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Second edition
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Health informatics — Device interoperability —

Part 10421: Personal health device communication — Device specialization — Peak expiratory flow monitor (peak flow)

Informatique de santé — Interopérabilité des dispositifs —Partie 10421: Communication entre dispositifs de santé personnels — Spécialisation des dispositifs — Moniteur de surveillance du débit expiratoire de pointe (débit de pointe)

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This second edition cancels and replaces the first edition (ISO/IEEE 11073-10421:2012), which has been technically revised.

The main changes are as follows:

— added support for Base-Offset-Time;

— defined new standard configuration 0x0835;

— updated normative references, to refer to ISO/IEEE 11703-20601;

— updated version of this device specialization;

— updated the association details based on the new version;

— updated the wording in 6.3 regarding the Observational;

— updated the examples in 8.4.2 and Annex E to indicate the support of BaseOffsetTime;

— updated the qualifier in MDS and other objects to recommend BaseOffsetTime; also updated the description of the qualifiers in 6.5;

— added some text to 6.12 to further elaborate the DIM extensibility rule;

— corrected the use condition of GET MDS at E.4.1;

— updated the text in 8.5.2 regarding attribute-id-list, in order to be compliant with 20601-V4;

— added subclause 3.4 – Compliance with other standards;

— removed the year in the bibliography to represent the latest version;

— extended Table 1 to specify qualifier details for all possible configurations;

— made the IEEE std 11073-10101 as normative reference;

— updated the wording at 1.3 and 4.1 regarding the precedence of nomenclature between 10101, 20601, 104xx, and this standard;

— updated the usage of nomenclature-version. Tied it with the corresponding protocol-version.

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IEEE Std 11073-10421™-2023
(Revision of IEEE Std 11073-10421-2010)

Health Informatics—Device Interoperability

Part 10421: Personal Health Device Communication—Device Specialization—Peak Expiratory Flow Monitor (Peak Flow)

Developed by the

IEEE 11073™ Standards Committee
of the
IEEE Engineering in Medicine and Biology Society

Approved 30 March 2023

IEEE SA Standards Board

Abstract: Within the context of the ISO/IEEE 11073 family of standards for device communication, a normative definition of communication is established in this standard between personal telehealth peak expiratory flow monitor devices and compute engines (e.g., cell phones, personal computers, personal health appliances, and set-top boxes) in a manner that enables plug-and-play interoperability. Appropriate portions of existing standards are leveraged, including ISO/IEEE 11073 terminology, information models, application profile standards, and transport standards. The use of specific term codes, formats, and behaviors is specified in telehealth environments restricting optionality in base frameworks in favor of interoperability. A common core of communication functionality is defined for personal telehealth peak expiratory flow monitor devices.

Keywords: forced expiratory volume, IEEE 11073-10421™, medical device communication, peak expiratory flow, peak expiratory flow monitor, peak flow, personal health devices

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Introduction

This introduction is not part of IEEE Std 11073-10421™-2023, Health Informatics—Device Interoperability—Part 10421: Personal Health Device Communication—Device Specialization—Peak Expiratory Flow Monitor (Peak Flow).

The object classes and attributes in this standard are identified by nomenclature codes. Each code consists of a reference identifier (RefID) string and an integer code value. By using a consistent nomenclature, interoperability is enhanced as all implementations maintain the same semantic meaning for the numeric codes. This standard leverages the existing nomenclature codes in IEEE Std 11073-10101™. Between this standard, IEEE Std 11073-10101, ISO/IEEE 11073-20601, and other IEEE Std 11073-104zz, all required nomenclature codes for implementation are documented. New codes may be defined in newer versions/revisions of each of these documents. In the case of a conflict, where one term code has been assigned to two separate semantic concepts with different RefIDs, in general, the oldest definition in actual use should take precedence. The same policy applies when one RefID has two different code values assigned in different specifications. The resolution of such conflicts will be determined through joint action by the responsible working groups and other stakeholders, and any corrective action will be published as corrigenda.

NOTE—In this standard, IEEE 11073-104zz is used to refer to the collection of device specialization standards that utilize ISO/IEEE 11073-20601, where zz can be any number from 01 to 99, inclusive.[6]

[6] Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

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Health Informatics—Device Interoperability

Part 10421: Personal Health Device Communication—Device Specialization—Peak Expiratory Flow Monitor (Peak Flow)

1. Overview

1.1 Scope

The scope of this standard is to establish a normative definition of communication between personal telehealth peak flow monitoring devices (agents) 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 work done in other ISO/IEEE 11073 standards including existing terminology, information profiles, application profile standards. 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 functionality of a peak-flow monitoring device. The use case is restricted to personal respiratory monitoring and therefore does not include hospital-based spirometry. Continuous and high-acuity monitoring (e.g., for emergency response) are outside the scope of the use case. In the context of personal health devices, a peak flow meter is a device used to measure the respiratory function of those managing respiratory conditions such as asthma and chronic obstructive pulmonary disease. The ability to identify declining respiratory status prior to the need for acute intervention improves the quality of life for the individual while reducing the overall costs of care. Respiratory status data are collected by a personal respiratory monitoring device and forwarded to a central data repository for review and action by a health care provider. The data are episodic in nature and are forwarded at designated intervals or when the person is symptomatic.

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 key to growing the potential market for these devices and enabling people to be better informed participants in the management of their health.

1.3 Word usage

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (*shall* equals *is required to*).[7,8]

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (*should* equals *is recommended that*).

The word *may* is used to indicate a course of action permissible within the limits of the standard (*may* equals *is permitted to*).

The word *can* is used for statements of possibility and capability, whether material, physical, or causal (*can* equals *is able to*).

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in the 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.

ISO/IEEE 11073-10101, Health informatics—Device interoperability—Part 10101: Point-of-care medical device communication—Nomenclature.[9,10]

ISO/IEEE 11073-20601, Health informatics—Device interoperability—Part 20601: Personal health device communication—Application profile—Optimized exchange protocol.

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

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause. [11]

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

class: In object-oriented modeling, a class describes the attributes, methods, and events that objects instantiate from the class utilize.

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

[7] The use of the word *must* is deprecated and cannot be used when stating mandatory requirements; *must* is used only to describe unavoidable situations.
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device: A term used to refer to a physical apparatus implementing either an agent or a manager role.

forced expiratory volume: The expiratory volume of a subject under forced conditions at time t in seconds, measured from time zero.

handle: An unsigned 16-bit number that is locally unique and identifies one of the object instances within an agent.

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.

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

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

peak expiratory flow: maximum flow measured at the mouth during an expiration delivered with maximal force starting immediately after achieving maximum lung inflation.

peak expiratory flow monitor: A medical device used to measure the respiratory function of those managing respiratory conditions such as asthma.

personal best: This value is determined by a healthcare professional or based on predicted average peak flow and is typically the highest peak expiratory flow (PEF) reading an individual can obtain while in peak condition.

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

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

predicted average peak flow: The value of peak expiratory flow that is calculated based on the user's age, height, and sex to serve as a benchmark for the user's measurements.

time zero: In the context of this document, time zero is the instant at which a user starts blowing into the peak-flow monitor to record a measurement.

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)
FEV	forced expiratory volume
FEV1	forced expiratory volume in 1 s
FEV6	forced expiratory volume in 6 s
ICS	implementation conformance statements

MDC	medical device communication
MDER	medical device encoding rules
MDS	medical device system
MOC	managed object class
OID	object identified
PDU	protocol data unit
PEF	peak expiratory flow
PHD	personal health device
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 ISO/IEEE 11073-20601 for a description of the guiding principles for this series of ISO/IEEE 11073 Personal Health Device standards.

ISO/IEEE 11073-20601 supports the modeling and implementation of an extensive set of personal health devices. This standard defines aspects of the peak expiratory flow monitor device. It describes all aspects necessary to implement the application layer services and data exchange protocol between an ISO/IEEE 11073 PHD peak expiratory flow monitor agent and a manager. This standard defines a subset of the objects and functionality contained in ISO/IEEE 11073-20601 and extends and adds definitions where appropriate. All new definitions are given in Annex B in Abstract Syntax Notation One (ASN.1) [B8]. Nomenclature codes referenced in this standard, which are not defined in ISO/IEEE 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 ISO/IEEE 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 communication model. See ISO/IEEE 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 an agent can communicate to a manager. Communication between the agent and the manager is defined by the application protocol in ISO/IEEE 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 ISO/IEEE 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 ISO/IEEE 11073-20601. The security of this communication is largely determined by, but not limited to, the physical security of the device along with the inherent security of the underlying transports. Additional security may be defined by future revisions of ISO/IEEE 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.

4.3 Compliance with other standards

Devices that comply with this standard may also be required to comply with other domain- and device-specific standards that supersede the requirements of this standard with respect to issues including safety, reliability, and risk management. A user of this standard is expected to be familiar with all other such standards that apply and to comply with any higher specifications thus imposed.

Typically, medical devices should comply with the IEC 60601-1 [B1] base standards with respect to electrical and mechanical safety and any device-specific standard as might be defined in the IEC 60601-2 [B2] series of standards. Software aspects may apply through standards such as IEC 62304 [B3]. Devices that comply with this standard implement higher layers of network software and utilize lower layers as appropriate to the application. The requirements for the performance of such applications and conformance are defined elsewhere and are outside the scope of this standard. Moreover, the use of any medical equipment is subject to risk assessment and risk management appropriate to the application. Some relevant examples are ISO 14971 [B5] and IEC 80001-1 [B4]. The requirements of such risk assessment, risk management, and conformance are outside the scope of this standard. The applicable versions of the referenced safety-related standards may differ per country.

