
**Earth-moving machinery and mobile
road construction machinery —
Worksite data exchange —**

**Part 3:
Telematics data**

*Engins de terrassement et machines mobiles de construction de
routes — Échange de données sur le chantier —*

Partie 3: Données télématiques



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 3, *Machine characteristics, electrical and electronic systems, operation and maintenance*.

This second edition cancels and replaces the first edition (ISO/TS 15143-3:2016), which has been technically revised.

The main changes compared to the previous edition are as follows:

- addition of [Annex E](#) (normative) that specifies process for adding new data elements to ISO/TS 15143-3;
- editorial improvement of the text.

This document is intended to be used in conjunction with ISO 15143-1 and ISO 15143-2.

A list of all parts in the ISO 15143 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is a data schema for data transmitted directly from the equipment manufacturer or provider to the equipment owner in a standardized format for the use and convenience of equipment owners with mixed fleets of equipment.

It defines a set of web services that provide information about fleets of mobile equipment and their associated telematics data. The information about a fleet is provided as a resource, typically on the Internet, at a known Uniform Resource Location (URL).

Customer application can access these resources by sending HTTPS GET requests to the server at the given location. The server responds with an equipment information document whose vocabulary is defined in this document.

ISO/TC 127/SC 3 wishes to acknowledge the Association of Equipment Manufacturers and the Association of Equipment Management Professionals for their contributions to prior work on this subject.

The goal of this document is to provide direct access by end users to their specific fleet data, and not to enable third parties for data aggregation across end users or other purposes. The use of this document enables each end user or assigned customer application developer to develop applications for purposes deemed appropriate by the end user.

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Earth-moving machinery and mobile road construction machinery — Worksite data exchange —

Part 3: Telematics data

1 Scope

This document specifies the communication schema designed to provide mobile machinery status data from a telematics provider's server to customer applications via the Internet. The data is collected from a mobile machine using telematics data-logging equipment and stored on a telematics provider's server. This document describes the communications records used to request data from the server and the responses from the server containing specified data elements to be used in the analysis of machine performance and machine management status related with operation and/or maintenance.

It is applicable to self-propelled earth-moving machinery as defined in ISO 6165 and mobile road construction machinery as defined in ISO 22242 equipped with location and time instrumentation.

It is not applicable to the on-board data collection, on-board communication protocol (e.g. CANbus) or wireless transmission of the mobile machinery data to the telematics provider's server after the data have been collected at the data logger. See [Figure 1](#).

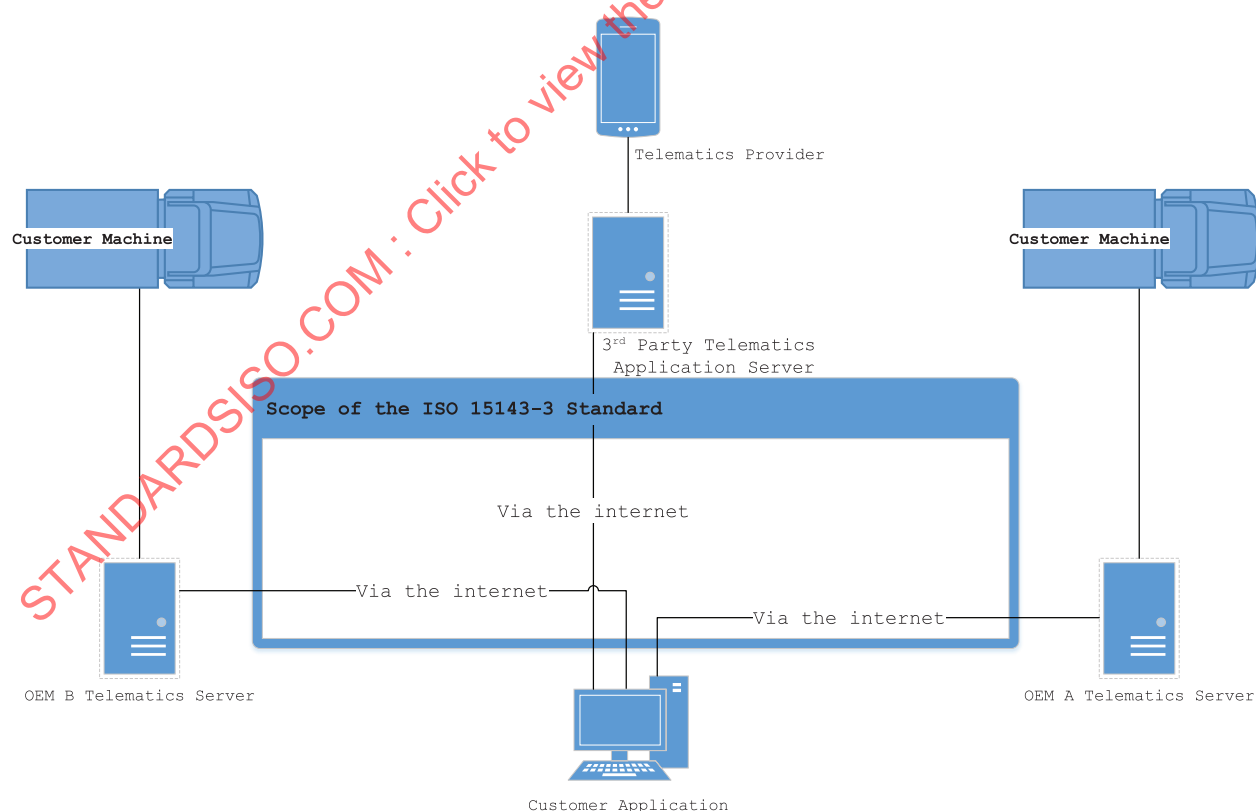


Figure 1 — Topography of conceptual mixed fleet telematics system within the scope of this document

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3779, *Road vehicles — Vehicle identification number (VIN) — Content and structure*

ISO 6405-1, *Earth-moving machinery — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 6405-2, *Earth-moving machinery — Symbols for operator controls and other displays — Part 2: Symbols for specific machines, equipment and accessories*

ISO 7000, *Graphical symbols for use on equipment — Registered symbols*

ISO 8601 (all parts), *Date and time — Representations for information interchange*

ISO 10261, *Earth-moving machinery — Product identification numbering system*

ISO 15143-2:2010, *Earth-moving machinery and mobile road construction machinery — Worksite data exchange — Part 2: Data dictionary*

IEC 60417, *Graphical symbols for use on equipment*

ECMA-404, *The JSON Data Interchange Format*

IETF RFC 7231, *Hypertext Transfer Protocol (HTTP/1.1): Semantics and Context*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1.1

caution codes referencing number

ISO/IEC symbol registration number as defined in ISO 7000 and referenced in ISO 6405-1 and ISO 6405-2.

