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Health informatics — Personal health device communication —

Part 10442: Device specialization — Strength fitness equipment

Informatique de santé — Communication entre dispositifs de santé personnels —

Partie 10442: Spécialisation des dispositifs — Équipement de mise en forme musculaire

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— replacement of front page footer and deletion of watermark.

Health informatics—Personal health device communication

Part 10442: Device specialization—Strength fitness equipment

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Approved 26 September 2008

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Abstract: Within the context of the ISO/IEEE 11073 family of standards for device communication, this standard establishes a normative definition of the communication between personal strength fitness devices and managers (e.g., cell phones, personal computers, personal health appliances, and set top boxes) in a manner that enables plug-and-play interoperability. It leverages appropriate portions of existing standards including ISO/IEEE 11073 terminology and information models. It specifies the use of specific term codes, formats, and behaviors in telehealth environments restricting optionality in base frameworks in favor of interoperability. This standard defines a common core of communication functionality for personal telehealth strength fitness devices. In this context, strength fitness devices are being used broadly to cover strength fitness devices that measure musculo-skeletal strength-conditioning activities.

Keywords: medical device communication, personal health devices, strength fitness equipment

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Introduction

This introduction is not part of IEEE Std 11073-10442-2008, Health informatics—Personal health device communication—Part 10442: Device specialization—Strength fitness equipment.

ISO/IEEE 11073 standards enable communication between medical devices and external computer systems. This document uses the optimized framework created in IEEE Std 11073-20601[a] and describes a specific, interoperable communication approach for strength fitness equipment. These standards align with and draw on the existing clinically focused standards to provide easy management of data from either clinical or personal health devices.

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[a] For information on references, see Clause 2.

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Health informatics—Personal health device communication

Part 10442: Device specialization—Strength fitness equipment

1. Overview

1.1 Scope

Within the context of the ISO/IEEE 11073 family of standards for device communication, this standard establishes a normative definition of the communication between personal strength fitness devices and managers (e.g., cell phones, personal computers, personal health appliances, and set top boxes) in a manner that enables plug-and-play interoperability. It leverages appropriate portions of existing standards, including ISO/IEEE 11073 terminology and information models. It specifies the use of specific term codes, formats, and behaviors in telehealth environments restricting optionality in base frameworks in favor of interoperability. This standard defines a common core of communication functionality for personal telehealth strength fitness devices. In this context, strength fitness devices are being used broadly to cover strength fitness devices that measure musculo-skeletal strength-conditioning activities.

1.2 Purpose

This standard addresses a need for an openly defined, independent standard for controlling information exchange to and from personal health devices and managers (e.g., cell phones, personal computers, personal health appliances, and set top boxes). Interoperability is the key to growing the potential market for these devices and to enabling people to be better-informed participants in the management of their health.

1.3 Context

See IEEE Std 11073-20601™ for an overview of the environment within which this standard is written.

This document, IEEE Std 11073-10442 defines the device specialization for the strength fitness device, being a specific agent type, and it provides a description of the device concepts, its capabilities, and its implementation according to this standard.

This standard is based on IEEE Std 11073-20601, which in turn draws information from both ISO/IEEE 11073-10201:2004 [B3][1] and ISO/IEEE 11073-20101:2004 [B4]. The medical device encoding rules (MDER) used within this standard are fully described in IEEE Std 11073-20601.

This standard reproduces relevant portions of the nomenclature found in ISO/IEEE 11073-10101:2004 [B2] and adds new nomenclature codes for the purposes of this standard. Between this standard and IEEE Std 11073-20601, all required nomenclature codes for implementation are documented.

NOTE—In this standard, IEEE Std 11073-104zz is used to refer to the collection of device specialization standards that utilize IEEE Std 11073-20601, where zz can be any number from 01 to 99, inclusive.[2]

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so that each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEEE Std 11073-20601™-2008, Health informatics—Personal health device communication—Part 20601: Application profile—Optimized exchange protocol.[3, 4]

See Annex A for all informative material referenced by this standard.

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this standard, the following terms and definitions apply. The *Authoritative Dictionary of IEEE Standards Terms* [B1] should be referenced for terms not defined in this clause.

3.1.1 agent: A node that collects and transmits personal health data to an associated manager.

3.1.2 class: In object-oriented modeling, a class describes the attributes, method, and events that objects instantiated from the class utilize.

3.1.3 compute engine: *See*: **manager.**

3.1.4 device: A term used to refer to a physical apparatus implementing either an agent or a manager role.

[1] The numbers in brackets correspond to those of the bibliography in Annex A.
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3.1.5 handle: An unsigned 16-bit number that is locally unique and identifies one of the object instances within an agent.

3.1.6 manager: A node receiving data from one or more agent systems. Some examples of managers include a cellular phone, health appliance, set top box, or a computer system.

3.1.7 obj-handle: *See:* **handle.**

3.1.8 object: In object-oriented modeling, a particular instantiation of a class. The instantiation realizes attributes, methods, and event from the class.

3.1.9 personal health device: A device used in personal health applications.

3.1.10 personal telehealth device: *See:* **personal health device.**

3.2 Acronyms and abbreviations

APDU	application protocol data unit
ASN.1	Abstract Syntax Notation One
DIM	domain information model
EUI-64	extended unique identifier (64 bits)
ICS	implementation conformance statement
MDC	medical device communication
MDER	medical device encoding rules
MDS	medical device system
MOC	medical object class
OID	object identifier
PDU	protocol data unit
PHD	personal health device
RT-SA	real-time sample array
VMO	virtual medical object
VMS	virtual medical system

4. Introduction to ISO/IEEE 11073 personal health devices

4.1 General

This standard and the remainder of the series of ISO/IEEE 11073 personal health device (PHD) standards fit in the larger context of the ISO/IEEE 11073 series of standards. The full suite of standards enables agents to interconnect and interoperate with managers and with computerized health-care information systems. See IEEE Std 11073-20601 for a description of the guiding principles for this series of ISO/IEEE 11073 personal health device standards.

IEEE Std 11073-20601 supports the modeling and implementation of an extensive set of personal health devices. This standard defines aspects of the strength fitness device. It describes all aspects necessary to implement the application layer services and data exchange protocol between an ISO/IEEE 11073 PHD strength fitness agent and a manager. This standard defines a subset of the objects and functionality contained in IEEE Std 11073-20601 and extends and adds definitions where appropriate. All new definitions are given in Annex B in Abstract Syntax Notation One (ASN.1). Nomenclature codes referenced in this standard, which are not defined in IEEE Std 11073-20601, are normatively defined in Annex C.

4.2 Introduction to IEEE 11073-20601 modeling constructs

4.2.1 General

The ISO/IEEE 11073 series of standards, and in particular IEEE Std 11073-20601 is based on an object-oriented systems management paradigm. The overall system model is divided into three principal components: the domain information model (DIM), the service model, and the communications model. See IEEE Std 11073-20601 for a detailed description of the modeling constructs.

4.2.2 Domain information model

The DIM is a hierarchical model that describes an agent as a set of objects. These objects and their attributes represent the elements that control behavior and report on the status of the agent and data that the agent can communicate to the manager. Communication between the agent and the manager is defined by the application protocol in IEEE Std 11073-20601.

4.2.3 Service model

The service model defines the conceptual mechanisms for the data exchange services. Such services are mapped to messages that are exchanged between the agent and the manager. Protocol messages within the ISO/IEEE 11073 series of standards are defined in ASN.1. The messages defined in IEEE Std 11073-20601 can coexist with messages defined in other standard application profiles defined in the ISO/IEEE 11073 series of standards.

4.2.4 Communication model

In general, the communication model supports the topology of one or more agents communicating over logical point-to-point connections to a single manager. For each logical point-to-point connection, the dynamic system behavior is defined by a connection state machine as specified in IEEE Std 11073-20601.

4.2.5 Implementing the models

An agent implementing this standard shall implement all mandatory elements of the information, service, and communication models as well as all conditional elements where the condition is met. The agent should implement the recommended elements, and it may implement any combination of the optional elements. A manager implementing this standard shall utilize at least one of the mandatory, conditional, recommended, or optional elements. In this context, “utilize” means to use the element as part of the primary function of the manager device. For example, a manager whose primary function is to display data would need to display a piece of data in the element in order to utilize it.

5. Strength fitness device concepts and modalities

5.1 General concepts

Strength fitness agents measure the extent to which a person can perform a certain motion with a given resistance. The agents in this category are varied, and they range from single exercise machines, such as a leg press, to multi-function agents that can be used to perform a variety of exercises. While these agents may take a variety of forms, the measurements they capture are largely the same.

Agents in this category operate in a store and forward mode. Exercise is measured for a period of time, and sometime after the exercise period has ended, the agent transfers all the measurements to the manager. This period of exercise measurement is called a set.

5.2 Set

A set is an episode of a strength training exercise performed on a single agent at the same resistance. A set includes the time that it was started, the muscle group engaged, and optionally, the duration. A set may also have other measurements associated with it, such as the repetition count, details for each repetition, resistance, exercise laterality, exercise grip, exercise position, and exercise movement.

5.3 Repetition

A repetition is an instance of a given strength exercise. Each repetition is associated with a set and defines when the repetition was performed. Additionally, the repetition may specify the duration and/or the distance of the repetition.

5.4 Repetition count

The repetition count is the number of time an exercise had been performed within an associated set.