5. Peak expiratory flow monitor device concepts and modalities

5.1 General

This clause presents the general concepts of peak expiratory flow monitor devices. In the context of personal health devices in this family of standards, a peak expiratory flow monitor is a device that measures the respiratory function of those managing respiratory conditions such as asthma. In general, the peak expiratory flow monitor will take measurements of the lung function of the subject by recording the flow and volume of air during exhalation with maximum effort. Typically, a peak expiratory flow monitor accomplishes this task by measuring and recording peak expiratory flow (PEF) and forced expiratory volume in 1 s (FEV1). In some cases, forced expiratory volume in 6 s (FEV6) is also measured.

The methods to determine PEF and forced expiratory volume (FEV) vary, but common methods include the use of pressure sensors, mechanical turbines, piezo-electric crystals, and so on as sensors. The subject is required to deliver an expiration with maximal force into a mouthpiece that channels the air to the sensor. Typically, the sensor will measure airflow to determine PEF, and from the area of the tube in which the sensor is placed, the volume (FEV1 or FEV6) may be calculated.

5.2 PEF

PEF is a measure of how fast an individual can push air out of their lungs after taking maximal inspiration and followed by a maximal expiration. PEF is measured in liters per minute. Figure 1 shows the typical rate of flow during the measurement of PEF with the maximal value at around 0.1 s.

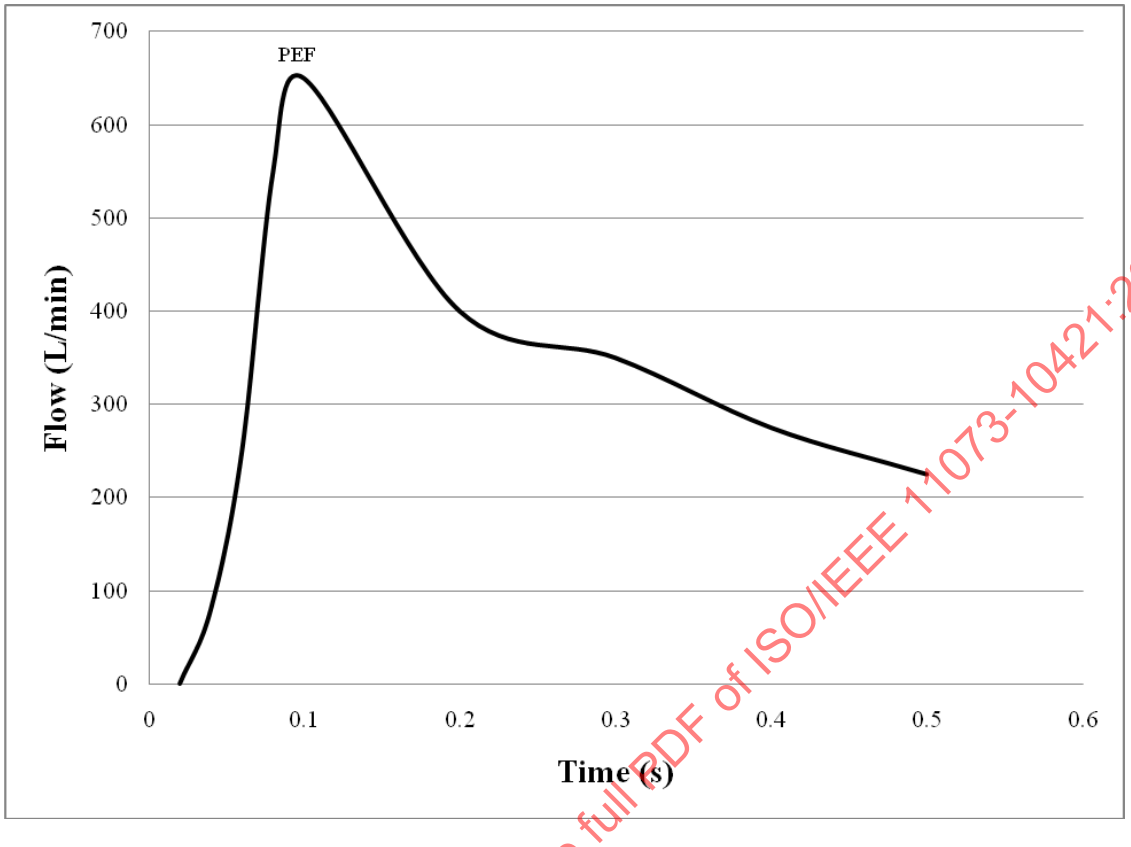

Figure 1—PEF waveform (representation only—does not correspond to real values)

5.3 Personal best

Personal best is not a constantly measured value; rather, it is determined by a health-care professional or based on predicted average peak flow. The personal best is typically the highest PEF reading an individual can obtain while in peak condition. Personal best, as a value of PEF, is measured in liters per minute.

5.4 FEV1

FEV1 is a measure of forced expiratory volume. It is a measure of the expiratory volume of a subject under forced conditions at 1 s, measured from time zero (the time at which the subject starts the expiration). FEV1 is measured in liters. Figure 2 shows a typical pulmonary waveform where FEV1 is the total volume of air and would be calculated as the area under the curve between 0 s and 1 s.

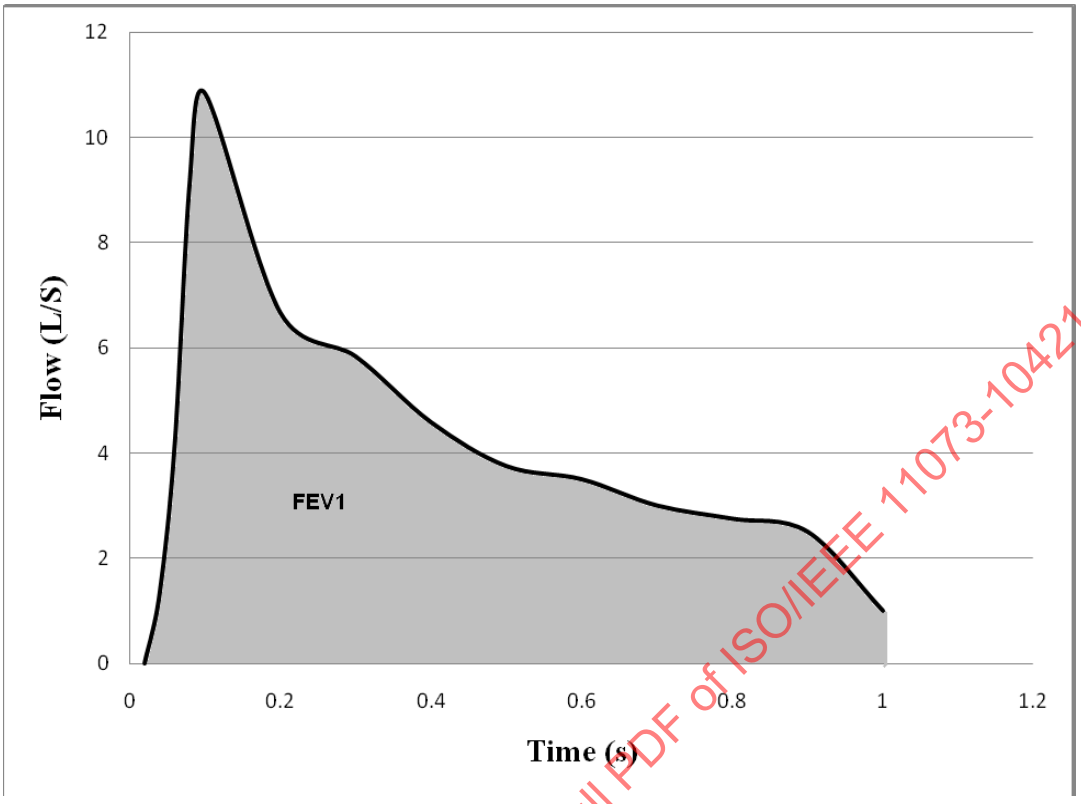

Figure 2—FEV1 waveform (representation only—does not correspond to real values)

5.5 FEV6

FEV6 is a measure of the forced expiratory volume of a subject under forced conditions at 6 s measured from time zero. FEV6 is measured in liters.

6. Peak expiratory flow monitor domain information model

6.1 Overview

This subclause describes the domain information model of the peak expiratory flow monitor.

6.2 Class extensions

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

6.3 Object instance diagram

The object instance diagram of the peak expiratory flow monitor domain information model, defined for the purposes of this standard, is shown in Figure 3.