Note 1 to entry: Caution codes referencing numbers are returned from the *telematics provider* (3.1.18) server and refer to standardized symbols representing various conditions present on EMM and mobile road construction machinery.

3.1.2

construction worksite

location of the operation of a fleet of mobile equipment generally identified as construction machines, where the machines are used to perform work

3.1.3

customer application

end user (3.1.7) or assigned third-party developer application

3.1.4**data element**

instance of data transmitted by the OEM server to the *customer application* (3.1.3) adhering to the definition of the quantity or condition described by [Clause 11](#) of this document

3.1.5**discoverability**

requirement that the data be stored in such a manner that it can be accessed if necessary

3.1.6**endpoint**

address or connection point to the provider's server for a specific API method

Note 1 to entry: Endpoints are associated by a URL.

3.1.7**end user**

organization owning or operating the mobile machinery or both

Note 1 to entry: The end user utilizes the telematics data for the purpose of managing the tasks associated with work performed on a *construction worksite* (3.1.2).

3.1.8**fault code**

set of codes unique to each OEM related to diagnostic trouble codes as defined in SAE J1939-73

Note 1 to entry: Fault codes are defined by the OEM and might not be standardized. The *customer application* (3.1.3) developer needs to obtain fault code definitions from each OEM.

3.1.9**Internet media-type**

two-part identifier for file formats on the Internet

3.1.10**link**

element to allow the *customer application* (3.1.3) to be directed to additional data or resources

3.1.11**make code**

alphabetic string representing the OEM of a specific piece of equipment

3.1.12**model**

alphanumeric string representing the machine form type and series as defined by the OEM

3.1.13**namespace**

set of symbols that are used to organize objects of various kinds, so that these objects may be referred to by name

3.1.14**namespace URL**

uniquely named elements and attributes in an XML document

Note 1 to entry: *Namespaces* (3.1.13) are defined in a W3C recommendation. An XML instance might contain element or attribute names from more than one XML vocabulary.

3.1.15**request**

HTTP request to retrieve a complete information set

Note 1 to entry: "Request" can be of one or more HTTP request(s)."

Note 2 to entry: “Request” can be for one or multiple pages.

Note 3 to entry: Fleet snapshot request is a request to retrieve all (or subset) pages for the fleet.

Note 4 to entry: Equipment snapshot request is a request to retrieve all equipment snapshot data.

Note 5 to entry: *Time series* (3.1.19) request is a request to retrieve all details (or subset) of a piece of equipment.

3.1.16

serial number

alphanumeric string defined by the OEM identifying a specific piece of equipment

Note 1 to entry: The serial number is generally the PIN as defined in ISO 10261.

3.1.17

snapshot time

date and time at which the snapshot of the fleet was created

3.1.18

telematics provider

OEM or third party providing telematics equipment or services

3.1.19

time series

sequence of data points, typically consisting of successive measurements made over a period of time

Note 1 to entry: Examples of a time series would be the geospatial position of a piece of equipment or the set of *fault codes* (3.1.8) generated by a piece of equipment over a period of time.

3.1.20

version

integer that is used to distinguish different editions of the contract

3.1.21

XML declaration

processing instruction that identifies the document as being XML

Note 1 to entry: All XML documents should begin with an XML declaration, which should be situated at the first position of the first line in the XML.

3.1.22

resource owner

equipment/fleet owner or end-user

3.2 Abbreviated terms

For the purposes of this document, the abbreviated terms given in [Table 1](#) apply.

Table 1 — Abbreviated terms

API	application programming interface
DEF	diesel exhaust fluid
EI	electronic interface
EMM	earth-moving machinery
FMI	failure mode indicator
GPS	global positioning system
HREF	hypermedia reference URL
ID	identification
IETF	Internet engineering task force

Table 1 (continued)

MA	maintenance agency
OEM	original equipment manufacturer
PIN	product identification number
REL	reference attribute
SI	<i>systeme internationale</i> (international system of units)
SOAP	simple object access protocol
SPN	suspect parameter number
URL	universal resource location
URN	universal resource name
UTC	universal coordinated time
UTF-8	unicode transformation format, 8 bit
VIN	vehicle identification number
XML	extensible markup language

4 Data management and access control

4.1 Polling period

The recommended frequency the telematics provider will serve data to the customer application is one response per 15 min.

The server will supply the last known data to the application independent of the update rate from the machine to the server. The telematics device communication from the machine can vary due to cell coverage, telematics settings, etc., so last known data may be significantly older, and may not change between server data transmissions.

The data provider may cache telematics data or rate limit responses in order to provide the highest quality of service possible.

4.2 Editing the data elements over time

The data set identified in this document is expected to be modified over time in a controlled fashion as set forth in ISO 15143-1:2010, A.2 with updated .XSD files to be posted at <http://www.jcmanet.org/english2017/ISO/15143/-3/> as they become available. Annex E process shall be followed for this purpose.

An accept header will be included with every request to negotiate the definition of data desired in the response. The accept header will correlate to a version of the ISO document. The version will be the Date String (YYYYMMDD) when the ISO document was published. See Table 2.

NOTE The text in this second edition of this document is referencing “20190501” XSD file folder and relating URLs; any updates to them are made through the MA.

If no accept header is included in a request, version 1 (20161201) will be assumed. This will be the format of the data included in the response.

Example xml accept header for version 1:
Accept: application/x.iso15143-3.v20161201+xml

Example json accept header for version 1:
Accept: application/x.iso15143-3.v20161201+json

Table 2 — Version number date string example

Version	Data string	XSD URL
1	20161201	http://standards.iso.org/iso/15143/-3/
2	20190501	http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/
3	TBD When Published	http://www.jcmanet.or.jp/english2017/ISO/15143/-3/TBDWhenPublished/

4.3 Data element use case

A use case as described in ISO 15143-1 for each data element defined in this document is presented in [Table A.2](#).