5.5 Resistance

The resistance is a representation of the amount of force applied to accomplish the exercise.

5.6 Exercise position

The position employed to perform the exercise.

5.7 Exercise laterality

Exercise laterality identifies which side of the body engaged in the exercise.

5.8 Exercise grip

The grip employed to perform the exercise.

5.9 Exercise movement

The movement employed in the exercise.

6. Strength fitness domain information model

6.1 Overview

This clause describes the domain information model for strength fitness equipment.

6.2 Class extensions

In this standard, no class extensions are defined with respect to IEEE Std 11073-20601.

6.3 Object instance diagram

The object instance diagram of the strength fitness domain information model, defined for the purpose of this standard, is shown in Figure 1.

The objects of the DIM, as shown in Figure 1, are described in 6.4 to 6.11. This includes the medical device system (MDS) object (see 6.5), the numeric objects (see 6.6), the real-time sample array (RT-SA) objects (see 6.7), the enumeration objects (see 6.8), the PM-store objects (see 6.9), and the scanner objects (see 6.10). See 6.11 for rules for extending the information model beyond elements as described in this standard. Each clause that describes an object of the strength fitness contains the following information:

— The nomenclature code used to identify the class of the object. One example of where this code is used is the configuration event, where the object class is reported for each object. This allows the manager to determine whether the class of the object being specified is a numeric, real time sample array, enumeration, scanner, or PM-store class.

— The attributes of the object. Each object has attributes that represent and convey information on the physical agent and its data sources. Each object has a Handle attribute that identifies the object instance within an agent. Attribute values are accessed and modified using methods such as GET and SET. Attribute types are defined using ASN.1. The ASN.1 definitions for new attribute types specific to this standard are in Annex B, and the ASN.1 definitions for existing attribute types referenced in this standard are in IEEE Std 11073-20601.

— The methods available on the object.

— The potential events generated by the object. Data are sent to the manager using events.

— The available services such as getting or setting attributes.

The attributes for each class are defined in tables that specify the name of the attribute, its value, and its qualifier. The qualifiers mean M – Attribute is Mandatory, C – Attribute is Conditional and depends on the condition stated in the Remark or Value column (if IEEE Std 11073-20601 is referenced, then it contains the conditions), R – Attribute is Recommended, NR – Attribute is Not Recommended, and O – Attribute is Optional. Mandatory attributes shall be implemented by an agent. Conditional attributes shall be implemented if the condition applies and may be implemented otherwise. Recommended attributes should be implemented by the agent. Not recommended attributes should not be implemented by the agent. Optional attributes may be implemented by the agent.

The attributes can be either static, meaning that they shall remain unchanged after the configuration is agreed upon, or dynamic, meaning that the attribute may change at some point after configuration.

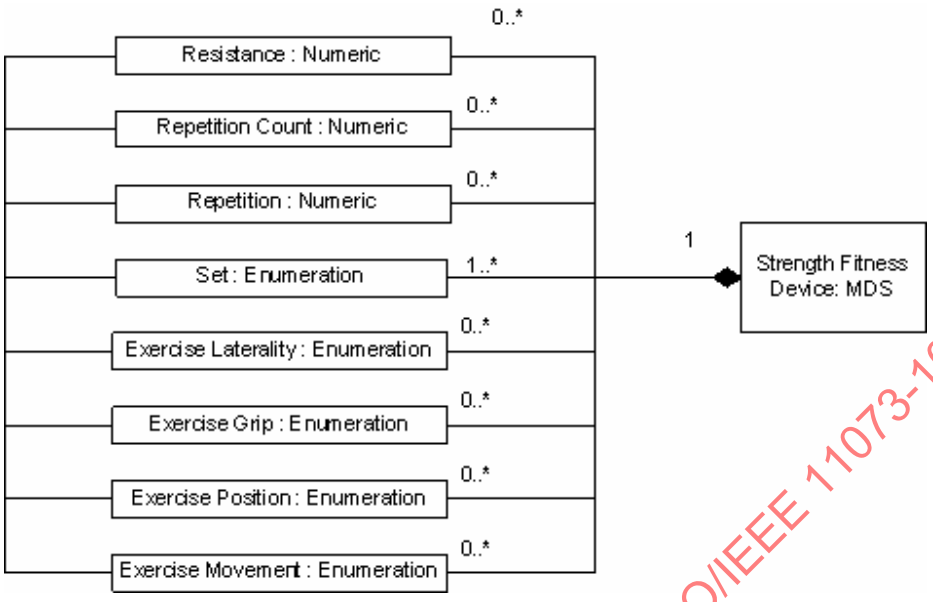

Figure 1—Object containment diagram

6.4 Types of configuration

6.4.1 General

As specified in IEEE Std 11073-20601, there are two styles of configuration available. Subclauses 6.4.2 and 6.4.3 briefly introduce standard and extended configurations.

6.4.2 Standard configuration

This standard does not define any standard configurations since the set of sensors for each agent configuration is likely to vary significantly for each deployment scenario. Therefore, all configurations shall be specified as extended configurations.

6.4.3 Extended configuration

In extended configurations, the agent's configuration is not predefined in a standard. The agent determines which objects, attributes, and values that it wants to use in a configuration and assigns a configuration identifier. When the agent associates with a manager, it negotiates an acceptable configuration. Typically, the manager does not recognize the agent's configuration on the first connection, so the manager responds that the agent must send its configuration information as a configuration event report. If, however, the manager already understands the configuration, either because it was preloaded in some way or the agent had previously associated with the manager, then the manager responds that the configuration is known and no further configuration information needs to be sent.

6.5 Medical device system object

6.5.1 MDS object attributes

Table 1 summarizes the attributes of the strength fitness MDS object. The nomenclature code to identify the MDS object class is MDC_MOC_VMS_MDS_SIMP.

Table 1—MDS object attributes

Attribute name	Value	Qual.
Handle	0	M
System-Type-Spec-List	MDC_DEV_SPEC_PROFILE_HF_STRENGTH (OID--Type) 1 (version).	M
System-Model	{"Manufacturer", "Model"}.	M
System-Id	See IEEE Std 11073-20601.	M
Dev-Configuration-Id	0x4000--0x7FFF.	M
Attribute-Value-Map	See IEEE Std 11073-20601.	C
Production-Specification	See IEEE Std 11073-20601.	O
Mds-Time-Info	See IEEE Std 11073-20601.	C
Date-and-Time	See IEEE Std 11073-20601.	C
Relative-Time	See IEEE Std 11073-20601.	C
HiRes-Relative-Time	See IEEE Std 11073-20601.	C
Date-and-Time-Adjustment	See IEEE Std 11073-20601.	C
Power-Status	onBattery or onMains.	R
Battery-Level	See IEEE Std 11073-20601.	R
Remaining-Battery-Time	See IEEE Std 11073-20601.	R
Reg-Cert-Data-List	See IEEE Std 11073-20601.	O
System-Type-Spec-List	{MDC_DEV_SPEC_PROFILE_HF_STRENGTH, 1}.	M
Confrim-Timeout	See IEEE Std 11073-20601.	O

NOTE—See IEEE Std 11073-20601 for information on whether an attribute is static or dynamic.

In the response to a Get MDS object command, only implemented attributes and their corresponding values are returned.

See IEEE Std 11073-20601 for descriptive explanations of the individual attributes as well as for information on attribute ID and attribute type.

The Dev-Configuration-Id attribute holds a locally unique 16-bit identifier that identifies the device configuration. For a strength fitness agent, this identifier is chosen in the range of extended-config-start to extended-config-end (see IEEE Std 11073-20601) as shown in Table 1.

The agent sends the Dev-Configuration-Id during the Associating state (see 8.3) to identify its configuration for the duration of the association. If the manger already holds the configuration information relating to the Dev-Configuration-Id, it recognizes the Dev-Configuration-Id. Then the Configuration state (see 8.4) is skipped, and the agent and manager enter the Operating state. If the manager does not recognize the Dev-Configuration-Id, the agent and manger enter the Configuring state.

If an agent implements multiple IEEE 11073-104zz specializations System-Type-Spec-List is a list of type/version pairs each referencing the respective device specialization and version of that specialization.

6.5.2 MDS object methods

Table 2 defines the methods (actions) of the MDS object. These methods are invoked using the Action service. In Table 2, the Subservice type name column defines the name of the method; the Mode column defines whether the method is invoked as an unconfirmed action (i.e., roiv-cmip-action from IEEE Std 11073-20601) or a confirmed action (i.e., roiv-cmip-confirmed-action); the Subservice type (action-type) column defines the nomenclature code to use in the action-type field of an action request and response (see IEEE Std 11073-20601); the Parameters (action-info-args) column defines the associated ASN.1 data structure (see IEEE Std 11073-20601 and ASN.1 definitions) to use in the action message for the action-info-args field of the request; and the Results (action-info-args) column defines the structure to use in the action-info-args of the response.

Table 2—MDS object methods

Service	Subservice type name	Mode	Subservice type (action-type)	Parameters (action-info-args)	Results (action-info-args)
ACTION	Set-Time	Confirmed	MDC_ACT_SET_TIME	SetTimeInvoke	—

Set-Time
This method allows the manager to set a real-time clock in the agent with the absolute time. The agent indicates whether the Set-Time command is valid using the mds-time-capab-set-clock bit in the Mds-Time-Info attribute (see IEEE Std 11073-20601). Agents with an internal real-time clock (RTC) shall indicate this capability by also setting the mds-time-capab-real-time-clock bit in the Mds-Time-Info attribute.