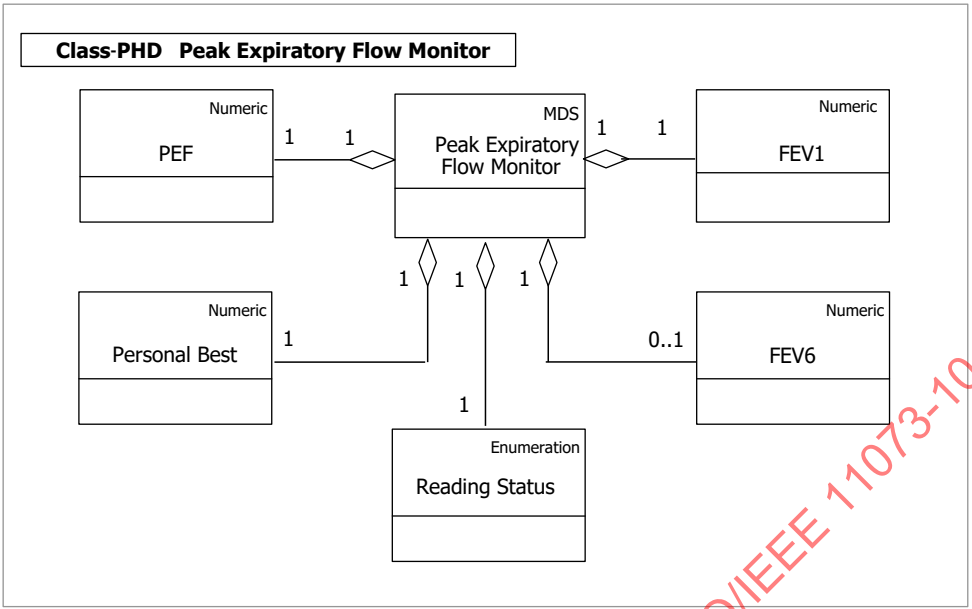

Figure 3—Peak expiratory flow monitor—domain information model

The objects of the DIM, as shown in Figure 3, are described in 6.5 through 6.10. This includes the medical device system (MDS) object (6.5), the numeric objects (6.6), the real-time sample array objects (6.7), the enumeration objects (6.8), the PM-store objects (6.9), and the scanner objects (6.10). Subclause 6.11 describes the rules for extending the peak expiratory flow monitor information model beyond elements as described in this standard. Each subclause that describes an object of the peak expiratory flow monitor contains the following information:

- The nomenclature code is used to identify the class of the object. One example 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 device 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 ISO/IEEE 11073-20601.
- The methods available on the object.
- The potential events generated by the object. The 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 ISO/IEEE 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. For attributes with qualifiers set to R or NR, underlying requirements stated in the Remark and Value column in ISO/IEEE 11073-20601 shall be followed. If any attribute (from the DIM of ISO/IEEE 11073-20601) is not included in the definition of that object in this standard, it shall not be included in that object by an implementation, unless it is a vendor-specific attribute extended according to 6.12.

An attribute is further qualified as static, dynamic, or observational. Static attributes shall not change value during the life of an association. Dynamic attributes have a value that may change during the life of an association. The dynamic attribute value should be sent at configuration time and shall be sent at or before the time when the value would be needed for interpreting a reported observation. Observational attributes have a value that may change during the life of an association. When a set of observational attribute values are received, these values are combined with the available context information (i.e., all related dynamic and static attribute values) to represent the observation at the observation time.

6.4 Types of configuration

6.4.1 General

As specified in ISO/IEEE 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

Standard configurations are defined in the IEEE 11073-104zz specializations (such as this standard) and are assigned a well-known identifier (Dev-Configuration-Id). The usage of a standard configuration is negotiated at association time between the agent and the manager. If the manager recognizes and selects to operate using the configuration, then the agent can send measurements immediately. If the manager does not recognize the configuration, the agent provides the configuration prior to transmitting measurement information.

This standard contains two standard configurations: Dev-Configuration-Id=2100 (0x0834) is for an agent using absolute time, and Dev-Configuration-Id=2101 (0x0835) is for an agent using base-offset-time.

6.4.3 Extended configuration

In extended configurations, the agent's configuration is not predefined in a standard. The agent determines the objects, attributes, and values that will be used in a configuration and assigns a configuration identifier. When the agent associates with a manager, an acceptable configuration is negotiated. Typically, the manager does not recognize the agent's configuration on the first connection, so the manager responds that the agent needs to send its configuration information as a configuration event report. If, however, the manager recognizes 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 peak expiratory flow monitor MDS object. The nomenclature code to identify the MDS class is MDC_MOC_VMS_MDS_SIMP.

Table 1—MDS object attributes

Attribute name	Value	Qualifier		
		Extended configuration	Standard configuration (Dev-Configuration-Id = 0x0834)	Standard configuration (Dev-Configuration-Id = 0x0835)
Handle	0	M	M	M
System-Type	Attribute not present. See ISO/IEEE 11073-20601.	C	C	C
System-Type-Spec-List	{MDC_DEV_SPEC_PROFILE_PEFM, 2}.	M	M	M
System-Model	{"Manufacturer","Model"}.	M	M	M
System-Id	Extended unique identifier (64-bits) (EUI-64).	M	M	M
Dev-Configuration-Id	Standard config: 0x0834 (2100) Standard config: 0x0835 (2101) Extended configs: 0x4000-0x7FFF.	M	M	M
Attribute-Value-Map	See ISO/IEEE 11073-20601.	C	C	C
Production-Specification	See ISO/IEEE 11073-20601.	O	O	O
Mds-Time-Info	See ISO/IEEE 11073-20601.	C	C	M
Date-and-Time	See ISO/IEEE 11073-20601.	C	R	NR
Base-Offset-Time	See ISO/IEEE 11073-20601.	C	NR	R
Relative-Time	See ISO/IEEE 11073-20601.	C	NR	NR
HiRes-Relative-Time	See ISO/IEEE 11073-20601.	C	NR	NR
Date-and-Time-Adjustment	See ISO/IEEE 11073-20601.	C	C	C
Power-Status	*onBattery* or *onMains*.	O	O	O
Battery-Level	See ISO/IEEE 11073-20601.	O	O	O
Remaining-Battery-Time	See ISO/IEEE 11073-20601.	O	O	O
Reg-Cert-Data-List	See ISO/IEEE 11073-20601.	O	O	O
Confirm-Timeout	See ISO/IEEE 11073-20601.	O	O	O
Transport-Timeout	See ISO/IEEE 11073-20601.	O	O	O

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

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

See ISO/IEEE 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 peak expiratory flow monitor agent with extended configuration, this identifier is chosen in the range of extended-config-start to extended-config-end (see ISO/IEEE 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 manager already holds the configuration information relating to the Dev-Configuration-Id, it recognizes the Dev-Configuration-Id, and the Configuring state (see 8.4) is skipped, and the agent and manager then enter the Operating state. If the manager does not recognize the Dev-Configuration-Id, the agent and manager 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 ISO/IEEE 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 ISO/IEEE 11073-20601); the Parameters (action-info-args) column defines the associated ASN.1 data structure (see ISO/IEEE 11073-20601 for 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	—
ACTION	Set-Base-Offset-Time	Confirmed	MDC_ACT_SET_BO_TIME	SetBOTimeInvoke	—

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 ISO/IEEE 11073-20601). Agents with an internal real-time clock shall indicate this capability by also setting the mds-time-capab-real-time-clock bit in the Mds-Time-Info attribute.

The Set-Time method can be supported only if the Absolute-Time-Stamp attribute is supported.

Set-Base-Offset-Time

This method allows the manager to set a real-time clock in the agent with the base time and offset. The agent indicates whether the Set-Base-Offset-Time command is valid using the mds-time-capab-set-clock bit in the Mds-Time-Info attribute (see ISO/IEEE 11073-20601).

The Set-Base-Offset-Time method can be supported only if the Base-Offset-Time-Stamp attribute is supported.

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), data-req-mode-capab shall be set to the appropriate value for the event report style. As a result, the manager shall assume the peak expiratory flow monitor agent does not support any of the MDS-Data-Request features (see ISO/IEEE 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 peak expiratory flow monitor MDS object.

Table 3—Peak expiratory flow monitor 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-Configuration-Event:**
This event is sent by the peak expiratory flow monitor agent during the configuring procedure if the manager does not already know the peak expiratory flow monitor agent's configuration from past associations or because the manager has not been implemented to recognize the configuration according to the peak expiratory flow monitor device specialization. The event provides static information about the supported measurement capabilities of the peak expiratory flow monitor agent.

— **MDS-Dynamic-Data-Update-Var:**
This event provides dynamic measurement data from the peak expiratory flow monitor agent for the PEF, FEV1, and, optionally FEV6 numeric objects. 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 peak expiratory flow monitor agent for the PEF, FEV1, and, optionally FEV6 numeric objects. These data are reported in the fixed format defined by the Attribute-Value-Map attribute of the object. 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.

NOTE—ISO/IEEE 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 peak expiratory flow monitor 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 only after the Manager has confirmed the selection of the Agent's configuration.

The GET request for all attributes shall be supported. An attribute-id-list parameter may be supported.

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

Table 4—Peak expiratory flow monitor 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 peak expiratory flow monitor specialization does not require an implementation to support the MDS object SET service.

6.6 Numeric objects

6.6.1 General

The peak expiratory flow monitor DIM (see Figure 3) contains three simple numeric objects for PEF, personal best, and FEV1, and optionally it can contain a fourth simple numeric object for FEV6. These are described in 6.6.2 through 6.6.5.

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-LabelString 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.

6.6.2 PEF

Table 5 summarizes the attributes of the simple numeric object that reports PEF. The nomenclature code to identify the numeric class is MDC_MOC_VMO_METRIC_NU. The PEF numeric object shall be supported by a peak expiratory flow monitor agent.