4.4 Data element cross reference

The data element names and attributes identified in this document have been harmonized with similar data elements defined in ISO 15143-2:2010, Table A.1 and further defined in ISO 15143-2:2010, Table A.2. The relationships between the data elements in this document and the related ones in ISO 15143-2 are presented in [Annex A](#).

4.5 Access authentication

Implementers control access via OAuth 2.0 using HTTPS, as defined by the Internet engineering task force (IETF). Refer to <http://www.ietf.org> for additional information.

The telematics provider assigns security credential and access information when the end user registers the fleet. Each telematics provider has its own registration procedure. End users should contact the telematics provider for information on how to register for access to data via this document.

To prevent excessively frequent access, the provider may return the message “429 Too many requests” or return cached data for requests that are more frequent than allowed by the provider one per 15 min interval as expressed in [4.1](#).

OAuth provides customer applications a secure delegated access to server resources on behalf of a resource owner. It specifies a process for resource owners to authorize third-party access to the server resources without sharing credentials. OAuth allows access tokens to be issued to customer by an authorization server, with the approval of the resource owner, or end-user. The customer then uses the access token to access the protected resources hosted by the resource server.

5 Response formats

This document recommends and describes the use of either of two representation formats: XML version 1.0 or JSON.

For examples in this document, XML version 1.0 is used. The recommended encoding is UTF-8. XML files are expected to be stand-alone documents. Each endpoint provides its own XML schema, with a common schema being located at <http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd>. The file or stream that contains one XML document consists of zero or more records. Each record consists of several fields, which are detailed below. An XML document is sent without a wrapper (such as SOAP). Its Internet media-type is application/xml. XML is the preferred representation format.

JSON shall be compliant with the ECMA-404 standard representation. Naming conventions for JSON shall follow XML protocols.

If schema validation is required, use of the XML representation formats is recommended.

6 XML declaration links to definition segments

XML documents shall begin with an XML declaration which includes the following attributes:

- XML Namespace & URL; snapshotTime; version;

XML namespaces provide a simple method for qualifying element and attribute names used in XML documents by associating them with namespaces identified by URL references.

The snapshot time is the date and time at which the snapshot of the fleet was created. Its format is described in [Clause 9](#).

Declaration Version specifies the version of the XML standard to which the XML document conforms. See [4.2](#) for a list of versions.

Namespace URL identifies the Internet domain address. < Fleet snapshotTime="2015-05-29T10:57:19Z" version="1" xmlns="<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501>"

7 Paging

Any endpoints that return more than one piece of equipment or list of telematics data shall be paged. This navigation is controlled by the page number parameter present on the endpoint URL. Each endpoint that provides paging shall also include links for easy navigation to the current (self), previous (prev), next (next), and last (last) pages. By default, a maximum of 100 records is returned per page.

8 Discoverability

8.1 General

Integrators using this document are encouraged to discover the data being supplied. For this reason, endpoints presented in this document contain sets of links that allow traversal of pages of data, as well as linking to other endpoints within the standard. This allows a program to travel these links and find the data that is supported for each implementation. There are two classifications of endpoints: snapshot (see [8.2](#)) and time series (see [8.3](#)). Snapshot endpoints return data for a fleet (see [8.2.2](#)) or a single piece of equipment (see [8.2.3](#)).

8.2 Snapshot endpoint

8.2.1 General

The set of snapshot endpoints listed in [8.2.2](#) and [8.2.3](#) use the common schema to provide a snapshot view of a fleet or an individual piece of equipment. A snapshot is a single point in time. Time-series data, such as fault codes and switch status, are not included in the snapshot view.

8.2.2 Fleet snapshot

The snapshot fleet endpoint is defined to be: URL: /Fleet/{pageNumber}. The snapshot fleet endpoint uses the Common Schema. See [Annex A](#).

This endpoint provides a snapshot view of the fleet. This endpoint is paginated with a default of 100 records per page. See [Annex C](#).

The detailed specification of each data element is listed in [Clause 11](#).

Fleet snapshot data elements defined in this document are listed here:

- Header information (EquipmentHeader);

- Last Known Location (Location);
- Operating Hours (CumulativeOperatingHours);
- Cumulative Fuel Used (FuelUsed);
- Fuel Used in the Preceding 24 hours (FuelUsedLast24);
- Cumulative Distance Travelled (Distance);
- Cumulative Idle Hours (CumulativeIdleHours);
- Fuel Remaining Ratio (FuelRemaining);
- DEF Remaining Ratio (DEFRemaining);
- Engine Condition (EngineStatus);
- Cumulative Power Take-Off Hours (CumulativePowerTakeOffHours);
- Average Daily Engine Load Factor (AverageDailyLoadFactorLast24);
- Peak Daily Speed (MaximumSpeedLast24);
- Cumulative Load Count (CumulativeLoadCount);
- Cumulative Payload Total (CumulativePayloadTotals);
- Cumulative Non-Productive Regeneration Hours (CumulativeActiveRegenerationHours);
- Cumulative Non-Productive Idle Hours (CumulativeNonProductiveIdleHours).

8.2.3 Single-element snapshot

The single-element snapshot endpoint is defined to be: URL: /Fleet/Equipment/{identifier}.

The single-element snapshot uses the Common Schema. See [Annex C](#).

The single-element snapshot provides the same data as the Fleet Snapshot Endpoint, but is limited to a single piece of equipment. This piece of equipment is identified by the inclusion of a PIN or VIN as parameters in the URL.

The PIN or VIN identifier is chosen depending upon the classification of the machine as earth-moving machinery according to ISO 6165 or mobile road construction machinery according to ISO 22242.

The single-element snapshot contains the data elements listed below describing a single piece of equipment. The details of each data element are provided in [Clause 11](#).