Agents following only this device specialization and no others shall send event reports using agent initiated measurement data transmission. Agents following this device specialization as well as others shall send event reports in the appropriate fashion. During the association procedure (see 8.3), DataReqModeCapab shall be set to the appropriate value for the event report style. As a result, the manager shall assume the agent does not support any of the MDS-Data-Request features (see IEEE Std 11073-20601 for additional information). Thus, implementation of the MDS-Data-Request method/action is not required in this standard and is not shown in Table 2.

6.5.3 MDS object events

Table 3 defines the events that can be sent by the strength fitness MDS object.

Table 3—MDS object events

Service	Subservice type name	Mode	Subservice type (event-type)	Parameters (event-info)	Results (event-reply-info)
EVENT REPORT	MDS-Configuration-Event	Confirmed	MDC_NOTI_CONFIG	ConfigReport	ConfigReportRsp
	MDS-Dynamic-Data-Update-Var	Confirmed	MDC_NOTI_SCAN_REPORT_VAR	ScanReportInfoVar	—
	MDS-Dynamic-Data-Update-Fixed	Confirmed	MDC_NOTI_SCAN_REPORT_FIXED	ScanReportInfoFixed	—
	MDS-Dynamic-Data-Update-MP-Var	Confirmed	MDC_NOTI_SCAN_REPORT_MP_VAR	ScanReportInfoMPVar	—
	MDS-Dynamic-Data-Update-MP-Fixed	Confirmed	MDC_NOTI_SCAN_REPORT_MP_FIXED	ScanReportInfoMPFixed	—

— **MDS-Configuration-Event:**
This event is sent by the agent during the configuring state of start up if the manager does not already know the agent's configuration from past associations. The event provides static information about the supported measurement capabilities of the agent.

— **MDS-Dynamic-Data-Update-Var:**
This event provides dynamic measurement data from agent. These data are reported using a generic attribute list variable format. The event is sent as an unsolicited message by the agent (i.e., an agent-initiated measurement data transmission). See 8.5.3 for more information on unsolicited event reporting.

— **MDS-Dynamic-Data-Update-Fixed:**
This event provides dynamic measurement data from the agent. These data are reported in the fixed format defined by the Attribute-Value-Map attribute of the relevant metric objects.

The event is sent as an unsolicited message by the agent (i.e., an agent-initiated measurement data transmission). See 8.5.3 for more information on unsolicited event reporting.

— **MDS-Dynamic-Data-Update-MP-Var:**
This is the same as MDS-Dynamic-Data-Update-Var but allows inclusion of data from multiple people.

— **MDS-Dynamic-Data-Update-MP-Fixed:**
This is the same as MDS-Dynamic-Data-Update-Fixed but allows inclusion of data from multiple people.

NOTE—IEEE Std 11073-20601 requires that managers support all of the MDS object events listed above.

6.5.4 Other MDS services

6.5.4.1 GET service

A strength fitness agent shall support the GET service, which is provided by the MDS object to retrieve the values of all implemented MDS object attributes. The GET service can be invoked as soon as the agent receives the Association Response and moves to the Associated state, including the Operating and Configuring substates.

The manager may request the MDS object attributes of the agent, in which the manager shall send the "Remote Operation Invoke | Get" message (see roiv-cmip-get in IEEE Std 11073-20601) with the reserved MDS handle value of 0. The agent shall report its MDS object attributes to the manager using the "Remote Operation Response | Get" message (see rors-cmip-get in IEEE Std 11073-20601). See Table 4 for a summary of the GET service including some message fields.

Table 4—MDS object GET service

Service	Subservice type name	Mode	Subservice type	Parameters	Results
GET	<na>	<implied confirmed>	<na>	GetArgumentSimple = (obj-handle = 0), attribute-id-list *<optional>*	GetResultSimple = (obj-handle = 0), attribute-list

See 8.5.2 for details on the procedure for getting the MDS object attributes.

6.5.4.2 SET service

The strength fitness specialization does not require an implementation to support the MDS object SET service.

6.6 Numeric objects

6.6.1 General

6.6.1.1 Definitions

The numeric objects listed in this subclause represent the numeric observations that can be produced by a strength fitness agent. The nomenclature code to identify a numeric object class is MDC_MOC_VMO_METRIC_NU. Each object specifies how each of the attributes are to be used, but there are some concepts that apply to each numeric in a general fashion that are described in subclauses 6.6.1.2 through 6.6.1.5.

6.6.1.2 Dependent attributes

Sometimes, the interpretation of one attribute value in an object depends on other attribute values in the same object. For example, Unit-Code and Unit-Label-String provide context for the observed values. Whenever a contextual attribute changes, the agent shall report these changes to the manager using an MDS object event (see 6.5.3) prior to reporting any of the dependent values.

6.6.1.3 Methods

The objects listed in this clause do not support any methods.

6.6.1.4 Events

The objects listed in this clause do not support any events.

6.6.1.5 Services

The objects listed in this clause do not support any services.

6.6.2 Repetition count

Table 5 defines the attributes for the object that represents the number of repetitions completed in the set. The object may be supported by the agent.

Table 5—Repetition count attributes

Attribute name	Value	Qual.
Handle	See IEEE Std 11073-20601.	M
Type	MDC_PART_PHD_HF | MDC_HF_REP_COUNT.	M
Supplemental-Types	See IEEE Std 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent | mss-avail-stored-data | mss-updt-aperiodic | mss-msmt-aperiodic | mss-acc-agent-initiated.	M
Metric-Structure-Small	See IEEE Std 11073-20601.	NR
Measurement-Status	See IEEE Std 11073-20601.	O
Metric-Id	See IEEE Std 11073-20601.	O
Metric-Id-List	See IEEE Std 11073-20601.	C
Metric-Id-Partition	See IEEE Std 11073-20601.	O
Unit-Code	See IEEE Std 11073-20601.	O
Attribute-Value-Map	See IEEE Std 11073-20601.	C
Source-Handle-Reference	See IEEE Std 11073-20601.	M
Label-String	See IEEE Std 11073-20601.	O
Unit-LabelString	See IEEE Std 11073-20601.	O
Absolute-Time-Stamp	See IEEE Std 11073-20601.	C
Relative-Time-Stamp	See IEEE Std 11073-20601.	C
HiRes-Time-Stamp	See IEEE Std 11073-20601.	C
Simple-Nu-Observed-Value	See IEEE Std 11073-20601.	C
Compound-Simple-Nu-Observed-Value	See IEEE Std 11073-20601.	NR
Basic-Nu-Observed-Value	See IEEE Std 11073-20601.	C
Compound-Basic-Nu-Observed-Value	See IEEE Std 11073-20601.	NR
Nu-Observed-Value	See IEEE Std 11073-20601.	C
Compound-Nu-Observed-Value	See IEEE Std 11073-20601.	NR
Accuracy	See IEEE Std 11073-20601.	O
Measure-Active-Period	See IEEE Std 11073-20601.	O

NOTE—See IEEE Std 11073-20601 for information on whether an attribute is static or dynamic.

The observed value reported in this object is the number of repetitions completed for a set. Only non-negative whole values shall be used, with zero (0) indicating that no repetitions were completed.

The Source-Handle-Reference attribute shall be valued with the handle of the set object to which this object is associated. Additionally, this object shall use the same timestamp attribute and value as the associated set object.

6.6.3 Resistance

Table 6 defines the attributes for the object that represents the resistance used for the set. The object may be supported by the agent.

Table 6—Resistance attributes

Attribute name	Value	Qual.
Handle	See IEEE Std 11073-20601.	M
Type	MDC_PART_PHD_HF | MDC_HF_RESISTANCE.	M
Supplemental-Types	See IEEE Std 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent | mss-avail-stored-data | mss-updt-aperiodic | mss-msmt-aperiodic | mss-acc-agent-initiated.	M
Metric-Structure-Small	See IEEE Std 11073-20601.	NR
Measurement-Status	See IEEE Std 11073-20601.	O
Metric-Id	See IEEE Std 11073-20601.	O
Metric-Id-List	See IEEE Std 11073-20601.	C
Metric-Id-Partition	See IEEE Std 11073-20601.	O
Unit-Code	Valid values are limited to MDC_DIM_DIMLESS, MDC_DIM_X_G or MDC_DIM_LB.	M
Attribute-Value-Map	See IEEE Std 11073-20601.	C
Source-Handle-Reference	See IEEE Std 11073-20601.	M
Label-String	See IEEE Std 11073-20601.	O
Unit-LabelString	See IEEE Std 11073-20601.	O
Absolute-Time-Stamp	See IEEE Std 11073-20601.	C
Relative-Time-Stamp	See IEEE Std 11073-20601.	C
HiRes-Time-Stamp	See IEEE Std 11073-20601.	C
Simple-Nu-Observed-Value	See IEEE Std 11073-20601.	C
Compound-Simple-Nu-Observed-Value	See IEEE Std 11073-20601.	NR
Basic-Nu-Observed-Value	See IEEE Std 11073-20601.	C
Compound-Basic-Nu-Observed-Value	See IEEE Std 11073-20601.	NR
Nu-Observed-Value	See IEEE Std 11073-20601.	C
Compound-Nu-Observed-Value	See IEEE Std 11073-20601.	NR
Accuracy	See IEEE Std 11073-20601.	O
Measure-Active-Period	See IEEE Std 11073-20601.	O

NOTE—See IEEE Std 11073-20601 for information on whether an attribute is static or dynamic.

