testable Objects</i> referenced by the test, and the IDs of all <i>Testable Object Properties</i> referenced by the test.