Table 5—PEF simple numeric object attributes

Attribute name	Extended configuration		Standard configuration (Dev-Configuration-Id = 0x0834)		Standard configuration (Dev-Configuration-Id = 0x0835)	
	Value	Qual.	Value	Qual.	Value	Qual.
Handle	See ISO/IEEE 11073-20601.	M	1	M	1	M
Type	{MDC_PART_SCADA, MDC_FLOW_AWAY_EXP_FORCED_PEAK }.	M	{MDC_PART_SCADA, MDC_FLOW_AWAY_EXP_FORCED_PEAK }.	M	{MDC_PART_SCADA, MDC_FLOW_AWAY_EXP_FORCED_PEAK }.	M
Supplemental-Types	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent, mss-avail-stored-data, mss-msmt-aperiodic, mss-acc-agent-initiated.	M	mss-avail-intermittent, mss-avail-stored-data, mss-msmt-aperiodic, mss-acc-agent-initiated.	M	mss-avail-intermittent, mss-avail-stored-data, mss-msmt-aperiodic, mss-acc-agent-initiated.	M
Metric-Structure-Small	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Measurement-Status	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Metric-Id	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Metric-Id-List	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Metric-Id-Partition	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Unit-Code	MDC_DIM_X_L_PER_MIN .	M	MDC_DIM_X_L_PER_MIN	M	MDC_DIM_X_L_PER_MIN	M
Attribute-Value-Map	See ISO/IEEE 11073-20601.	C	MDC_ATTR_NU_VAL_OBS_SIMP, then MDC_ATTR_TIME_STAMP_ABS	M	MDC_ATTR_NU_VAL_OBS_SIMP, then MDC_ATTR_TIME_STAMP_BO	M
Source-Handle-Reference	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Label-String	See ISO/IEEE 11073-20601.	O	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	O	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	O
Unit-LabelString	See ISO/IEEE 11073-20601.	O	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	O	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	O
Absolute-Time-Stamp	See ISO/IEEE 11073-20601.	C	If fixed format is used and the standard configuration is not adjusted, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	R	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Base-Offset-Time-Stamp	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601. If fixed format is used and the standard configuration is not adjusted, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	R

Attribute name	Extended configuration		Standard configuration (Dev-Configuration-Id = 0x0834)		Standard configuration (Dev-Configuration-Id = 0x0835)	
Relative-Time-Stamp	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
HiRes-Time-Stamp	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Measure-Active-Period	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Simple-Nu-Observed-Value	See ISO/IEEE 11073-20601.	C	See ISO/IEEE 11073-20601. If fixed format is used and the standard configuration is unchanged, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply	C	See ISO/IEEE 11073-20601. If fixed format is used and the standard configuration is unchanged, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply	C
Compound-Simple-Nu-Observed-Value	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601	NR
Basic-Nu-Observed-Value	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Compound-Basic-Nu-Observed-Value	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601	NR
Compound-Nu-Observed-Value	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Accuracy	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR

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

For a peak expiratory flow monitor agent with standard configuration, the AttrValMap structure (see ISO/IEEE 11073-20601) of the Attribute-Value-Map attribute shall contain the attribute ID and attribute length information of the Simple-Nu-Observed-Value and Absolute-Time-Stamp attribute in the same order as indicated in Attribute-Value-Map value in Table 5.

The PEF simple numeric object does not support any methods, events, or other services.

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

6.6.3 Personal best

Table 6 summarizes the attributes of the personal best numeric object. The nomenclature code to identify the numeric class is MDC_MOC_VMO_METRIC_NU. The personal best numeric object shall be supported by a peak expiratory flow monitor agent.

Table 6—Personal best simple numeric object attributes

Attribute name	Extended configuration		Standard configuration (Dev-Configuration-Id = 0x0834)		Standard configuration (Dev-Configuration-Id = 0x0835)	
	Value	Qual.	Value	Qual.	Value	Qual.
Handle	See ISO/IEEE 11073-20601,	M	2	M	2	M
Type	{MDC_PART_SCADA, MDC_FLOW_AWAY_EXP_FORCED_PEAK_PB}.	M	{MDC_PART_SCADA, MDC_FLOW_AWAY_EXP_FORCED_PEAK_PB}.	M	{MDC_PART_SCADA, MDC_FLOW_AWAY_EXP_FORCED_PEAK_PB}.	M
Supplemental-Types	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent, mss-avail-stored-data, mss-acc-agent-initiated, mss-cat-setting.	M	mss-avail-intermittent, mss-avail-stored-data, mss-acc-agent-initiated, mss-cat-setting.	M	mss-avail-intermittent, mss-avail-stored-data, mss-acc-agent-initiated, mss-cat-setting.	M
Metric-Structure-Small	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Measurement-Status	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Metric-Id	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Metric-Id-List	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Metric-Id-Partition	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Unit-Code	MDC_DIM_X_L_PER_MIN.	M	MDC_DIM_X_L_PER_MIN	M	MDC_DIM_X_L_PER_MIN	M
Attribute-Value-Map	See ISO/IEEE 11073-20601.	C	MDC_ATTR_NU_VAL_OBS_SIMP, then MDC_ATTR_TIME_STAMP_ABS.	M	MDC_ATTR_NU_VAL_OBS_SIMP, then MDC_ATTR_TIME_STAMP_BO.	M
Source-Handle-Reference	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Label-String	See ISO/IEEE 11073-20601.	O	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	O	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	O
Unit-LabelString	See ISO/IEEE 11073-20601.	O	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	O	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	O
Absolute-Time-Stamp	See ISO/IEEE 11073-20601.	C	If fixed format is used and the standard configuration is not adjusted, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	R	If fixed format is used and the standard configuration is not adjusted, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	NR
Base-Offset-Time-Stamp	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601. If fixed format is used and the standard configuration is not adjusted, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	R

Attribute name	Extended configuration		Standard configuration (Dev-Configuration-Id = 0x0834)		Standard configuration (Dev-Configuration-Id = 0x0835)	
Relative-Time-Stamp	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
HiRes-Time-Stamp	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Measure-Active-Period	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Simple-Nu-Observed-Value	See ISO/IEEE 11073-20601.	C	See ISO/IEEE 11073-20601. If fixed format is used and the standard configuration is unchanged, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	C	See ISO/IEEE 11073-20601. If fixed format is used and the standard configuration is unchanged, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	C
Compound-Simple-Nu-Observed-Value	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601	NR
Basic-Nu-Observed-Value	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Compound-Basic-Nu-Observed-Value	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Compound-Nu-Observed-Value	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Accuracy	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR

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

For a peak expiratory flow monitor agent with standard configuration, the AttrValMap structure (see ISO/IEEE 11073-20601) of the Attribute-Value-Map attribute shall contain the attribute ID and attribute length information of the Simple-Nu-Observed-Value and Absolute-Time-Stamp attribute in the same order as indicated in Table 6.

The Personal Best simple numeric object does not support any methods, events, or other services.

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

6.6.4 FEV1

Table 7 summarizes the attributes of the simple numeric object that reports FEV1. The nomenclature code to identify the numeric class is MDC_MOC_VMO_METRIC_NU. The simple numeric object that reports FEV1 shall be supported by a peak expiratory flow monitor agent.

Table 7—FEV1 simple numeric object attributes

Attribute name	Extended configuration		Standard configuration (Dev-Configuration-Id = 0x0834)		Standard configuration (Dev-Configuration-Id = 0x0835)	
	Value	Qual.	Value	Qual.	Value	Qual.
Handle	See ISO/IEEE 11073-20601.	M	3	M	3	M
Type	{MDC_PART_SCADA, MDC_VOL_AWAY_EXP_FORCED_1S}.	M	{MDC_PART_SCADA, MDC_VOL_AWAY_EXP_FORCED_1S }.	M	{MDC_PART_SCADA, MDC_VOL_AWAY_EXP_FORCED_1S }.	M
Supplemental-Types	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent, mss-avail-stored-data, mss-msmt-aperiodic, mss-acc-agent-initiated.	M	mss-avail-intermittent, mss-avail-stored-data, mss-msmt-aperiodic, mss-acc-agent-initiated.	M	mss-avail-intermittent, mss-avail-stored-data, mss-msmt-aperiodic, mss-acc-agent-initiated.	M
Metric-Structure-Small	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Measurement-Status	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Metric-Id	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Metric-Id-List	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Metric-Id-Partition	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Unit-Code	MDC_DIM_X_L.	M	MDC_DIM_X_L	M	MDC_DIM_X_L	M
Attribute-Value-Map	See ISO/IEEE 11073-20601.	C	MDC_ATTR_NU_VAL_OBS_SIMP, then MDC_ATTR_TIME_STAMP_ABS	M	MDC_ATTR_NU_VAL_OBS_SIMP, then MDC_ATTR_TIME_STAMP_BO	M
Source-Handle-Reference	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Label-String	See ISO/IEEE 11073-20601.	O	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	O	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	O
Unit-LabelString	See ISO/IEEE 11073-20601.	O	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	O	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	O
Absolute-Time-Stamp	See ISO/IEEE 11073-20601.	C	If fixed format is used and the standard configuration is not adjusted, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	R	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Base-Offset-Time-Stamp	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601. If fixed format is used and the standard configuration is not adjusted, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	R
Relative-Time-Stamp	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR

Attribute name	Extended configuration		Standard configuration (Dev-Configuration-Id = 0x0834)		Standard configuration (Dev-Configuration-Id = 0x0835)	
HiRes-Time-Stamp	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Measure-Active-Period	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Simple-Nu-Observed-Value	See ISO/IEEE 11073-20601.	C	See ISO/IEEE 11073-20601. If fixed format is used and the standard configuration is unchanged, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	C	See ISO/IEEE 11073-20601. If fixed format is used and the standard configuration is unchanged, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	C
Compound-Simple-Nu-Observed-Value	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Basic-Nu-Observed-Value	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Compound-Basic-Nu-Observed-Value	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Compound-Nu-Observed-Value	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Accuracy	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR

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

For a peak expiratory flow monitor agent with standard configuration, the AttrValMap structure (see ISO/IEEE 11073-20601) of the Attribute-Value-Map attribute shall contain the attribute ID and attribute length information of the Simple-Nu-Observed-Value and Absolute-Time-Stamp attribute in the same order as indicated in Table 7.