Single-element snapshot data elements defined in this document are listed here:

- Header information (EquipmentHeader);
- Last Known Location (Location);
- Operating Hours (CumulativeOperatingHours);
- Cumulative Fuel Used (FuelUsed);
- Fuel Used in the Preceding 24 h (FuelUsedLast24);
- Cumulative Distance Travelled (Distance);
- Cumulative Idle Hours (CumulativeIdleHours);
- Fuel Remaining Ratio (FuelRemaining);

- DEF Remaining Ratio (DEFRemaining);
- Engine Condition (EngineStatus);
- Cumulative Power Take-Off Hours (CumulativePowerTakeOffHours);
- Average Daily Engine Load Factor (AverageDailyLoadFactorLast24);
- Peak Daily Speed (MaximumSpeedLast24);
- Cumulative Load Count (CumulativeLoadCount);
- Cumulative Payload Total (CumulativePayloadTotals);
- Cumulative Non-Productive Regeneration Hours (CumulativeActiveRegenerationHours);
- Cumulative Non-Productive Idle Hours (CumulativeNonProductiveIdleHours);

8.3 Time series endpoint

Time series endpoints provide a view into telematics data for a single construction machine over the specified time.

The range of a time series is specified by its start date and time and end date and time.

These endpoints are designed to be discoverable so that the integrating system can follow links to sets of time series telematics data as dictated by the business need. A detailed description of these linkable telematics data endpoints can be found in [Clause 11](#).

A time series endpoint is defined to be: URL:
/Fleet/Equipment/{identifier}/{startDateUTC}/{endDateUTC}.

The set of time series endpoints use the time series schema and the common schema.

These endpoints provide telematics data for a single machine over the specified time range.

The single piece of equipment is identified by the inclusion of a PIN or VIN as the parameter {identifier} in the URL. A call to both of these endpoints shall return the available readings within the timeframe for the equipment specified.

The time series endpoints are

- Locations
- CumulativeOperatingHours
- CumulativeFuelUsed
- FuelUsedInThePreceding24Hours
- Distance
- CautionCodes
- CumulativeIdleHours
- FuelRemainingRatio
- DEFRemaining
- EngineCondition
- SwitchStatus

- CumulativePowerTakeOffHours
- AverageDailyEngineLoadFactors
- PeakDailySpeed
- CumulativeLoadCount
- CumulativePayloadTotals
- CumulativeActiveRegenerationHours
- CumulativeNonProductiveIdleHours
- Faults

8.4 Links

8.4.1 General

Each endpoint that returns more than one piece of equipment or message shall include a set of links. These links are used to describe the metadata about the web service call. Each link shall contain a relationship (rel) and a hyperlink (href).

- Links
 - Relationship (rel)
 - Hyperlink (href)

8.4.2 Reference attribute (rel)

The reference attribute describes the link. Paginated services shall include a collection of links that describe the current page (self), next page (next), previous page (prev), and last page (last).

The time series summary endpoints contain links to the available telematics data for each piece of equipment. These links are referenced by the name of the type of telematics data. Acceptable strings for the reference element of a time series summary response are as follows:

- Locations
- CumulativeOperatingHours
- CumulativeFuelUsed
- FuelUsedInThePreceding24Hours
- Distance
- CautionCodes
- CumulativeIdleHours
- FuelRemainingRatio
- DEFRemaining
- EngineCondition
- SwitchStatus
- CumulativePowerTakeOffHours

- AverageDailyEngineLoadFactors
- PeakDailySpeed
- CumulativeLoadCount
- CumulativePayloadTotals
- CumulativeActiveRegenerationHours
- CumulativeNonProductiveIdleHours
- Faults

8.4.3 Hypermedia reference URL (href)

The hypermedia reference URL ([href](#)) is a reference to another endpoint. These references are provided so that available data is discoverable by automated systems. The reference should be an absolute URL.

9 Date and time formats

All date and time stamps in an XML document shall be formatted as ISO 8601 (all parts) “date and time” that includes the year, month, day, hour, minutes, and seconds. It does not include fractional seconds. If the information available to the server does not include minutes and seconds, the minutes and seconds are set to zero. It is expressed in universal coordinated time (UTC) with the use of the UTC indicator (“Z”).

Date and Time are expressed as: YYYY-MM-DDThh:mm:ssZ.

NOTE In accordance with ISO 8601 (all parts), minutes and seconds are optional.

10 Data fields summary

The data elements identified in this document are summarized in [Table 3](#) with the supporting attributes in the order of presentation in the XML response to a request. The parameters in parentheses in [Table 3](#) are names of data elements and attributes found in the .XSD files.

[Annex A](#) contains a cross reference table that harmonizes data element names and value domain names defined in ISO 15143-2 with the provisions of this document. The data element and attribute names found in the .XSD listings in [Clause 11](#) and on URN <http://www.jcmanet.or.jp/english2017/ISO/15143-3/20190501> are listed adjacent to data element names and value domain names defined in ISO 15143-2:2010, Tables A.1 and A.2.

Table 3 — Data elements and attributes

Data element	Attributes
Header information (EquipmentHeader)	— Telematics Unit Installation Date (UnitInstallDateTime) — Equipment Make (OEMName) — Equipment Model (Model) — Equipment ID (EquipmentID) — Serial Number (SerialNumber) — OEM ISO Number (PIN)^a
^a PIN and VIN are interchangeable and mutually exclusive. PIN is the name used in common.xsd.	

Table 3 (continued)

Data element	Attributes
Last known location (Location)	— Date and time (datetime) — Latitude of location (Latitude) — Longitude of location (Longitude) — Altitude of location (Altitude) — Units of Altitude (AltitudeUnits)
Operating hours (CumulativeOperatingHours)	— Date and time (datetime) — Cumulative operating hours (Hour)
Cumulative fuel used (FuelUsed)	— Date and time (datetime) — Unit of measure of fuel (FuelUnits) — Cumulative fuel used (FuelConsumed)
Fuel used in the preceding 24 hours (FuelUsedLast24)	— Date and time (datetime) — Unit of measure of fuel (FuelUnits) — Fuel used preceding 24 hours (FuelConsumed)
Cumulative distance travelled (Distance)	— Date and time (datetime) — Unit of measure of distance (OdometerUnits) — Cumulative distance travelled (Odometer)
Caution Codes (CautionMessages)	— Date and time (datetime) — Caution codes referencing number identifier (Identifier) — Description of caution (Description)
Cumulative idle operating hours (CumulativeIdleHours)	— Date and time (datetime) — Cumulative idle hour (Hour)
Fuel remaining ratio (FuelRemaining)	— Date and time (datetime) — Fuel remaining ratio (Percent) — Unit of Measure of Fuel Tank (FuelTankCapacityUnits) — Fuel Tank Capacity (FuelTankCapacity)
DEF remaining ratio (DEFRemaining)	— Date and time (datetime) — DEF remaining ratio (Percent) — Unit of Measure of DEF Tank (DEFTankCapacityUnits) — DEF Tank Capacity (DEFTankCapacity)
Engine condition (EngineStatus)	— Date and time (datetime) — Engine number (EngineNumber) — Engine running (Running)
Digital input state (SwitchStatus)	— Date and time (datetime) — Digital input number (SwitchNumber) — Is switch on or off (IsOn)
^a PIN and VIN are interchangeable and mutually exclusive. PIN is the name used in common.xsd.	