The observed value reported in this object is the resistance setting for a set. Only non-negative values shall be used, with zero (0) indicating that no resistance was used. When the resistance is measured in weight, either MDC_DIM_X_G or MDC_DIM_LB shall be used for the Unit-Code attribute. If resistance is measured in an indexed value, such as setting 1, 2, 3, etc., or some other unit, then the MDC_DIM_DIMLESS shall be used with, optionally, the Unit-Label-String attribute providing additional information as needed.

The Source-Handle-Reference attribute shall be valued with the handle of the set object to which this object is associated. Additionally, this object shall use the same timestamp attribute and value as the associated set object.

6.6.4 Repetition

Table 7 defines the attributes for the object that represents a repetition in a set. The object may be supported by the agent.

Table 7—Repetition attributes

Attribute name	Value	Qual.
Handle	See IEEE Std 11073-20601.	M
Type	MDC_PART_PHD_HF | MDC_HF_REPETITION.	M
Supplemental-Types	See IEEE Std 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent | mss-avail-stored-data | mss-updt-aperiodic | mss-msmt-aperiodic | mss-acc-agent-initiated	M
Metric-Structure-Small	See IEEE Std 11073-20601.	NR
Measurement-Status	See IEEE Std 11073-20601.	O
Metric-Id	See IEEE Std 11073-20601.	O
Metric-Id-List	See IEEE Std 11073-20601.	C
Metric-Id-Partition	See IEEE Std 11073-20601.	O
Unit-Code	Valid values are MDC_DIM_X_M, MDC_DIM_X_INCH.	M
Attribute-Value-Map	See IEEE Std 11073-20601.	C
Source-Handle-Reference	See IEEE Std 11073-20601.	M
Label-String	See IEEE Std 11073-20601.	O
Unit-LabelString	See IEEE Std 11073-20601.	O
Absolute-Time-Stamp	See IEEE Std 11073-20601.	C
Relative-Time-Stamp	See IEEE Std 11073-20601.	C
HiRes-Time-Stamp	See IEEE Std 11073-20601.	C
Simple-Nu-Observed-Value	See IEEE Std 11073-20601.	C
Compound-Simple-Nu-Observed-Value	See IEEE Std 11073-20601.	NR
Basic-Nu-Observed-Value	See IEEE Std 11073-20601.	C
Compound-Basic-Nu-Observed-Value	See IEEE Std 11073-20601.	NR
Nu-Observed-Value	See IEEE Std 11073-20601.	C
Compound-Nu-Observed-Value	See IEEE Std 11073-20601.	NR
Accuracy	See IEEE Std 11073-20601.	O
Measure-Active-Period	See IEEE Std 11073-20601.	O

NOTE—See IEEE Std 11073-20601 for information on whether an attribute is static or dynamic.

The observed value reported in this object is the distance traveled during the repetition, measured as the distance moved from the starting position (i.e., the one-way distance, not the roundtrip cumulative distance). Only non-negative values shall be used. The Measure-Active-Period may be used to specify the amount of time taken to complete the repetition.

The Source-Handle-Reference shall be valued with the handle of the set object to which this object is associated. Additionally, this object shall use the same timestamp attribute as the associated set object.

If the related set object has a Measure-Active-Period defined, the timestamp for this object shall fall within the time range defined by the associated set object's timestamp attribute and shall last for the Measure-Active-Period defined by the related set object's Measure-Active-Period attribute. Additionally, if the repetition object specifies a Measure-Active-Period, the time period defined by the repetition object shall fall completely within the time range defined by the associated set object.

6.7 Real-time sample array objects

Real-time sample array objects are not required by this standard.

6.8 Enumeration objects

6.8.1 General

6.8.1.1 Definitions

The enumeration objects listed in this clause represent the enumeration observations that can be produced by a strength fitness agent. The nomenclature code used to identify an enumeration object class is MDC_MOC_VMO_METRIC_ENUM. Each object specifies how each of the attributes should be used, but there are some concepts that apply to each enumeration in a general fashion that are described here.

6.8.1.2 Methods

The objects listed in this clause do not support any methods.

6.8.1.3 Events

The objects listed in this clause do not support any events.

6.8.1.4 Services

The objects listed in this clause do not support any services.

6.8.2 Set

Table 8 defines the attributes for the object that represents a set. The agent shall include one instance of this object for each measurement period reported.

Table 8—Set attributes

Attribute name	Value	Qual.
Handle	See IEEE Std 11073-20601.	M
Type	MDC_PART_PHD_HF | MDC_HF_SET.	M
Supplemental-Types	See IEEE Std 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent | mss-avail-stored-data | mss-updt-aperiodic | mss-msmt-aperiodic | mss-acc-agent-initiated.	M
Metric-Structure-Small	See IEEE Std 11073-20601.	NR
Measurement-Status	See IEEE Std 11073-20601.	O
Metric-Id	See IEEE Std 11073-20601.	O
Metric-Id-List	See IEEE Std 11073-20601.	C
Metric-Id-Partition	See IEEE Std 11073-20601.	O
Unit-Code	See IEEE Std 11073-20601.	O
Attribute-Value-Map	See IEEE Std 11073-20601.	C
Source-Handle-Reference	See IEEE Std 11073-20601.	NR
Label-String	See IEEE Std 11073-20601.	O
Unit-LabelString	See IEEE Std 11073-20601.	O
Absolute-Time-Stamp	See IEEE Std 11073-20601.	C
Relative-Time-Stamp	See IEEE Std 11073-20601.	C
HiRes-Time-Stamp	See IEEE Std 11073-20601.	C
Measure-Active-Period	See IEEE Std 11073-20601.	C
Enum-Observed-Value-Simple-Oid	Valid values are limited to MDC_MUSC_*.	M
Enum-Observed-Value-Simple-Bit-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Basic-Bit-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Simple-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Partition	MDC_PART_SITES.	M

NOTE—See IEEE Std 11073-20601 for information on whether an attribute is static or dynamic.

The purpose of this object is to define the set at a high level by specifying the muscle group engaged, the date and time of the exercise, and how much time was spent in the activity. This object defines the context for all the objects associated with it.

The muscle group being engaged is defined in the Enum-Observed-Value-Simple-Oid attribute.

The duration of the set, if known, shall be specified in the Measure-Active-Period attribute.

6.8.3 Exercise position

Table 9 defines the attributes for the object that represents the user position employed for the exercise defined in the associated set object. This object may be supported by the agent.

Table 9—Exercise position attributes

Attribute name	Value	Qual.
Handle	See IEEE Std 11073-20601.	M
Type	MDC_PART_PHD_HF | MDC_HF_EXERCISE_POSITION.	M
Supplemental-Types	See IEEE Std 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent | mss-avail-stored-data | mss-updt-aperiodic | mss-msmt-aperiodic | mss-acc-agent-initiated.	M
Metric-Structure-Small	See IEEE Std 11073-20601.	NR
Measurement-Status	See IEEE Std 11073-20601.	O
Metric-Id	See IEEE Std 11073-20601.	O
Metric-Id-List	See IEEE Std 11073-20601.	C
Metric-Id-Partition	See IEEE Std 11073-20601.	O
Unit-Code	See IEEE Std 11073-20601.	O
Attribute-Value-Map	See IEEE Std 11073-20601.	C
Source-Handle-Reference	See IEEE Std 11073-20601.	M
Label-String	See IEEE Std 11073-20601.	O
Unit-LabelString	See IEEE Std 11073-20601.	O
Absolute-Time-Stamp	See IEEE Std 11073-20601.	C
Relative-Time-Stamp	See IEEE Std 11073-20601.	C
HiRes-Time-Stamp	See IEEE Std 11073-20601.	C
Measure-Active-Period	See IEEE Std 11073-20601.	O
Enum-Observed-Value-Simple-Oid	Valid values are limited to MDC_HF_POSITION_*.	M
Enum-Observed-Value-Simple-Bit-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Basic-Bit-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Simple-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Partition	See IEEE Std 11073-20601.	NR

NOTE—See IEEE Std 11073-20601 for information on whether an attribute is static or dynamic.

The purpose of this object is to define the position of the exerciser when performing the exercise defined in the associated set. The position is defined in the Enum-Observed-Value-Simple-Oid attribute. This object's timestamp shall be equal to the timestamp of the associated set object. Additionally, the timestamp attribute used for an exercise position object instance shall be the same as that which is used for the set object instance to which it is related. The Source-Handle-Reference attribute shall be equal to the handle of the associated set object.

6.8.4 Exercise laterality

Table 10 defines the attributes for the object that represents laterality of the exercise defined in the set. This object may be supported by the agent.