The FEV1 simple numeric object does not support any methods, events, or other services.

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

6.6.5 FEV6 (optional)

Table 8 summarizes the attributes of the simple numeric object that optionally reports FEV6. The nomenclature code to identify the numeric class is MDC_MOC_VMO_METRIC_NU. The simple numeric object that optionally reports FEV6 may be supported by a peak expiratory flow monitor agent.

Table 8—FEV6 simple numeric object attributes

Attribute name	Extended configuration	
	Value	Qual.
Handle	See ISO/IEEE 11073-20601.	M
Type	{MDC_PART_SCADA, MDC_VOL_AWAY_EXP_FORCED_6S}.	M
Supplemental-Types	See ISO/IEEE 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent, mss-avail-stored-data, mss-msmt-aperiodic, mss-acc-agent-initiated.	M
Metric-Structure-Small	See ISO/IEEE 11073-20601.	NR
Measurement-Status	See ISO/IEEE 11073-20601.	NR
Metric-Id	See ISO/IEEE 11073-20601.	NR
Metric-Id-List	See ISO/IEEE 11073-20601.	NR
Metric-Id-Partition	See ISO/IEEE 11073-20601.	NR
Unit-Code	MDC_DIM_X_L.	M
Attribute-Value-Map	See ISO/IEEE 11073-20601.	C
Source-Handle-Reference	See ISO/IEEE 11073-20601.	NR
Label-String	See ISO/IEEE 11073-20601.	O
Unit-LabelString	See ISO/IEEE 11073-20601.	O
Absolute-Time-Stamp	See ISO/IEEE 11073-20601.	C
Base-Offset-Time-Stamp	See ISO/IEEE 11073-20601.	C
Relative-Time-Stamp	See ISO/IEEE 11073-20601.	C
HiRes-Time-Stamp	See ISO/IEEE 11073-20601.	C
Measure-Active-Period	See ISO/IEEE 11073-20601.	NR
Simple-Nu-Observed-Value	See ISO/IEEE 11073-20601.	C
Compound-Simple-Nu-Observed-Value	See ISO/IEEE 11073-20601.	NR
Basic-Nu-Observed-Value	See ISO/IEEE 11073-20601.	NR
Compound-Basic-Nu-Observed-Value	See ISO/IEEE 11073-20601.	NR
Compound-Nu-Observed-Value	See ISO/IEEE 11073-20601.	NR
Accuracy	See ISO/IEEE 11073-20601.	NR

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

For a peak expiratory flow monitor agent with standard configuration, the AttrValMap structure (see ISO/IEEE 11073-20601) of the Attribute-Value-Map attribute shall contain the attribute ID and attribute length information of the Simple-Nu-Observed-Value and Absolute-Time-Stamp attribute in the same order as indicated in Table 8.

The optional FEV6 simple numeric object does not support any methods, events, or other services.

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

6.7 Real-time sample array objects

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

The peak expiratory flow monitor uses one enumeration object for enumerating the conditions/events during the measurement.

6.8 Enumeration objects

The peak expiratory flow monitor uses one enumeration object for enumerating the conditions/events during the measurement.

6.8.1 Reading status

The reading status object allows the peak expiratory to monitor specific conditions or events recorded during a measurement in order to ascertain reasons for variations. Measurements are susceptible to the user having had or not had medication before the measurement, coughing, or not properly blowing air into the monitor. An Enumeration object can account for such conditions to be recorded.

The object identified (OID)-Type and bit assignments shall be implemented as described in this clause. The nomenclature code to identify the enumeration object class is MDV_MOC_VMO_METRIC_ENUM. Refer to Table 9 for the set of attributes of this object.

The object is instantiated in both standard and extended configurations. An agent shall support this object to transmit these occurrences.

Table 9—Reading status enumeration object attributes

Attribute name	Extended configuration		Standard configuration (Dev-Configuration-Id = 0x0834)		Standard configuration (Dev-Configuration-Id = 0x0835)	
	Value	Qual.	Value	Qual.	Value	Qual.
Handle	See ISO/IEEE 11073-20601.	M	5	M	5	M
Type	{MDC_PART_PHD_DM, MDC_PEF_READING_STATUS}.	M	{ MDC_PART_PHD_DM, MDC_PEF_READING_STATUS }.	M	{ MDC_PART_PHD_DM, MDC_PEF_READING_STATUS }.	M
Supplemental-Types	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR
Metric-Spec-Small	mss-avail-intermittent, mss-avail-stored-data, mss-msmt-aperiodic, mss-acc-agent-initiated.	M	mss-avail-intermittent, mss-avail-stored-data, mss-msmt-aperiodic, mss-acc-agent-initiated.	M	mss-avail-intermittent, mss-avail-stored-data, mss-msmt-aperiodic, mss-acc-agent-initiated.	M
Metric-Structure-Small	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR
Measurement-Status	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR
Metric-Id	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR
Metric-Id-List	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR
Metric-Id-Partition	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR
Unit-Code	See the following text.	NR	See the following text.	NR	See the following text.	NR
Attribute-Value-Map	See ISO/IEEE 11073-20601.	C	MDC_ATTR_NU_VAL_OBS_BASIC_BIT_STRING, then MDC_ATTR_TIME_STAMP_ABS.	M	MDC_ATTR_NU_VAL_OBS_BASIC_BIT_STRING, then MDC_ATTR_TIME_STAMP_BO.	M
Source-Handle-Reference	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR
Label-String	See ISO/IEEE 11073-20601.	O	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	O	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	O
Unit-LabelString	See ISO/IEEE 11073-20601.	O	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	O	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	O
Absolute-Time-Stamp	See ISO/IEEE 11073-20601.	C	If fixed format is used and the standard configuration is not adjusted, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	R	Attribute not initially present. If present, follow ISO/IEEE 11073-20601.	NR
Base-Offset-Time-Stamp	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601. If fixed format is used and the standard configuration is not adjusted, this attribute is mandatory; otherwise, the conditions from ISO/IEEE 11073-20601 apply.	R
Relative-Time-Stamp	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR
HiRes-Time-Stamp	See ISO/IEEE 11073-20601.	C	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR

Attribute name	Extended configuration		Standard configuration (Dev-Configuration-Id = 0x0834)		Standard configuration (Dev-Configuration-Id = 0x0835)	
Enum-Observed-Value- Simple-OID	See ISO/IEEE 11073-20601.	O	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	O	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	O
Enum-Observed-Value- Simple-Bit-Str	See ISO/IEEE 11073-20601.	NR	See ISO/IEEE 11073-20601.	NR	See ISO/IEEE 11073-20601.	NR
Enum-Observed-Value- Basic-Bit-Str	See ISO/IEEE 11073-20601.	M	See ISO/IEEE 11073-20601.	M	See ISO/IEEE 11073-20601.	M
Enum-Observed-Value- Simple-Str	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR
Enum-Observed-Value	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR
Enum-Observed-Value-Partition	See ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR	Attribute not initially present. If present follow ISO/IEEE 11073-20601.	NR

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

Because these are essentially event flags, the Unit-Code attribute is not appropriate for this object. Similarly, the Source-Handle-Reference is inappropriate as this object monitors the external conditions before and during the readings. The mnemonic of Enum-Observed-Value-Simple-Bit-Str and Enum-Observed-Value-Basic-Bit-Str within Table 9 are defined in Table 10.

Table 10—Mapping of reading status to object Bit-Str attribute

Reading status	PEFReadStat mnemonic
Agent reports that the user had medication before taking the reading.	pefm-read-stat-post-medication
Agent reports that the user coughed while taking the reading.	pefm-read-stat-cough
Agent reports that the users effort was short while taking the reading.	pefm-read-stat-short-effort
Agent reports that the user took longer time than expected to reach maximum blow force.	pefm-read-stat-long-time-to-peak

NOTE—The specific bit mappings of PEFReadStat are defined in Annex B.

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 Class extension objects

In this standard, no class extension objects are defined with respect to ISO/IEEE 11073-20601.

6.12 Peak expiratory flow monitor information model extensibility rules

The peak expiratory flow monitor domain information model of this standard may be extended by including vendor-specific metrics and attributes as required. Any object or attribute extensions implemented should follow the guidelines of this standard as closely as possible. Such vendor-specific objects and attributes shall be identified by assigning nomenclature codes from the private numbering space (0xF000 – 0xFFFF) within the appropriate partition as defined in IEEE 11073-20601.

A peak expiratory flow monitor agent having a configuration with extensions beyond the standard configuration, as specified in this standard, shall use a configuration ID in the range of IDs reserved for extended configurations (see ISO/IEEE 11073-20601).