Table 3 (continued)

Data element	Attributes
Cumulative power take-off hours (CumulativePowerTakeOffHours)	— Date and time (datetime) — Cumulative power take-off hours (Hour)
Average daily engine load factor (Average-LoadFactorLast24)	— Date and time (datetime) — Average daily load factor (Percent)
Peak Daily Speed (MaximumSpeedLast24)	— Date and time (datetime) — Unit used for speed (SpeedUnits) — Peak speed (Speed)
Cumulative Load Count (CumulativeLoadCount)	— Date time (datetime) — Cumulative load count (Count)
Cumulative Payload Totals (CumulativePayloadTotals)	— Date and time (datetime) — Unit of measure for payload (PayloadUnits) — Cumulative payload (Payload)
Cumulative Non-Productive Regeneration Hours (CumulativeActiveRegenerationHours)	— Date and time (datetime) — Cumulative regeneration hour (Hour)
Cumulative idle non-operating hours (CumulativeNonProductiveIdleHours)	— Date and time (datetime) — Cumulative non-productive idle (Hour)
Diagnostic Trouble Codes (DiagnosticTroubleCode)	— Diagnostic Trouble Code Identifier (CodeIdentifier) — Date and time (datetime) — Code severity (CodeSeverity) — Code description (CodeDescription) — Temperature units (TemperatureUnit) — Ambient air temperature (AirTemperature) — Description of Code Source (CodeSource)
^a PIN and VIN are interchangeable and mutually exclusive. PIN is the name used in common.xsd.	

11 Data field descriptions

11.1 General

Endpoints (requests) shall be sent from the customer application to the telematics provider server; [11.2](#) to [11.21](#) contain examples of URL describing the endpoints. Illustrative examples of two optional URLs are listed below.

Option 1

URL: /Fleet/Equipment/ID/{OEM ISO identifier}/Locations/{startDateUTC}/{endDateUTC}/{pageNumber}

Option 2

URL: /Fleet/Equipment/MakeModelSerial/{makeCode}/{model}/{serialNumber}/Locations/{startDateUTC}/{endDateUTC}/{pageNumber}.

The format of Option 1 is preferred.

Option 1 is used when the machine is identified by a PIN or a VIN. Option 1 contains the argument /ID/{OEM ISO identifier}.

Option 2 is used when the machine is identified by serial number but a PIN or VIN is not available. If using Option 2 URLs; make code, model, and serial number are required to be supplied in the Fleet Response. Option 2 contains the argument /MakeModelSerial/{makeCode}/{model}/{serialNumber}.

Only Option 1 is listed in 11.2 to 11.21. However, Option 2 may be supported by the OEM if desired.

Each response field is described in detail in 11.2 to 11.21. Responses from the endpoints provide specific time series data. If a time range is not specified, the response should default to the last 14 consecutive days of data. Results are paginated with a default of 100 records per page.

The common schema referenced in each of the data elements listed in 11.2 to 11.21 are found in Annex C and are posted to URN <http://www.jcmanet.or.jp/english2017/ISO/15143/-3/>, where the filename describes the data element.

NOTE This document uses decimal points where the text indicates XSD format.

11.2 Machine header information

11.2.1 General

Header information (EquipmentHeader)

- Telematics Unit Installation Date (UnitInstallDateTime)
- Equipment Make (OEMName)
- Equipment Model (Model)
- Equipment ID (EquipmentID)
- Serial Number (SerialNumber)
- OEM ISO Number (PIN)

NOTE PIN and VIN are both 17-character fields. Either one is acceptable depending upon the classification of the specific machine. PIN is the name used in the file common.xsd.

11.2.2 Telematics unit installation date

This date and time describes when the telematics unit was installed on the machine. Its format is described in Clause 9. This field is optional, and if blank, it is assumed that the telematics unit was installed when the machine was built.

11.2.3 Equipment make

If this data element is unavailable, then it is populated with blanks. If the data element is available, then the equipment make is returned. This field is optional.

11.2.4 Equipment model

Equipment Model is the model or series of the machine. The data type of the equipment model is string. Its length is unbounded. If this data element is unavailable, then it is populated with blanks. If the data element is available, then the equipment model is returned. This field is optional.

11.2.5 Equipment ID

The end user shall provide this information to the telematics provider during fleet registration. Because this field is defined by the end user, it is not a unique identifier. Its data type is string, and its length is unbounded. This field is optional.

11.2.6 Serial number

The serial number identifies the specific instance of the machine for those machines that are not identified by a PIN or a VIN. The data type is character string and the length is unbounded. This field is optional.

If a PIN or VIN is assigned to the machine, the PIN or VIN shall be used in place of the serial number.

11.2.7 OEM ISO identifier (PIN or VIN)

PIN and VIN are mutually exclusive.

The PIN shall be as defined by ISO 10261. PIN is used for earth-moving machinery and may be used for other types of off-road machines.

The VIN shall be as defined by ISO 3779. VIN is used for on-road vehicles.

A listing of the .XSD declaration for the equipment header can be found at URN <http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd>.

11.3 Last known location

11.3.1 General

The last known equipment location is expressed by the following fields.

- **Last known location (Location)**
 - Date and time (DateTime)
 - Latitude of location (Latitude)
 - Longitude of location (Longitude)
 - Altitude of location (Altitude)
 - Units of Altitude (AltitudeUnits)

11.3.2 Date and time of location

The date and time indicate when the machine was at the described location. Its format is described in [Clause 9](#).