Table 10—Exercise laterality attributes

Attribute name	Value	Qual.
Handle	See IEEE Std 11073-20601.	M
Type	MDC_PART_PHD_HF | MDC_HF_EXERCISE_LATERALITY.	M
Supplemental-Types	See IEEE Std 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent | mss-avail-stored-data | mss-updt-aperiodic | mss-msmt-aperiodic | mss-acc-agent-initiated.	M
Metric-Structure-Small	See IEEE Std 11073-20601.	NR
Measurement-Status	See IEEE Std 11073-20601.	O
Metric-Id	See IEEE Std 11073-20601.	O
Metric-Id-List	See IEEE Std 11073-20601.	C
Metric-Id-Partition	See IEEE Std 11073-20601.	O
Unit-Code	See IEEE Std 11073-20601.	O
Attribute-Value-Map	See IEEE Std 11073-20601.	C
Source-Handle-Reference	See IEEE Std 11073-20601.	M
Label-String	See IEEE Std 11073-20601.	O
Unit-LabelString	See IEEE Std 11073-20601.	O
Absolute-Time-Stamp	See IEEE Std 11073-20601.	C
Relative-Time-Stamp	See IEEE Std 11073-20601.	C
HiRes-Time-Stamp	See IEEE Std 11073-20601.	C
Measure-Active-Period	See IEEE Std 11073-20601.	O
Enum-Observed-Value-Simple-Oid	Valid values are limited to MDC_HF_LATERALITY_*.	M
Enum-Observed-Value-Simple-Bit-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Basic-Bit-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Simple-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Partition	See IEEE Std 11073-20601.	NR

NOTE—See IEEE Std 11073-20601 for information on whether an attribute is static or dynamic.

The purpose of this object is to define whether the user employed their left, right, or both sides when performing the exercise defined in the associated set. The laterality is defined in the Enum-Observed-Value-Simple-Oid attribute. This object's timestamp shall be equal to the timestamp of the associated set object. Additionally, the timestamp attribute used for an exercise modifier object instance shall be the same as that which is used for the set object instance to which it is related. The Source-Handle-Reference attribute shall be equal to the handle of the associated set object.

6.8.5 Exercise grip

Table 11 defines the attributes for the object that represents the grip employed in the performance of the exercise defined in the associated set. This object may be supported by the agent.

Table 11—Exercise grip attributes

Attribute name	Value	Qual.
Handle	See IEEE Std 11073-20601.	M
Type	MDC_PART_PHD_HF | MDC_HF_EXERCISE_GRIP.	M
Supplemental-Types	See IEEE Std 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent | mss-avail-stored-data | mss-updt-aperiodic | mss-msmt-aperiodic | mss-acc-agent-initiated.	M
Metric-Structure-Small	See IEEE Std 11073-20601.	NR
Measurement-Status	See IEEE Std 11073-20601.	O
Metric-Id	See IEEE Std 11073-20601.	O
Metric-Id-List	See IEEE Std 11073-20601.	C
Metric-Id-Partition	See IEEE Std 11073-20601.	O
Unit-Code	See IEEE Std 11073-20601.	O
Attribute-Value-Map	See IEEE Std 11073-20601.	C
Source-Handle-Reference	See IEEE Std 11073-20601.	M
Label-String	See IEEE Std 11073-20601.	O
Unit-LabelString	See IEEE Std 11073-20601.	O
Absolute-Time-Stamp	See IEEE Std 11073-20601.	C
Relative-Time-Stamp	See IEEE Std 11073-20601.	C
HiRes-Time-Stamp	See IEEE Std 11073-20601.	C
Measure-Active-Period	See IEEE Std 11073-20601.	O
Enum-Observed-Value-Simple-Oid	Valid values are limited to MDC_HF_GRIP_*.	M
Enum-Observed-Value-Simple-Bit-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Basic-Bit-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Simple-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Partition	See IEEE Std 11073-20601.	NR

NOTE—See IEEE Std 11073-20601 for information on whether an attribute is static or dynamic.

The purpose of this object is to define the grip employed by the exerciser when performing the exercise defined in the associated set. The grip is defined in the Enum-Observed-Value-Simple-Oid attribute. This object's timestamp shall be equal to the timestamp of the associated set object. Additionally, the timestamp attribute used for an exercise grip object instance shall be the same as that which is used for the set object

instance to which it is related. The Source-Handle-Reference attribute shall be equal to the handle of the associated set object.

6.8.6 Exercise movement

Table 12 defines the attributes for the object that represents the movement employed during the exercise defined in the set. This object may be supported by the agent.

Table 12—Exercise movement attributes

Attribute name	Value	Qual.
Handle	See IEEE Std 11073-20601.	M
Type	MDC_PART_PHD_HF | MDC_HF_EXERCISE_MOVEMENT.	M
Supplemental-Types	See IEEE Std 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent | mss-avail-stored-data | mss-updt-aperiodic | mss-msmt-aperiodic | mss-acc-agent-initiated.	M
Metric-Structure-Small	See IEEE Std 11073-20601.	NR
Measurement-Status	See IEEE Std 11073-20601.	O
Metric-Id	See IEEE Std 11073-20601.	O
Metric-Id-List	See IEEE Std 11073-20601.	C
Metric-Id-Partition	See IEEE Std 11073-20601.	O
Unit-Code	See IEEE Std 11073-20601.	O
Attribute-Value-Map	See IEEE Std 11073-20601.	C
Source-Handle-Reference	See IEEE Std 11073-20601.	O
Label-String	See IEEE Std 11073-20601.	O
Unit-LabelString	See IEEE Std 11073-20601.	O
Absolute-Time-Stamp	See IEEE Std 11073-20601.	C
Relative-Time-Stamp	See IEEE Std 11073-20601.	C
HiRes-Time-Stamp	See IEEE Std 11073-20601.	C
Measure-Active-Period	See IEEE Std 11073-20601.	O
Enum-Observed-Value-Simple-Oid	Valid values are limited to MDC_HF_MOVEMENT_*.	M
Enum-Observed-Value-Simple-Bit-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Basic-Bit-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Simple-Str	See IEEE Std 11073-20601.	NR
Enum-Observed-Value	See IEEE Std 11073-20601.	NR
Enum-Observed-Value-Partition	See IEEE Std 11073-20601.	NR

NOTE—See IEEE Std 11073-20601 for information on whether an attribute is static or dynamic.

The purpose of this object is to specify the movement used in the exercise being performed in the associated set. The exercise movement is defined in the Enum-Observed-Value-Simple-Oid attribute.

This object's timestamp shall be equal to the timestamp of the associated set object. Additionally, the timestamp attribute used for an exercise movement object instance shall be the same as that which is used for the set object instance to which it is associated. The Source-Handle-Reference attribute shall be equal to the handle of the associated set object.

6.9 PM-store objects

PM-store objects are not required by this standard.

6.10 Scanner objects

Scanner objects are not required by this standard.

6.11 Strength fitness information model extensibility rules

Beyond the information model as specified in this standard, the device designer may include other vendor-specific metrics and attributes if required. However, any metric or attribute that is implemented should follow the guidelines of this standard as closely as possible.

7. Strength fitness service model

7.1 General

The service model defines the conceptual mechanisms for data exchange services. These services are mapped to messages that are exchanged between the agent and the manager. Protocol messages within the ISO/IEEE 11073 series of standards are defined in ASN.1. See IEEE Std 11073-20601 for a detailed description of the personal health device service model. Subclauses 7.2 through 7.3 define the specifics of object access and event reporting services for a strength fitness agent according to this standard.

7.2 Object access services

The object access services of IEEE Std 11073-20601 are used to access the information objects defined in the domain information model of the strength fitness agent.

The following generic object access services are supported by a strength fitness agent according to this standard:

- GET service: used by the manager to retrieve the values of the agent MDS object attributes. The list of MDS object attributes is given in 6.5.1.
- SET service: used by the manager to set the values of the agent object attributes. There are no settable attributes defined for a strength fitness agent according to this standard.
- Event report service: used by the agent to send configuration reports and measurement data to the manager. The list of event reports for the strength fitness device specialization is given in 6.5.3.
- Action service: used by the manager to invoke actions (or methods) supported by the agent. An example is Set-Time action, which is used to set a real-time clock with the absolute time at the agent.

Table 13 summarizes the object access services supported by the strength fitness equipment object access model.

Table 13—Strength fitness MDS object events

Service	Subservice type name	Mode	Subservice Type	Parameters	Result	Remarks
GET	<na>	<implied Confirmed>	<na>	GetArgumentSimple = (obj-handle = 0), attribute-id-list *<optional>*	GetResultSimple = (obj-handle = 0), attribute-list	Allows the manager to retrieve the value of an attribute of an object in the agent.
EVENT REPORT	MDS-Configuration-Event	Confirmed	MDC_NOTI_CONFIG	ConfigReport	ConfigReportRsp	Configuration report to inform manager of the configuration of the agent.
	MDS-Dynamic-Data-Update-Var	Confirmed	MDC_NOTI_SCAN_REPORT_VAR	ScanReportInfoVar	—	Data report to provide dynamic data to manager for some or all of the agent's objects in variable format.
	MDS-Dynamic-Data-Update-Fixed	Confirmed	MDC_NOTI_SCAN_REPORT_FIXED	ScanReportInfoFixed	—	Data report to provide dynamic data to manager for some or all of the agent's objects in fixed format.
	MDS-Dynamic-Data-Update-MP-Var	Confirmed	MDC_NOTI_SCAN_REPORT_MP_VAR	ScanReportInfoMPVar	—	This is the same as MDS-Dynamic-Data-Update-Var but allows inclusion of data from multiple people.
	MDS-Dynamic-Data-Update-MP-Fixed	Confirmed	MDC_NOTI_SCAN_REPORT_MP_FIXED	ScanReportInfoMPFixed	—	This is the same as MDS-Dynamic-Data-Update-Fixed but allows inclusion of data from multiple people.
ACTION	Set-Time	Confirmed	MDC_ACT_SET_TIME	SetTimeInvoke	—	Manager method to invoke the agent to set time to requested value.