7. Peak expiratory flow monitor 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 ISO/IEEE 11073-20601 for a detailed description of the personal health device service model. Subclauses 7.2 and 0 define the specifics of object access and event reporting services for a peak expiratory flow monitor agent according to this standard.

7.2 Object access services

The object access services of ISO/IEEE 11073-20601 are used to access the objects defined in the domain information model of the peak expiratory flow monitor.

The following generic object access services are supported by a peak expiratory flow monitor agent according to this standard:

— GET service: used by the manager to retrieve the values of the agent MDS object attributes. The list of peak expiratory flow monitor MDS object attributes is given in 6.5.4.1.

— SET service: used by the manager to set the values of the agent object attributes. There are no settable attributes defined for a peak expiratory flow monitor 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 peak expiratory flow monitor 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 the Set-Time action, which is used to set a real-time clock with the absolute time at the agent.

Table 11 summarizes the object access services described in this standard.

Table 11—Peak expiratory flow monitor object access services

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-Scan-Report-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-Scan-Report-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 a fixed format.
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 11) 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 ISO/IEEE 11073-20601.

The following conditions apply for a peak expiratory flow monitor agent according to this standard:

— Event reports shall be used in confirmed mode.

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

A peak expiratory flow monitor agent is typically designed to operate in an environment where data may be collected from only one person; hence, 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 peak expiratory flow monitor agent may support only single-person event reports. The formats for single-person reports are described in ISO/IEEE 11073-20601.

8. Peak expiratory flow monitor communication model

8.1 Overview

This clause describes the general communication model and procedures of the peak expiratory flow monitor agent as defined in ISO/IEEE 11073-20601. Therefore, the respective parts of ISO/IEEE 11073-20601 are not reproduced; rather, the specific choices and restrictions with respect to optional elements (e.g., objects, attributes, and actions) and specific extensions (e.g., nomenclature terms) are specified.

For an illustrative overview of the various message transactions during a typical measurement session, 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

In this subclause, limits on the size of an application protocol data unit (APDU) transmitted or to be received by a peak expiratory flow monitor agent are defined. Small limits allow for simple implementations in terms of low cost and complexity.

A peak expiratory flow monitor agent implementing only this device specialization shall not transmit any APDU larger than N_{tx} and shall be capable of receiving any APDU up to a size of N_{rx}. For this standard, N_{tx} shall be 2030 octets and N_{rx} shall be 224 octets.

For a peak expiratory flow monitor agent implementing functions from other device specializations, an upper bound estimation of the APDU sizes brings the following: An agent shall not transmit any APDU larger than the sum of N_{tx} of all the device specializations implemented and shall be capable of receiving any APDU up to the sum of N_{rx} of all the device specializations implemented. If these numbers are higher than the maximum size determined in ISO/IEEE 11073-20601, the latter shall be applied.

In case the APDU size limit does not allow for the inclusion of a certain amount of multiple pending measurements at the agent, they shall be sent using multiple event reports. See 8.5.3 for the maximum number of measurements allowed for inclusion in a single event report.

8.3 Association procedure

8.3.1 General

Unless otherwise stated, the association procedure for a peak expiratory flow monitor agent and manager according to this standard shall be pursued as specified in ISO/IEEE 11073-20601.

Table 12 lists the valid combinations of the protocol version and nomenclature version. In the association procedure, an agent indicating support for a specific protocol version shall indicate support for the corresponding nomenclature version as well. In the association procedure, a manager selecting a specific protocol version shall select the corresponding nomenclature version.

To indicate support for multiple protocol versions, the bit values are combined. For example, if the agent supports protocol-version2, protocol-version3, and protocol-version4, it shall use protocol version bits 0x70000000 and nomenclature-version bits 0xE0000000.

Future versions of this specification may include further valid combinations that can be used by implementations that comply with that future version.

Table 12 Valid combinations of protocol and nomenclature version

Protocol version	Bit value	Corresponding nomenclature version	Bit value
1	0x80000000	1	0x80000000
2	0x40000000	1	0x80000000
3	0x20000000	2	0x40000000
4	0x10000000	3	0x20000000

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 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-version4 (i.e., *protocol-version* = *0x10000000*). Support for any other version may be indicated by setting additional bits. When protocols lower than protocol-version4 are used, the agent shall use only features in that protocol.
2) At least the MDERs shall be supported (i.e., *encoding-rules* = 0x8000).
3) The protocol version bits and nomenclature version bits shall consist of valid combinations of bits as defined in Table 12.
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 peak expiratory flow monitor 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 peak expiratory flow monitor specialization, then the field indicating the data request modes (*data-req-mode-capab*) supported by the peak expiratory flow monitor agent shall be set to *data-req-supp-init-agent.*

9) If the agent supports only the peak expiratory flow monitor specialization, then *data-req-init-manager-count* shall be set to zero, and *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 ISO/IEEE 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 manager following this specialization shall support protocol-version4. The manager may support additional protocol versions and select them if the agent offers them. When protocols lower than protocol-version4 are used, the manager shall use only features in that protocol.

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 MDERs.

3) The manager shall select a valid combination of the protocol version and nomenclature version as defined in Table 12.

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 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 fields *data-req-init-agent-count* shall be 1, and *data-req-init-manager-count* shall be 0.

8.4 Configuring procedure

8.4.1 General

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 ISO/IEEE 11073-20601 shall be followed. Subclause 8.4.2 specifies the configuration notification and response messages for a peak expiratory flow monitor agent with standard configuration ID 2100 (0x0834). Normally, a manager would already know the standard configuration. However, standard configuration devices are required to send their configuration, if requested. This covers a case where an agent associates with a manager that does not have preconfigured knowledge of the standard configuration (e.g., due to a version mismatch between agent and manager).

8.4.2 Peak expiratory flow monitor—standard configuration

8.4.2.1 Agent procedure

The agent performs the configuration procedure using a “Remote Operation Invoke | Confirmed Event Report” message with an MDC_NOTI_CONFIG event to send its configuration to the manager (see ISO/IEEE 11073-20601). The ConfigReport structure is used for the *event-info* field (see Table 3). For a peak expiratory flow monitor agent with standard configuration ID 2101 (0x835), the format and contents of the configuration notification message are as follows:

0xE7 0x00	APDU CHOICE Type (PrstApdu)
0x00 0xBE	CHOICE.length = 190
0x00 0xBC	OCTET STRING.length = 188
0x00 0x02	invoke-id = 2 (start of DataApdu. MDER encoded.)
0x01 0x01	CHOICE(Remote Operation Invoke | Confirmed Event Report)
0x00 0xB6	CHOICE.length = 182
0x00 0x00	obj-handle = 0 (MDS object)
0xFF 0xFF 0xFF 0xFF	event-time=0xFFFFFFFF
0x0D 0x1C	event-type = MDC_NOTI_CONFIG
0x00 0xAC	event-info.length = 172 (start of ConfigReport)
0x08 0x35	config-report-id = 2101 (0x835)
0x00 0x04	config-obj-list.count = 4 Measurement objects will be “announced”
0x00 0xA6	config-obj-list.length = 166
0x00 0x06	obj-class = MDC_MOC_VMO_METRIC_NU
0x00 0x01	obj-handle = 1
0x00 0x04	attributes.count = 4
0x00 0x24	attributes.length = 36
0x09 0x2F	attribute-id = MDC_ATTR_ID_TYPE
0x00 0x04	attribute-value.length = 4
0x00 0x02 0x54 0x08	MDC_PART_SCADA | MDC_FLOW_AWAY_EXP_FORCED_PEAK
0x0A 0x46	attribute-id=MDC_ATTR_METRIC_SPEC_SMALL
0x00 0x02	attribute-value.length = 2
0xE0 0x40	attribute-value = 57408

```
0x09 0x96                 attribute-id = MDC_ATTR_UNIT_CODE
0x00 0x02                 attribute-value.length = 2
0x0C 0x00                 MDC_DIM_X_L_PER_MIN
0x0A 0x55                 attribute-id = MDC_ATTR_ATTRIBUTE_VAL_MAP
0x00 0x0C                 attribute-value.length = 12
0x00 0x02                 AttrValMap.count = 2
0x00 0x08                 AttrValMap.length = 8
0x0A 0x56                 attribute-id = MDC_ATTR_NU_VAL_OBS_SIMP
0x00 0x04                 attribute-value.length = 4
0x0A 0x82                 attribute-id = MDC_ATTR_TIME_STAMP_BO
0x00 0x08                 attribute-value.length = 8
0x00 0x06                 obj-class = MDC_MOC_VMO_METRIC_NU
0x00 0x02                 obj-handle = 2
0x00 0x04                 attributes.count = 4
0x00 0x24                 attributes.length = 36
0x09 0x2F                 attribute-id = MDC_ATTR_ID_TYPE
0x00 0x04                 attribute-value.length = 4
0x00 0x02 0x54 0x09       MDC_PART_SCADA |
                          MDC_FLOW_AWAY_EXP_FORCED_PEAK_PB
0x0A 0x46                 attribute-id=MDC_ATTR_METRIC_SPEC_SMALL
0x00 0x02                 attribute-value.length = 2
0xE0 0x40                 attribute-value = 57408
0x09 0x96                 attribute-id=MDC_ATTR_UNIT_CODE
0x00 0x02                 attribute-value.length = 2
0xC0 0x00                 MDC_DIM_X_L_PER_MIN
0x0A 0x55                 attribute-id=MDC_ATTR_ATTRIBUTE_VAL_MAP
0x00 0x0C                 attribute-value.length = 12
0x00 0x02                 AttrValMap.count = 2
0x00 0x08                 AttrValMap.length = 8
0x0A 0x56                 attribute-id = MDC_ATTR_NU_VAL_OBS_SIMP
0x00 0x04                 attribute-value.length = 4
0x0A 0x82                 attribute-id = MDC_ATTR_TIME_STAMP_BO
0x00 0x08                 attribute-value.length = 8
0x00 0x06                 obj-class = MDC_MOC_VMO_METRIC_NU
0x00 0x03                 obj-handle = 3
0x00 0x04                 attributes.count = 4
0x00 0x24                 attributes.length = 36

0x09 0x2F                 attribute-id = MDC_ATTR_ID_TYPE

0x00 0x04                 attribute-value.length = 4
0x00 0x02 0x54 0x0A       MDC_PART_SCADA | MDC_VOL_AWAY_EXP_FORCED_1S
0x0A 0x46                 attribute-id=MDC_ATTR_METRIC_SPEC_SMALL
0x00 0x02                 attribute-value.length = 2
0xE0 0x40                 attribute-value = 57408
0x09 0x96                 attribute-id=MDC_ATTR_UNIT_CODE
0x00 0x02                 attribute-value.length = 2
0x06 0x40                 MDC_DIM_X_L
0x0A 0x55                 attribute-id=MDC_ATTR_ATTRIBUTE_VAL_MAP
0x00 0x0C                 attribute-value.length = 12
0x00 0x02                 AttrValMap.count = 2
0x00 0x08                 AttrValMap.length = 8
```