11.3.3 Latitude of location

The latitude is expressed as a signed decimal number with six digits of precision in the range from -90.000000° to $+90.000000^\circ$. The latitude at the equator is represented by 0° . Latitudes north of the equator are represented as positive numbers; those south, by negative numbers.

11.3.4 Longitude of location

The longitude is expressed as a signed decimal number with six digits of precision in the range from -180.000000° to $+180.000000^\circ$. The prime meridian at Greenwich is represented by 0° . Longitudes to

the west of the prime meridian are represented as negative numbers; those to the east, by positive numbers.

11.3.5 Altitude of location

The altitude is expressed as distance above mean sea level of the machine's location. Altitude is reported in metres. This field is optional.

This description does not consider the geodesic model used in any GPS system. There can be a small difference between reported altitude when the value is derived from different GPS systems. This data element is the unique altitude value expressed in SI units.

11.3.6 Unit of measure of altitude

The altitude of the location shall be expressed in metres. If altitude is included in the response, this field is mandatory. It shall have the value "metre".

11.3.7 Location time series endpoint (request)

URL:

/Fleet/Equipment/{OEM ISO Identifier}/Locations/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Location Schema, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/Locations.xsd>

11.3.8 Location response schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include
    schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

  <xs:element name="LocationMessages">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
        />
        <xs:element name="Location" type="Location" minOccurs="0"
        maxOccurs="unbounded" />
      </xs:sequence>
    </xs:complexType>
  </xs:element>

</xs:schema>
```

11.4 Operating hours

11.4.1 General

The current lifetime total cumulative operating hours of the machine is expressed by two separate fields as shown below. This data element is optional (see [Annex B](#)).

— Operating hours (Cumulative Operating Hours)

- Date and time (DateTime)
- Cumulating operating hours (Hour)

NOTE Cumulative operating hours generally coincides with service meter hours.

11.4.2 Date and time of operating hours

The date and time indicate when the operating hours of the machine was recorded. The datetime format is described in [Clause 9](#).

11.4.3 Operating hours

The current total lifetime operating hours of the machine is expressed as the cumulative quantity of time during which the machine's engine has been running. This is generally the value of the hourmeter on the machine.

NOTE The value domain for operating hours is defined in ISO 15143-2:2010, Table A.2, "time_3" (e.g. hhhhhh.##).

11.4.4 Operating hours endpoint (request)

URL:

/Fleet/Equipment/{identifier}/CumulativeOperatingHours/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Operating Hr Schema, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/CumulativeOperatingHr.xsd>

11.4.5 Operating hours schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

  <xs:element name="CumulativeOperatingHoursMessages">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
        <xs:element name="CumulativeOperatingHours"
type="CumulativeOperatingHours" minOccurs="0" maxOccurs="unbounded" />

```

```

        </xs:sequence>
      </xs:complexType>
    </xs:element>

</xs:schema>

```

11.5 Cumulative fuel used (preferred)

11.5.1 General

The total amount of fuel consumed by the machine is expressed by three separate fields. This data element represents the cumulative amount of fuel used by the machine since its manufacture. This data element is optional (see [Annex B](#)).

— Cumulative fuel used (FuelUsed)

- Date and time (DateTime)
- Unit of measure of fuel (FuelUnits)
- Cumulative fuel used (FuelConsumed)

11.5.2 Date and time of cumulative fuel used

The date and time indicates when the machine had used the specified amount of fuel. Its format is described in [Clause 9](#).

11.5.3 Unit of measure of fuel used to date

The quantity of fuel is expressed in litres. If cumulative fuel used is included in the response, this field shall have the value “litre”.

11.5.4 Amount of fuel used to date

The value is expressed as an unsigned integer, which includes all values from 0 through 4 294 967 295.

11.5.5 Cumulative fuel used endpoint (request)

URL:

/Fleet/Equipment/{identifier}/CumulativeFuelUsed/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Cumulative Fuel Used, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/cumulativefuelused.xsd>

11.5.6 Cumulative fuel used schema (response)

```

<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-
3/20190501/common.xsd"/>

```

```

<xs:element name="FuelUsedMessages">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
      <xs:element name="FuelUsed" type="FuelUsed" minOccurs="0"
maxOccurs="unbounded" />
    </xs:sequence>
  </xs:complexType>
</xs:element>

</xs:schema>

```

11.6 Fuel used in the preceding 24 hours (alternative, not preferred)

11.6.1 General

The quantity of fuel the machine used during the previous 24 h period is expressed by three fields as shown below.

Fuel used in the preceding 24 h is not the preferred measure of fuel consumption, but it may be used as an alternative to cumulative fuel used.

The term “24 hours” refers to the last 24 h of elapsed clock time, not the last 24 h of machine operation. This data element is optional (see [Annex B](#)).

— Fuel used in the preceding 24 hours (FuelUsedLast24)

- Date and time (DateTime)
- Unit of measure of fuel (FuelUnits)
- Fuel used in preceding 24 hours (FuelConsumed)

11.6.2 Date and time of fuel use in the preceding 24 hours

The date and time indicate when the 24 h period ended, during which the machine used the specified amount of fuel. Its format is described in [Clause 9](#).

11.6.3 Unit of measure of fuel used in the preceding 24 hours

If cumulative fuel used in the preceding 24 h is included in the response, this field shall have the value “litre”.

11.6.4 Fuel used in the preceding 24 hours

The date and time indicate the end of the 24 h period, during which the machine used the specified amount of fuel. Its format is described in [Clause 9](#).

This field indicates the quantity of fuel that was used by the machine, during the 24 h period that ended at the specified date and time. Its data type is decimal.