7.3 Object access event report services

The event report service (see Table 13) is used by the agent to report its information (e.g., measurements). Event reports in this standard are a property of the MDS object only. The event reports used in this standard are defined in detail in IEEE Std 11073-20601.

The following conditions apply for a strength fitness agent according to this standard:

— Event reports shall be used in confirmed mode.

— Agent-initiated mode shall be supported for measurement data transmission.

An agent designed to operate in an environment where data may be collected from multiple people may use one of the multiple-person event report styles to transmit all the data from each person in a single event. If this functionality is not required, the agent may use the single-person event report styles, which have reduced overhead.

A manager shall support both single-person and multiple-person event reports. A strength fitness agent may support either one or both single-person and multiple-person event reports. The formats for single and multiple person reports are described in IEEE Std 11073-20601.

8. Strength fitness communication model

8.1 Overview

This clause describes the general communication model and procedures of the strength fitness agent with respect to the general communication model and procedures as defined in IEEE Std 11073-20601. Therefore, the respective parts of IEEE Std 11073-20601 are not reproduced, but rather the specific choices and restrictions with respect to optional elements (e.g., attributes, and procedures) and specific extensions (e.g., nomenclature terms) are specified.

For an illustrative overview of the various message transactions during a typical measurement period, see the sequence diagram for the example use case in Annex D and the corresponding protocol data unit (PDU) examples in Annex E.

8.2 Communications characteristics

This standard defines no additional constraints on the communication characteristics defined in EEE Std 11073-20601.

8.3 Association procedure

8.3.1 General

Unless otherwise stated, the association procedure for a strength fitness agent and manager according to this standard shall be pursued as specified in IEEE Std 11073-20601.

8.3.2 Agent procedure—association request

In the association request sent by the agent to the manager:

— The version of the association procedure used by the agent shall be set to the assoc-version1 (i.e., *assoc-version* = 0x80000000).

— The DataProtoList structure element of the data protocol identifier shall be set to data-proto-id-20601 (i.e., *data-proto-id* = 0x5079).

— The *data-proto-info* field shall contain a PhdAssociationInformation structure that shall contain the following parameter values:

1) The version of the data exchange protocol shall be set to protocol-version1 (i.e., *protocol-version* = 0x80000000).
2) At least the MDER shall supported (i.e., *encoding-rules* = 0x8000).
3) The version of the nomenclature used shall be set to nom-version1 (i.e., *nomenclature-version* = 0x80000000).
4) The field *functional-units* may have the test association bits set but shall not have any other bits set.
5) The field *system-type* shall be set to sys-type-agent (i.e., *system-type* = 0x00800000).
6) The *system-id* field shall be set to the value of the System-Id attribute of the MDS object of the agent. The manager may use this field to determine the identity of the agent with which it is associating and, optionally, to implement a simple access restriction policy.
7) The *dev-config-id* field shall be set to the value of the Dev-Configuration-Id attribute of the MDS object of the agent.
8) If the agent supports only the strength fitness specialization, then the field indicating the data request modes (*data-req-mode-capab*) supported by the strength fitness agent shall be set to *data-req-supp-init-agent*.
9) If the agent supports only the strength fitness specialization, then the *data-req-init-manager-count* shall be set to zero, and the *data-req-init-agent-count* shall be set to 1.

8.3.3 Manager procedure—association response

In the association response message sent by the manager:

— The *result* field shall be set to an appropriate response from those defined in IEEE Std 11073-20601. For example, if all other conditions of the association protocol are satisfied, accepted is returned when the manager recognizes the *dev-config-id* of the agent and accepted-unknown-config otherwise.

— In the DataProtoList structure element, the data protocol identifier shall be set to data-proto-id-20601 (i.e., *data-proto-id* = 0x5079).

The *data-proto-info* field shall be filled in with a PhdAssociationInformation structure which shall contain the following parameter values:

1) The version of the data exchange protocol shall be set to protocol-version1 (i.e., *protocol-version* = 0x80000000).
2) The manager shall respond with a single selected encoding rule that is supported by both agent and manager. The manager shall support at least the MDER.
3) The version of the nomenclature used shall be set to nom-version1 (i.e., *nomenclature-version* = 0x80000000).
4) The field *functional-units* shall have all bits reset except for those relating to a test association.
5) The field *system-type* shall be set to sys-type-manager (i.e., *system-type* = 0x80000000).

6) The *system-id* field shall contain the unique system id of the manager device, which shall be a valid extended unique identifier (64 bits) (EUI-64) type identifier.
7) The field *dev-config-id* shall be manager-config-response (0).
8) The field *data-req-mode-capab* shall be 0.
9) The field *data-req-init-** count shall be 0.

8.4 Configuring procedure

The agent enters the Configuring state if it receives an association response of accepted-unknown-config. In this case, the configuration procedure as specified in IEEE Std 11073-20601 shall be followed.

8.5 Operating procedure

8.5.1 General

The communication of data and status information about the strength fitness agent occurs during the operating state. If not stated otherwise, the operating procedure for a strength fitness agent according to this standard shall be pursued as specified in IEEE Std 11073-20601.

8.5.2 GET strength fitness MDS attributes

See Table 4 for a summary of the GET service including some message fields.

If the manager leaves the attribute-id-list field in the roiv-cmip-get service message empty, the agent shall respond with a rors-cmip-get service message, in which the attribute-list contains a list with the values of all implemented attributes of the MDS object.

If the manager requests specific MDS object attributes indicated by the elements in attribute-id-list and the agent supports this capability, the agent shall respond with a rors-cmip-get service message, in which the attribute-list contains a list of the values of the requested attributes of the MDS object that are implemented. If this capability is not implemented, the agent shall respond with a “Remote Operation Error Result” (roer) service message (see IEEE Std 11073-20601), with the error-value field is set to no-such-action (9).

8.5.3 Measurement data transmission

See Table 3 for a summary of the event report services available for measurement data transfer.

Measurement data transfer for a strength fitness agent of this standard shall always be initiated by the strength fitness agent (see agent-initiated measurement data transmission in IEEE Std 11073-20601). To limit the amount of data being transported within an application protocol data unit (APDU), the agent shall not include more than 25 temporarily stored measurements in a single event report. If more than 25 pending measurements are available for transmission, they shall be sent using multiple event reports. If multiple measurements are available, up to 25 measurements should be transmitted within a single event report. Alternatively, they may be transmitted using a single event report for each measurement. However, the former strategy is recommended to reduce overall message size and power consumption.

8.6 Time synchronization

Time synchronization between a strength fitness agent and a manager may be used to coordinate the clocks used when reporting physiological events. Note that the mechanism for synchronizing an agent to a manager is outside the scope of this standard. If time synchronization is used, then this shall be reported in the Mds-Time-Info attribute of the MDS object.

9. Test associations

A cardiovascular fitness and activity monitor standard does not define any test associations.

10. Conformance

10.1 Applicability

This standard shall be used in conjunction with IEEE Std 11073-20601.

An implementation or a system can conform to the following elements of this standard:

- Domain information model class hierarchy and object definitions (object attributes, notifications, methods and data type definitions)
- Nomenclature code values
- Protocol and service models
- Communication service model (association and configuration)

However, conformance to these elements alone does not provide interoperability of applications or medical devices.

10.2 Conformance specification

This standard offers levels of optionality in how the model is applied for an implementation, particularly in the following areas:

- Information model of a specific device
- Use of attributes, value ranges, and access

To support interoperability of applications and systems, an implementation based on this standard shall provide specific details about the way that the definitions of this standard are applied.

These specifications have to be provided in the form of a set of implementation conformance statements. An implementation conformance statement (ICS) is a form of data sheet that discloses details of a specific implementation and specifies which features are provided.

10.3 Levels of conformance

10.3.1 General

This standard defines the following levels of conformance for applications.

10.3.2 Conformance level 1

The application uses the object definitions (object hierarchy, data type definitions) and the nomenclature scheme defined in this standard. All mandatory features defined in the object definition tables and in the

ICS tables are implemented. Furthermore, any conditional or optional features that are implemented shall follow the requirements in this standard.

No private (nonstandard) extensions to the object model are used (no additional objects, object attributes, notifications, object methods, or object relations). No extensions to the nomenclature codes are used (no IDs from the private code space).

10.3.3 Conformance level 2

Conformance level 2 is the same as conformance level 1, except the application uses private extensions to the object model or the application uses private extensions to the nomenclature (private codes) or the application uses other nomenclature schemes (external nomenclature) in addition to the standard nomenclature.

10.4 Implementation conformance statements

10.4.1 General format

The ICSs have to be supplied in the form of tables. Subclauses 10.4.2 through 10.4.5 contain templates for these ICS tables. The tables have to be filled out and provided as an overall conformance statement document.

Generally, the column headings of an ICS table contain the following information:

Index	Feature	Reference	Status	Support	Comment

The table column headings have the following meaning:

- Index is an identifier (e.g., a tag) of a specific feature
- Feature briefly describes the characteristic for which a conformance statement shall be made.
- Reference is a reference to the definition of the feature (may be empty).
- Status specifies the conformance requirement (e.g., mandatory or recommended)—in some cases, this standard does not specify conformance requirements but still wants a definition of the status of a particular feature.
- Support is filled out by the implementer and specifies the characteristics of the feature in the implementation.
- Comment contains additional information provided by the implementer.