0x0A 0x56	attribute-id=MDC_ATTR_NU_VAL_OBS_SIMP
0x00 0x04	attribute-value.length = 4
0x0A 0x82	attribute-id = MDC_ATTR_TIME_STAMP_BO
0x00 0x08	attribute-value.length = 8
0x00 0x05	obj-class = MDC_MOC_VMO_METRIC_ENUM
0x00 0x05	obj-handle = 5
0x00 0x03	attributes.count = 3
0x00 0x1A	attributes.length = 26
0x09 0x2F	attribute-id = MDC_ATTR_ID_TYPE
0x00 0x04	attribute-value.length = 4
0x00 0x80 0x78 0x00	MDC_PART_PHD_DM | MDC_PEF_READING_STATUS
0x0A 0x46	attribute-id=MDC_ATTR_METRIC_SPEC_SMALL
0x00 0x02	attribute-value.length = 2
0x00 0x00	attribute-value = 0
0x0A 0x55	attribute-id=MDC_ATTR_ATTRIBUTE_VAL_MAP
0x00 0x08	attribute-value.length = 8
0x00 0x01	AttrValMap.count = 1
0x00 0x04	AttrValMap.length = 4
0x0A 0x66	attribute-id=MDC_ATTR_ENUM_OBS_VAL_BASIC_BIT_STR
0x00 0x02	attribute-value.length = 2

8.4.2.2 Manager procedure

The manager shall respond to a configuration notification message using a “Remote Operation Response | Confirmed Event Report” data message with an MDC_NOTI_CONFIG event using the ConfigReportRsp structure for the *event-info* field (see Table 3). As a response to the standard configuration notification message in 8.4.2.1, the format and contents of the manager’s configuration notification response message are as follows:

0xE7 0x00	APDU CHOICE Type (PrstApdu)
0x00 0x16	CHOICE.length = 22
0x00 0x14	OCTET STRING.length = 20
0x00 0x02	invoke-id (differentiates this message from any other outstanding)
0x02 0x01	CHOICE (Remote Operation Response | Confirmed Event Report)
0x00 0x0E	CHOICE.length = 14
0x00 0x00	obj-handle = 0 (MDS object)
0xFF 0xFF 0xFF 0xFF	currentTime
0x0D 0x1C	event-type = MDC_NOTI_CONFIG
0x00 0x04	event-reply-info.length = 4
0x08 0x35	ConfigReportRsp.config-report-id = 0x835
0x00 0x00	ConfigReportRsp.config-result = accepted-config

8.5 Operating procedure

8.5.1 General

Measurement data and status information are communicated from the peak expiratory flow monitor agent during the Operating state. If not stated otherwise, the operating procedure for a peak expiratory flow monitor agent of this standard shall be as specified in ISO/IEEE 11073-20601.

8.5.2 GET Peak expiratory flow monitor MDS attributes

See Table 4 for a summary of the GET service.

If the *attribute-id-list* field in the roiv-cmip-get service message is empty, the peak expiratory flow monitor agent shall respond with a rors-cmip-get service message in which the attribute-list contains a list 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 peak expiratory flow monitor agent shall respond with a rors-cmip-get service message in which the attribute-list contains a list of the requested attributes of the MDS object that are implemented. It is not required for a peak expiratory flow monitor agent to support this capability. If this capability is not implemented, the peak expiratory flow monitor agent shall respond as specified in the MDS object attributes clause in ISO/IEEE 11073-20601.

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 peak expiratory flow monitor agent of this standard shall always be initiated by the peak expiratory flow monitor (see agent-initiated measurement data transmission in ISO/IEEE 11073-20601). To limit the amount of data being transported within an APDU, the peak expiratory flow monitor 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 PEF, FEV1, and FEV6 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 PEF or FEV1, or FEV6 measurement. However, the former strategy is recommended to reduce overall message size and power consumption.

A peak expiratory flow monitor agent with standard configuration shall use the fixed format data update messages method for transmitting measurement data. A peak expiratory flow monitor agent with extended configuration may use either fixed or variable format data update messages for transmitting measurement data.

8.6 Time synchronization

Time synchronization between a peak expiratory flow monitor 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

The Test Association provides a manufacturer with the mechanism to test or demonstrate the features of a product in a comprehensive manner. This clause defines the behavior of the standard peak expiratory flow monitor agent during a test association. Support for test association is optional.

9.1 Behavior with standard configuration

An agent or manager entering a test association using the configuration ID for the standard peak expiratory flow monitor device of this standard shall enter the Operating state in test mode. When in test mode, where

possible, this should be indicated visually to any user. Normal functionality shall be suspended, and any test data generated shall not be processed by the device as physiological data.

The peak expiratory flow monitor agent shall send a single simulated PEF value of 600 liters/min and a single simulated FEV-1 value of 10 L (values never seen in normal usage and outside normal range) within 30 s of entering the Operating state. If the measurement-status attribute of the numeric object is implemented, then the test-data bit shall be set.

The test association is terminated in a manner consistent with the agent's normal behavior for terminating an association.

9.2 Behavior with extended configurations

This specification does not define a test association that uses an extended configuration.

10. Conformance

10.1 Applicability

This standard shall be used in conjunction with ISO/IEEE 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)

10.2 Conformance specification

This standard offers levels of conformance with respect to strict adherence to the standard device and the use of extensions for:

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

A vendor shall specify the level of conformance for an implementation based on this standard and provide details of the way in which the definitions of this standard and any extensions are applied.

Specifications shall be provided in the form of a set of implementation conformance statements (ICS) as detailed in 10.4

This standard is used in conjunction with the ISO/IEEE 11073-20601 standard. It is recommended that the ICS for this standard be created first so that the ICS created for the ISO/IEEE 11073-20601 standard may refer to the ICS for this standard where applicable.

10.3 Levels of conformance

10.3.1 General

This standard defines the following levels of conformance.

10.3.2 Conformance level 1: Base conformance

The application uses elements of the information, service, and communication models (object hierarchy, actions, event reports, and data type definitions) and the nomenclature scheme defined in ISO/IEEE 11073-20601 and IEEE Std 11073-104zz. All mandatory features defined in the object definition tables and in the ICS tables are implemented. Furthermore, any conditional, recommended, or optional features that are implemented shall follow the requirements in ISO/IEEE 11073-20601 and IEEE Std 11073-104zz.

10.3.3 Conformance level 2: Extended nomenclature (ASN.1 and/or ISO/IEEE 11073-10101)

Conformance level 2 meets conformance level 1 but also uses or adds extensions in at least one of the information, service, communication, or nomenclature models. These extensions shall conform to structures defined using ASN.1 and/or nomenclature codes within the ISO/IEEE 11073-10101 framework (0xF000 through 0xFFFF). These extensions should be defined in ICS tables pointing toward their reference.

10.4 Implementation conformance statements (ICSs)

10.4.1 General format

The ICSs are provided as an overall conformance statement document that comprises a set of tables in the form given by the templates in the following clauses.

Each ICS table has the following columns:

Index	Feature	Reference	Req./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 is made.
- **Reference,** is a reference to the clause or subclause within this standard or to an external source for the definition of the feature (may be empty).
- **Req/Status,** specifies the conformance requirement (e.g., mandatory, recommended). In some cases, this standard does not specify conformance requirements but requests the status of a particular feature be provided.
- **Support,** specifies the presence or absence of a feature and any description of the characteristics of the feature in the implementation. This column is to be filled out by the implementer.
- **Comment,** contains any additional information on the feature. This column is to be filled out by the implementer.

Subclauses 10.4.2 through 10.4.6 specify the format of the specific ICS tables.