11.6.5 Fuel used in the preceding 24 hours endpoint (request)

URL:

/Fleet/Equipment/{identifier}/FuelUsedInThePreceding24Hours/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Cumulative Fuel Used, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/FuelUsedinthepreceding24hr.xsd>

11.6.6 Fuel used in the preceding 24 hours schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

  <xs:element name="FuelUsedLast24Messages">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
        />
        <xs:element name="FuelUsedLast24" type="FuelUsed" minOccurs="0"
        maxOccurs="unbounded" />
      </xs:sequence>
    </xs:complexType>
  </xs:element>

</xs:schema>
```

11.7 Cumulative distance travelled

11.7.1 General

The distance the machine has travelled (regardless of direction) while operating is expressed by three fields as shown below.

Cumulative distance travelled is the total distance travelled by the machine, under its own power, since its manufacture. This data element is optional (see [Annex B](#)).

— Cumulative distance travelled (Distance)

- Date and time (DateTime)
- Unit of measure of distance (OdometerUnits)
- Cumulative distance travelled (Odometer)

11.7.2 Date and time of distance

The date and time indicate when the machine had travelled the cumulative distance. Its format is described in [Clause 9](#).

11.7.3 Unit of measure of distance

When available on a machine, the distance travelled by the machine shall be expressed in kilometres. If cumulative distance travelled is included in the response, this field shall have the value “kilometre”.

11.7.4 Cumulative distance travelled

When available on a machine, this field indicates the cumulative distance the machine has travelled as of the specified date and time. Its data type is decimal. The value shall contain one significant digit to the right of the decimal with the smallest unit of resolution equal to 0.1 km.

11.7.5 Cumulative distance travelled endpoint (request)

URL:

/Fleet/Equipment/{identifier}/Distance/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Distance, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/Distance.xsd>.

11.7.6 Cumulative distance travelled schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

  <xs:element name="DistanceMessages">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded" />
        <xs:element name="Distance" type="Distance" minOccurs="0" maxOccurs="unbounded" />
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

11.8 Caution codes referencing number

11.8.1 General

Caution codes arising from machine operation are expressed by three fields as shown below. This data element is optional.

— Caution Codes (CautionMessages)

- Date and time (datetime)
- Caution codes referencing number identifier (Identifier)
- Description of caution (Description)

11.8.2 Date and time of code

The date and time indicate when the given code identifier occurred on the asset. Its format is described in [Clause 9](#).

11.8.3 IEC/ISO symbol reference number identifier

The caution code reference number identifier shall be the ISO 7000 or IEC 60417 registration number of the symbol on the machine's display used to provide an alert about a system problem, event or state. This data element indicates the number of a code that occurred as a specific date and time.

Symbol registration numbers shall be as given in ISO 6405-1 and ISO 6405-2. The data type is string, and its length is unbounded. This data element is optional (see [Annex B](#)).

11.8.4 Code description

The code description is a string of text that describes the meaning of the code (e.g. "air filter blocked"). Symbol descriptions shall be as given in ISO 6405-1 and ISO 6405-2. The data type is string, and its length is unbounded. This data element is optional (see [Annex B](#)).

11.8.5 Caution codes referencing number endpoint (request)

URL:

/Fleet/Equipment/{identifier}/CautionCodes/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Caution Codes referencing number Schema, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/CautionCode.xsd>.

11.8.6 Caution codes referencing number schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-
3/20190501/common.xsd"/>

  <xs:element name="CautionMessages">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
        />
        <xs:element name="CautionDescription" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="Identifier" type="xs:string"/>
              <xs:element name="Description" type="xs:string"/>
            </xs:sequence>
            <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

11.9 Cumulative idle operating hours

11.9.1 General

The current lifetime total cumulative idle operating hours of the machine is expressed by two fields: date-time and cumulative idle operating hours. This value generally coincides with idle service meter hours. This data element is optional (see [Annex B](#)).

The manufacturer shall define idle for each machine model. The definition of idle state is unique to each manufacturer. Whether “idle” is a productive or non-productive state is user defined. Each OEM is expected to communicate to the user how idle has been calculated for each machine model. This technical specification does not attempt to define “idle”.

— Cumulative idle operating hours (CumulativeIdleHours)

- Date and time (datetime)
- Cumulative idle hours (Hour)

11.9.2 Date and time of cumulative idle operating hours

The date and time indicate when the idle hours of the machine was recorded (i.e. when the value for cumulative idle operating hours was valid). Its format is described in [Clause 9](#).

11.9.3 Cumulative idle operating hours

The value is expressed as a decimal.

NOTE The value domain for operating hours is defined in ISO 15143-2:2010, Table A.2, “time 3” (e.g. hhhhhh.##).

11.9.4 Cumulative idle operating hours endpoint (request)

URL:

/Fleet/Equipment/{identifier}/CumulativeIdleHours/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Cumulative Idle Hours, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/CumulativeIdleHours.xsd>.

11.9.5 Cumulative idle operating hours schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

  <xs:element name="CumulativeIdleHoursMessages">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
        />
        <xs:element name="CumulativeIdleHours" type="CumulativeIdleHours"
```

```
minOccurs="0" maxOccurs="unbounded" />
    </xs:sequence>
  </xs:complexType>
</xs:element>

</xs:schema>
```

11.10 Fuel remaining ratio

11.10.1 General

The percentage of fuel remaining in the fuel tank of the machine is expressed by four fields as shown below. This data element is optional (see [Annex B](#)).

- **Fuel remaining ratio (FuelRemaining)**
 - Date and time (DateTime)
 - Fuel remaining ratio (Percent)
 - Unit of measure of fuel tank (FuelTankCapacityUnits)
 - Fuel tank capacity (FuelTankCapacity)

11.10.2 Date and time of percentage of fuel remaining

The date and time indicate when the percentage of fuel remaining was valid. Its format is described in [Clause 9](#).

11.10.3 Fuel Remaining Ratio

This field indicates the estimated percentage of fuel remaining in the machine's fuel tank as of the specified date and time. Its data type is decimal with a maximum of 3 digits to the left of the decimal and with 2 digits to the right of the decimal. It includes all values from 0.00 to 100.00.

11.10.4 Unit of measure for fuel tank capacity

Fuel tank capacity shall be expressed in litres. If fuel tank capacity is included in the response, this field shall have the value "litre".

11.10.5 Fuel tank capacity

This field indicates the capacity of the fuel tank. The value is expressed as an unsigned integer, which includes all values from 0 to 4 294 967 295.

11.10.6 Fuel remaining ratio endpoint (request)

URL:

/Fleet/Equipment/{identifier}/FuelRemainingRatio/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Fuel Remaining, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/FuelRemaining.xsd>.