More complex expressions or specific lists of items are defined in the specific ICS table.

10.4.2 General implementation conformance statement

In a general top-level ICS, the implementer specifies the versions/revisions that are supported by the implementation as well as some high-level system behavior definitions.

Table 14 shows the general ICSs.

Table 14—IEEE 11073-10442 general ICSs' table

Index[a]	Feature	Reference	Status	Support	Comment
GEN 11073-10442-1	Implementation Description	—	Identification of the device/application. Description of functionality.		
GEN 11073-10442-2	Standards followed and their revisions	(standard documents)	(set of existing revisions)	(set of supported revision)	
GEN 11073-10442-3	Conformance Adherence - Level 1 -	See 10.3.2	Base conformance declaration that device meets the following IEEE Std 11073-10442 conformance requirements: a) All minimum mandatory (shall) requirements. b) All conditional and optional requirements that were implemented conform to this standard. It is expected that these would be fully described as part of the device specializations conformance statements.	Yes/No (No is not expected as No implies that the implementation is nonconformant)	
GEN 11073-10442-4	Conformance Adherence - Level 2 -	See 10.3.3	In addition to GEN 11073-10442-3, the device implements extensions.	Yes/No	
GEN 11073-10442-5	Object Containment Tree	See 6.3	Provide Object Containment Diagram showing relations between object instances used by the application. A conforming implementation uses only object relations as defined in the DIM.		
GEN 11073-10442-6	Nomenclature document used and revision	(standard documents)	(set of existing revisions)	(set of supported revision)	
GEN 11073-10442-7	Data Structure Encoding	—	—	description of encoding method(s) for ASN.1 data structures	
GEN 11073-10442-8	Use of Private Objects	—	Does the implementation use objects that are not defined in the DIM?	Yes/No (If yes: explain in DIM MOC ICS)	
GEN 11073-10442-9	Use of Private Nomenclature Extensions	—	Does the implementation use private extensions to the nomenclature? Private nomenclature extensions are *only* allowed if the standard nomenclature does not include the specific terms required by the application.	Yes/No (If yes: explain in the appropriate ICS)	
GEN 11073-10442-10	11073-20601 Conformance		Provide the conformance report required by IEEE Std 11073-10442.		

[a]The prefix GEN11073-10471- is used for the index in the general ICSs table.

10.4.3 DIM medical object class (MOC) implementation conformance statement

The DIM MOC ICS template shown in Table 15 is used to define which objects (not base classes) are used by the implementation. The following table is a template only. For each object supported by the implementation, one row shall be filled out.

Table 15—Template for DIM MOC ICS table

Index	Feature	Reference	Status	Support	Comment
MOC-[1-n]	Object Name and Object ID	Reference to the clause in the standard where the object is defined.	Implemented	Specify restrictions (e.g., maximum number of supported instances)	

If the implementation uses private objects, these objects should also be specified here. A separate definition can be appended to the conformance statement that can be referenced in the Reference column.

The Support column should indicate specific restrictions about the object implementation.

In addition to the MOC ICS table, an object containment diagram (class instance diagram) should be provided that allows reviewing the class hierarchy used by the implementation.

10.4.4 MOC attribute implementation conformance statement

For each supported object as defined in the DIM MOC ICS, a MOC Attribute ICS has to be provided that defines which attributes are used/supported by the implementation, including any inherited attributes. Table 16 is a template only.

Table 16—Template for MOC attribute ICS table

Index	Feature	Reference	Status	Support	Comment
ATTR-x-n	Attribute Name and Attribute ID	Reference to the clause in the standard where the object is defined.	M = Mandatory / C = Conditional / O = Optional (as per definition in Attribute Definition Tables)	Implemented? Yes/No	

If the implementation uses private attributes, these attributes should also be specified here. A separate definition can be appended to the conformance statement that can be referenced in the Reference column.

The x in the Index column is the ID of the managed object for which the table is supplied (this is the Index of the managed object as specified in the DIM MOC ICS). There is one separate table for each supported managed object.

The n in the Index column is just a serial number (1..m).

The Support column should also contain attribute value ranges (if applicable), hints about specific restrictions for attribute access, or attribute availability and information, if the attribute value is static or dynamic in the implementation.

NOTE—The attribute definition tables in the standard define a minimum mandatory set of attributes for each object.

10.4.5 MOC notification implementation conformance statement

The MOC notification ICS specifies all implemented notifications (typically in the form of the event report service) that are emitted by the agent. Table 17 is a template only. One table has to be provided for each object that supports special object notifications.

Table 17—Template for MOC notification ICS table

Index	Feature	Reference	Status	Support	Comment
NOTI-x-n	Notification Name and Notification ID	Reference to the clause in the standard where the event is defined.		Describe how attribute is accessed (e.g., Get, Set, sent in Configuration event report, sent in a data event report). Describe any specific restrictions.	

The x in the Index column is the ID of the managed object for which the table is supplied (this is the Index of the managed object as specified in the DIM MOC ICS). There is one separate table for each managed object that supports specific object notifications (events).

The n in the Index column is just a serial number (1..m).

Annex A

(informative)

Bibliography

[B1] IEEE 100™, *The Authoritative Dictionary of IEEE Standards Terms*, Seventh Edition. New York, Institute of Electrical and Electronic Engineers, Inc.[5,6]

[B2] ISO/IEEE 11073-10101:2004, Health informatics — Point-of-care medical device communication — Part 10101: Nomenclature.[7]

[B3] ISO/IEEE 11073-10201:2004, Health informatics — Point-of-care medical device communication — Part 10201: Domain information model.

[B4] ISO/IEEE 11073-20101:2004, Health informatics — Point-of-care medical device communication — Part 20101: Application profile — Base standard.

[B5] ITU-T Rec. X.680-2002, Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation.[8]

[5]IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08854, USA (http://standards.ieee.org/).
[6] The IEEE standards or products referred to in this clause are trademarks of the Institute of Electrical and Electronics Engineers, Inc.
[7] ISO/IEEE publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse (http://www.iso.ch/). ISO/IEEE publications are also available in the United States from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08854, USA (http://standards.ieee.org/).
[8] ITU publications are available from the International Telecommunications Union, Place des Nations, 1211 Geneva 20, Switzerland (http://www.itu.in/).

Annex B

(normative)

Any additional ASN.1 definitions

No additional ASN.1 definitions are defined.

Annex C

(normative)

Allocation of identifiers

This annex contains the nomenclature codes used in this document and not found in IEEE Std 11073-20601. For those not contained in this annex, the normative definition is found in IEEE Std 11073-20601.