10.4.2 General ICS

The general ICS specifies the versions/revisions that are supported by the implementation and high-level system behavior.

Table 13 shows general ICSs.

Table 13—11073-10421 general ICSs' table

Index[a]	Feature	Reference	Req./Status	Support	Comment
GEN11073-10421-1	Implementation Description	—	Identification of the device/ application. Description of functionality.		
GEN11073-10421-2	Standards followed, and their revisions	(standard documents)	(set of existing revisions)	(set of supported revisions)	
GEN11073-10421-3	Nomenclature document used and revision	(standard documents)	(set of existing revisions)	(set of supported revisions)	
GEN11073-10421-4	Conformance Adherence - Level 1 -	See 10.3.2	Base conformance declaration that the device meets the following IEEE 11073-10421 conformance requirements: a) All mandatory requirements shall be implemented. b) If implemented, conditional, recommended, and optional requirements shall conform to the standard.	Yes/No (No is not expected as No implies that the implementation is non-conformant)	
GEN11073-10421-5	Conformance Adherence - Level 2 -	See 10.3.3	In addition to GEN11073-10421-4, if the device implements extensions and/or additions, they shall conform to nomenclature codes from ASN.1 and/or 10101 framework. These extensions should also be defined in ICS tables pointing toward their reference.	Yes/No	
GEN11073-10421-6	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.		
GEN11073-	Nomenclature	(standard	(set of existing	(set of supported	

Index[a]	Feature	Reference	Req./Status	Support	Comment
10421-7	document used and revision	documents)	revisions)	revisions)	
GEN11073-10421-8	Data Structure Encoding	—	—	description of encoding method(s) for ASN.1 data structures	
GEN11073-10421-9	Use of Private Objects	—	Does the implementation use objects that are not defined in the DIM?	Yes/No (If yes: explain in Table 14)	
GEN11073-10421-10	Use of Private Nomenclature Extensions	—	Does the implementation use private extensions to the nomenclature (i.e., 0xF000–0xFFFF codes from ISO/IEEE 11073-10101)? Private Nomenclature extensions are allowed *only* if the standard nomenclature does not include the specific terms required by the application.	Yes/No (If yes: explain in Table 17)	
GEN11073-10421-11	11073-20601 Conformance		Provide the conformance report required by ISO/IEEE 11073-20601.		

[a]The prefix GEN11073-10421 is used for the index in the general ICSs table.

10.4.3 DIM MOC implementation conformance statement

The DIM MOC ICS defines which objects are implemented. Information on each object shall be provided as a separate row in the template of Table 14.

Table 14—Template for DIM MOC ICS table

Index	Feature	Reference	Req./Status	Support	Comment
MOC-*n*	Object description	Reference to the clause in the standard or other location where the object is defined.	Implemented	Specify restrictions (e.g., the maximum number of supported instances)	

The *n* in the Index column should be the object handle for implementations that have predefined objects. Otherwise, the Index column shall simply be a unique number (1..*m*).

All private objects should be specified and include either a reference to the definition for the object or, where no publicly available reference is available, the definition of the object should be appended to the conformance statement.

The Support column should indicate any restrictions for the object implementation.

An object containment diagram (class instance diagram) should be provided as part of the DIM MOC ICS.

10.4.4 MOC attribute ICS

The MOC attribute ICS defines which attributes, including any inherited attributes, are used/supported in each object of an implementation. Information on each attribute of an object shall be provided as a separate row in the template of Table 15. A separate MOC attribute ICS shall be provided for each object.

Table 15—Template for MOC attribute ICS table

Index	Feature	Reference	Req./Status	Support	Comment
ATTR-*n*-*x*	Attribute Name. Extended attributes shall include the attribute ID also.	Fill in the reference to the ASN.1 structure if the attribute is not defined in this standard.	M = Mandatory / C = Conditional / R = Recommended / O = Optional (as per the definition in Attribute Definition Tables)	Implemented? Yes/No Static/Dynamic Specify restrictions (e.g., value ranges). Describe how the attribute is accessed (e.g., Get, Set, sent in config event report, sent in a data event report). Describe any specific restrictions.	

The Support column shall specify the following:

— Whether the attribute is implemented
— For extension attributes, whether the attribute value is static or dynamic
— Any value ranges
— Restrictions on attribute access or availability
— Any other applicable information

The *n* in the Index column refers to the ID of the managed object for which the table is supplied (i.e., the index of the managed object as specified in the MOC ICS). There is one separate table for each supported managed object.

The *x* in the Index column is a unique serial number (1..*m*).

10.4.5 MOC notification ICS

The MOC notification ICS specifies all implemented notifications (typically in the form of the event report service) that are emitted by the agent. Table 16 provides a template for use. One table has to be provided for each object that supports special object notifications. One row of the table shall be used for each notification.

Table 16—Template for MOC notification ICS table

Index	Feature	Reference	Req./Status	Support	Comment
NOTI-*n*-*x*	Notification Name and Notification ID	Reference to the clause in the standard or other location where the event is defined.		The Support column shall specify how the notification is sent and any restrictions.	

The *n* in the Index column refers to the ID of the managed object for which the table is supplied (i.e., the index of the managed object as specified in the POC ICS). There is one separate table for each managed object that supports specific object notifications (i.e., events).

The *x* in the Index column is a unique serial number (1..*m*).

All private notifications should be specified and include a reference to the definition for the notification. Where no publicly available reference is available, the definition of the notification should be appended to the conformance statement.

10.4.6 MOC nomenclature ICS

The MOC nomenclature ICS specifies all nonstandard nomenclature codes that are utilized by the agent. Table 17 provides a template for use. One row of the table is to be used for each nomenclature element.

Table 17—Template for MOC nomenclature ICS table

Index	Feature	Reference	Req./Status	Support	Comment
NOME-*n*	Nomenclature Name and Nomenclature value	Reference to the clause in the standard or other location where the nomenclature is defined or used		Describe how the nomenclature is used. Describe any specific restrictions.	

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

Annex A

(informative)

Bibliography

Bibliographical references are resources that provide additional or helpful material but do not need to be understood or used to implement this standard. Reference to these resources is made for informational use only. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

[B1] IEC 60601-1, Medical electrical equipment—Part 1: General requirements for basic safety and essential performance.[12]

[B2] IEC 60601-2, Medical electrical equipment—Part 2: Particular requirements for the basic safety and essential performance for specific devices. (See the entire series of standards, Part 2-1 through Part 2-51.)

[B3] IEC 62304, Medical device software—Software life-cycle processes.

[B4] IEC 80001-1, Application of risk management for IT networks incorporating medical devices—Part 1: Roles, responsibilities, and activities.

[B5] ISO 14971, Medical devices—Application of risk management to medical devices.[13]

[B6] ISO/IEEE 11073-10201, Health informatics—Point-of-care medical device communication—Part 10201: Domain information model.

[B7] ISO/IEEE 11073-20101, Health informatics—Point-of-care medical device communication—Part 20101: Application profile—Base standard.

[B8] ITU-T Rec. X.680, Information technology—Abstract Syntax Notation One (ASN.1): Specification of basic notation.[14]

[12] IEC publications are available from the International Electrotechnical Commission (http://www.iec.ch/). IEC publications are also available in the United States from the American National Standards Institute (http://www.ansi.org).
[13] ISO publications are available from the ISO Central Secretariat (http://www.iso.org/). ISO publications are also available in the United States from the American National Standards Institute (http://www.ansi.org/).
[14] ITU publications are available from the International Telecommunication Union (http://www.itu.int/).

Annex B

(normative)

Any additional ASN.1 definitions

Reading status bit mapping.

```
PEFReadStat::=BITS-16{
                pefm-read-stat-post-medication(0),
                pefm-read-stat-cough(1),

                pefm-read-stat-short-effort(2),

                pefm-read-stat-long-time-to-peak(3)

                }
```

(Bits are set to 1 when the corresponding event occurs.)

Annex C

(normative)

Allocation of identifiers

This annex contains the nomenclature codes used in this document. For those not contained in this annex, the normative definition is found in ISO/IEEE 11073-20601 or ISO/IEEE 11073-10101.

The format used here follows that of ISO/IEEE 11073-10101.

```
/*********************************************************************************
* From Communication Infrastructure (MDC_PART_INFRA)
*********************************************************************************/
#define MDC_DEV_SPEC_PROFILE_PEFM               4117
/*********************************************************************************
* From Medical supervisory control and data acquisition (MDC_PART_SCADA)
*********************************************************************************/
#define MDC_FLOW_AWAY_EXP_FORCED_PEAK           21512 /* peak expiratory flow */
#define MDC_FLOW_AWAY_EXP_FORCED_PEAK_PB        21513 /* personal best of PEF */
#define MDC_VOL_AWAY_EXP_FORCED_1S              21514 /* forced expiratory volume over
                                                                        1 second */
#define MDC_VOL_AWAY_EXP_FORCED_EXP_6S          21515 /* forced expiratory volume over
                                                                        6 seconds */
/*********************************************************************************
* From Dimensions (MDC_PART_DIM)
*********************************************************************************/
#define MDC_DIM_X_L_PER_MIN             3072  /* l min-1                          */
#define MDC_DIM_X_L                     1600  /* l                                */
/*********************************************************************************
* From Dimensions (MDC_PART_DIM_DM)
*********************************************************************************/
# define MDC_PEF_READING_STATUS         30720
```