The format used here follows the one defined in ISO/IEEE 11073-10101.

```
/* Partition codes                                                    */
#define MDC_PART_SITES                  7     /* Body Sites          */
#define MDC_PART_PHD_HF                 129   /* Health and Fitness  */

/*********************************************************************
* From Dimensions (MDC_PART_DIM)
*********************************************************************/
#define MDC_DIM_DIMLESS                 512   /* dimension-less      */
#define MDC_DIM_X_M                     1280  /* m                   */
#define MDC_DIM_X_INCH                  1376  /* in                  */
#define MDC_DIM_X_G                     1728  /* g                   */
#define MDC_DIM_LB                      1760  /*  lb                 */

/*********************************************************************
* From Body Site (MDC_PART_SITES)
*********************************************************************/

#define MDC_MUSC_SKELETAL                                  248 /* */
#define MDC_MUSC_HEAD                                      252 /* */
#define MDC_MUSC_HEAD_EYE                                  256 /* */
#define MDC_MUSC_HEAD_RECT_SUP                             260 /* */
#define MDC_MUSC_HEAD_RECT_INF                             264 /* */
#define MDC_MUSC_HEAD_RECT_MED                             268 /* */
#define MDC_MUSC_HEAD_RECT_LAT                             272 /* */
#define MDC_MUSC_HEAD_OBLIQ_SUP                            276 /* */
#define MDC_MUSC_HEAD_OBLIQ_INF                            280 /* */
#define MDC_MUSC_HEAD_FACIAL                               284 /* */
#define MDC_MUSC_HEAD_OCCIPITOFRONT_VENTER                 288 /* */
#define MDC_MUSC_HEAD_ORBIC_OCUL                           292 /* */
#define MDC_MUSC_HEAD_ORBIC_OCUL_PARS_ORBIT                296 /* */
#define MDC_MUSC_HEAD_AURIC_POST                           300 /* */
#define MDC_MUSC_HEAD_ORBIC_ORIS                           304 /* */
#define MDC_MUSC_HEAD_DEPRESSOR_ANGUL_ORIS                 308 /* */
#define MDC_MUSC_HEAD_RISOR                                312 /* */
#define MDC_MUSC_HEAD_ZYGOMATIC_MAJOR                      316 /* */
#define MDC_MUSC_HEAD_ZYGOMATIC_MINOR                      320 /* */
#define MDC_MUSC_HEAD_LEVATOR_LAB_SUP                      324 /* */
#define MDC_MUSC_HEAD_LEVATOR_LAB_SUP_AL_NASI              328 /* */
#define MDC_MUSC_HEAD_DEPRESSOR_LAB_INF                    332 /* */
#define MDC_MUSC_HEAD_LEVATOR_ANGUL_ORIS                   336 /* */
#define MDC_MUSC_HEAD_BUCCINATOR                           340 /* */
#define MDC_MUSC_HEAD_MENTAL                               344 /* */
```

```
#define MDC_MUSC_HEAD_MASSETER                          348 /* */
#define MDC_MUSC_HEAD_TEMPOR                            352 /* */
#define MDC_MUSC_HEAD_PTERYGOID                         356 /* */
#define MDC_MUSC_HEAD_PTERYGOID_LAT                     360 /* */
#define MDC_MUSC_HEAD_PTERYGOID_MED                     364 /* */
#define MDC_MUSC_HEAD_LING                              368 /* */
#define MDC_MUSC_HEAD_GENIOGLOSS                        372 /* */
#define MDC_MUSC_HEAD_LARING                            376 /* */
#define MDC_MUSC_HEAD_CRICOTHYROID                      380 /* */
#define MDC_MUSC_HEAD_THYROARYTEROID                    384 /* */
#define MDC_MUSC_NECK                                   388 /* */
#define MDC_MUSC_NECK_PLATYSMA                          392 /* */
#define MDC_MUSC_NECK_CAPT_LONG                         396 /* */
#define MDC_MUSC_NECK_STERNOCLEIDOMASTOID               400 /* */
#define MDC_MUSC_NECK_DIGRASTRIC                        404 /* */
#define MDC_MUSC_NECK_DIGRASTRIC_VENTER_ANT             408 /* */
#define MDC_MUSC_NECK_DIGRASTRIC_VENTER_POST            412 /* */
#define MDC_MUSC_NECK_MYLOHYOID                         416 /* */
#define MDC_MUSC_TRUNK                                  420 /* */
#define MDC_MUSC_BACK                                   424 /* */
#define MDC_MUSC_BACK_UPPER                             428 /* */
#define MDC_MUSC_BACK_LOWER                             432 /* */
#define MDC_MUSC_BACK_TRAPEZ                            436 /* */
#define MDC_MUSC_BACK_LASTISSIM_DORS                    440 /* */
#define MDC_MUSC_BACK_RHOMB_MAJOR                       444 /* */
#define MDC_MUSC_BACK_RHOMB_MINOR                       448 /* */
#define MDC_MUSC_BACK_SCAP_LEVATOR                      452 /* */
#define MDC_MUSC_BACK_SERRAT_POST                       456 /* */
#define MDC_MUSC_BACK_SPLEN_CAPT                        460 /* */
#define MDC_MUSC_BACK_SPLEN_CERVIC                      464 /* */
#define MDC_MUSC_BACK_SPLEN                             468 /* */
#define MDC_MUSC_BACK_SPINAL_ERECTOR                    472 /* */
#define MDC_MUSC_BACK_SPINAL                            476 /* */
#define MDC_MUSC_BACK_SPINAL_THORAC                     480 /* */
#define MDC_MUSC_BACK_SPINAL_CERVIC                     484 /* */
#define MDC_MUSC_BACK_SPINAL_CAPIT                      488 /* */
#define MDC_MUSC_BACK_SEMISPINAL                        492 /* */
#define MDC_MUSC_BACK_SEMISPINAL_THOR                   496 /* */
#define MDC_MUSC_BACK_SEMISPINAL_CERV                   500 /* */
#define MDC_MUSC_BACK_SEMISPINAL_CAPIT                  504 /* */
#define MDC_MUSC_BACK_MULTIFID                          508 /* */
#define MDC_MUSC_BACK_INTERSPINAL                       512 /* */
#define MDC_MUSC_BACK_INTERSPINAL_CERVIC                516 /* */
#define MDC_MUSC_BACK_INTERSPINAL_THORAC                520 /* */
#define MDC_MUSC_BACK_INTERSPINAL_LUMBOR                524 /* */
#define MDC_MUSC_THORAX                                 528 /* */
#define MDC_MUSC_THORAX_PECTORAL_MAJOR                  532 /* */
#define MDC_MUSC_THORAX_PECTORAL_MINOR                  536 /* */
#define MDC_MUSC_THORAX_SUBCLAV                         540 /* */
#define MDC_MUSC_THORAX_SERRAT_ANT                      544 /* */
#define MDC_MUSC_THORAX_INTERCOSTAL                     548 /* */
#define MDC_MUSC_THORAX_DIAPHRAGM                       552 /* */
#define MDC_MUSC_ABDOM                                  556 /* */
#define MDC_MUSC_ABDOM_ABDOMIN                          560 /* */
#define MDC_MUSC_ABDOM_OBLIQ_EXT                        564 /* */
```

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#define MDC_MUSC_ABDOM_OBLIQ_INT                    568 /* */
#define MDC_MUSC_ABDOM_ABDOM_TRANSVERS              572 /* */
#define MDC_MUSC_ABDOM_LUMBOR_QUADRAT               576 /* */
#define MDC_MUSC_ABDOM_PELV                         580 /* */
#define MDC_MUSC_ABDOM_PUBORECT                     584 /* */
#define MDC_MUSC_ABDOM_COCCYG                       588 /* */
#define MDC_MUSC_ABDOM_ANI_SPHINCTER                592 /* */
#define MDC_MUSC_ABDOM_ANI_SPHINCTER_EXT            596 /* */
#define MDC_MUSC_UPEXT                              600 /* */
#define MDC_MUSC_UPEXT_DELTOID                      604 /* */
#define MDC_MUSC_UPEXT_SUPRASPINAT                  608 /* */
#define MDC_MUSC_UPEXT_INFRASPINAT                  612 /* */
#define MDC_MUSC_UPEXT_TERES_MINOR                  616 /* */
#define MDC_MUSC_UPEXT_TERES_MAJOR                  620 /* */
#define MDC_MUSC_UPEXT_SUBSCAP                      624 /* */
#define MDC_MUSC_UPEXT_BRACHI_BICEPS                628 /* */
#define MDC_MUSC_UPEXT_BRACHIAL                     632 /* */
#define MDC_MUSC_UPEXT_CORACOBRACH                  636 /* */
#define MDC_MUSC_UPEXT_BRACH_TRICEPS                640 /* */
#define MDC_MUSC_UPEXT_BRACH_TRICEPS_CAP_LONG       644 /* */
#define MDC_MUSC_UPEXT_BRACH_TRICEPS_CAP_LAT        648 /* */
#define MDC_MUSC_UPEXT_BRACH_TRICEPS_CAP_MED        652 /* */
#define MDC_MUSC_UPEXT_ANCON                        656 /* */
#define MDC_MUSC_UPEXT_PRONATOR                     660 /* */
#define MDC_MUSC_UPEXT_FLEX_CARPI_RADIAL            664 /* */
#define MDC_MUSC_UPEXT_PALMAR_LONG                  668 /* */
#define MDC_MUSC_UPEXT_FLEX_CARPI_ULNAR             672 /* */
#define MDC_MUSC_UPEXT_FLEX_DIGIT_SUPERF            676 /* */
#define MDC_MUSC_UPEXT_FLEX_DIGIT_PROFUND           680 /* */
#define MDC_MUSC_UPEXT_FLEX_POLLIC_LONG             684 /* */
#define MDC_MUSC_UPEXT_PRONATOR_QUADRAT             688 /* */
#define MDC_MUSC_UPEXT_BRACHIORADIAL                692 /* */
#define MDC_MUSC_UPEXT_EXTENS_CARP_RADIAL_LONG      696 /* */
#define MDC_MUSC_UPEXT_EXTENS_CARP_RADIAL_BREV      700 /* */
#define MDC_MUSC_UPEXT_EXTENS_DIGIT                 704 /* */
#define MDC_MUSC_UPEXT_EXTENS_DIGIT_MIN             708 /* */
#define MDC_MUSC_UPEXT_EXTENS_CARP_ULNAR            712 /* */
#define MDC_MUSC_UPEXT_SUPINATOR                    716 /* */
#define MDC_MUSC_UPEXT_ABDUC_POLLIC_LONG            720 /* */
#define MDC_MUSC_UPEXT_EXTENS_POLLIC_BREV           724 /* */
#define MDC_MUSC_UPEXT_EXTENS_POLLIC_LONG           728 /* */
#define MDC_MUSC_UPEXT_EXTENS_INDIC                 732 /* */
#define MDC_MUSC_UPEXT_PALMAR_BREV                  736 /* */
#define MDC_MUSC_UPEXT_ABDUC_POLLIC_BREV            740 /* */
#define MDC_MUSC_UPEXT_FLEX_POLLIC_BREV             744 /* */
#define MDC_MUSC_UPEXT_OPPON_POLLIC                 748 /* */
#define MDC_MUSC_UPEXT_ADDUC_POLLIC                 752 /* */
#define MDC_MUSC_UPEXT_ABDUC_DIGIT_MIN              756 /* */
#define MDC_MUSC_UPEXT_FLEX_DIGIT_BREV_MIN          760 /* */
#define MDC_MUSC_UPEXT_OPPON_DIGIT_MIN              764 /* */
#define MDC_MUSC_UPEXT_LUMBRICAL                    768 /* */
#define MDC_MUSC_UPEXT_INTEROSS_DORSAL              772 /* */
#define MDC_MUSC_UPEXT_INTEROSS_PALMAR              776 /* */
#define MDC_MUSC_LOEXT_HIP_THIGH                    780 /* */
#define MDC_MUSC_LOEXT_LEG                          784 /* */
```