11.10.7 Fuel remaining ratio schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
```

```

    elementFormDefault="qualified"
    xmlns:xs="http://www.w3.org/2001/XMLSchema"
    targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
    xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
    version="1.0.0"
  >

    <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-
3/20190501/common.xsd"/>

    <xs:element name="FuelRemainingMessages">
      <xs:complexType>
        <xs:sequence>
          <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
          <xs:element name="FuelRemaining" type="FuelRemaining" minOccurs="0"
maxOccurs="unbounded" />
        </xs:sequence>
      </xs:complexType>
    </xs:element>
  </xs:schema>

```

11.11 Percent of DEF remaining

11.11.1 General

The percentage of DEF remaining in the DEF tank of the machine is expressed by four fields as shown below. This data element is optional (see [Annex B](#)).

— DEF remaining ratio (DEFRemaining)

- Date and time (DateTime)
- DEF remaining ratio (Percent)
- Unit of measure of DEF tank (DEFTankCapacityUnits)
- DEF Tank capacity (DEFTankCapacity)

11.11.2 Date and time of percent DEF remaining

The date and time indicate when the DEF remaining ratio was valid. Its format is described in [Clause 9](#).

11.11.3 Percent of DEF remaining

This field indicates the estimated percentage of DEF remaining in the machine's DEF tank as of the specified date and time. Its data type is decimal with a maximum of 3 digits to the left of the decimal and with 2 digits to the right of the decimal. It includes all values from 0.00 to 100.00.

11.11.4 Unit of measure for DEF tank capacity

DEF tank capacity shall be expressed in litres. If DEF tank capacity is included in the response, this field shall have the value "litre".

11.11.5 DEF tank capacity

This field indicates the capacity of the DEF tank. The value is expressed as a decimal with up to 2 digits to the right of the decimal.

11.11.6 Percent DEF remaining endpoint (request)

URL:

/Fleet/Equipment/{identifier}/DEFRemaining/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series DEF Remaining, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/DEFremaining.xsd>.

11.11.7 Percent DEF remaining schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

  <xs:element name="DEFRemainingMessages">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
        <xs:element name="DEFRemaining" type="DEFRemaining" minOccurs="0"
maxOccurs="unbounded" />
      </xs:sequence>
    </xs:complexType>
  </xs:element>

</xs:schema>
```

11.12 Engine condition

11.12.1 General

This value is an indicator of the current status of the machine's engine running state, which is expressed by three fields as shown below. This data element is optional (see [Annex B](#)).

— Engine condition (EngineStatus)

- Date and time (DateTime)
- Engine number (EngineNumber)
- Engine running (Running)

11.12.2 Date and time of engine condition

The date and time indicate when the machine's running status changed (i.e. from a running to not running state or from not running to a running state). Its format is described in [Clause 9](#).

11.12.3 Engine number

The engine number is an unbounded alphanumeric string assigned by the OEM representing the unique engine in the construction machine.

11.12.4 Engine condition

Engine condition is the running state of the engine as of the specified date and time. This data type is Boolean with false (i.e. 0) indicating not running and true (i.e. 1) indicating running.

The intent of this data element is to supply a record of changes from engine running on to engine not running and from engine not running to engine running.

11.12.5 Engine condition endpoint (request)

URL:

/Fleet/Equipment/{identifier}/EngineCondition/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Engine condition, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/EngineCondition.xsd>

11.12.6 Engine condition schema (Response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

  <xs:element name="EngineStatusMessages">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
        <xs:element name="EngineStatus" type="EngineStatus" minOccurs="0"
maxOccurs="unbounded" />
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

11.13 Digital input state

11.13.1 General

This value is the current status of any digital input on the machine available manufacturer's telematics device, which is expressed by three fields as shown below. A digital input on a telematics device is a gate or proximity switch. Other forms of switches and logic outputs may be used. This data element is optional (see [Annex B](#)).

— Digital input state (SwitchStatus)

- Date and time (DateTime)
- Digital input number (SwitchNumber)
- Switch state, on or off (IsOn)

11.13.2 Date and time of digital input set response

The date and time indicate when the digital input changed (i.e. from off to on or on to off). Its format is described in [Clause 9](#).

11.13.3 Digital input number

The number of the digital input indicates the specific input on the telematics devices whose state changed (i.e. on to off, or off to on) as of the specified date and time. The value is expressed as an unsigned integer, which includes all values from 0 through 4 294 967 295.

11.13.4 Digital input state

Digital input state is the state of the specified switch as of the specified date and time. This data type is Boolean with false (i.e. 0) indicating not running and true (i.e. 1) indicating running.

11.13.5 Digital input state endpoint (request)

URL:

/Fleet/Equipment/{identifier}/SwitchStatus/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Switch Status Schema, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/SwitchStatus.xsd>.

11.13.6 Digital input state schema (Response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-
3/20190501/common.xsd"/>

  <xs:element name="SwitchStatusMessages">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
        <xs:element name="SwitchStatus" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="SwitchNumber" type="xs:int"/>
              <xs:element name="IsOn" type="xs:boolean"/>
            </xs:sequence>
            <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>

</xs:schema>
```

11.14 Cumulative power take-off hours

11.14.1 General

Current lifetime total power take-off hours of the machine is expressed by two fields as shown below. This data element is optional (see [Annex B](#)).

— Cumulative power take-off hours (CumulativePowerTakeOffHours)

- Date and time (DateTime)
- Cumulative power take-off hours (Hour)

11.14.2 Date and time of cumulative power take-off

The date and time indicate when the machine registered cumulative power take-off hours. Its format is described in [Clause 9](#).

11.14.3 Cumulative power take-off hours

The value is expressed as a decimal eight digits in length with two digits to the right of the decimal point.

NOTE The value domain for operating hours is defined in ISO 15143-2:2010, Table A.2, "time_3" (e.g. hhhhhh.##).

11.14.4 Cumulative power take-off hours endpoint (request)

URL:

/Fleet/Equipment/{identifier}/CumulativePowerTakeOffHours/{startDateUTC}/{endDateUTC}/{page Number}

SCHEMAS: Time Series Cumulative Power Take Off Hours, Common Schema.

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/CumulativePowerTakeOffHours.xsd>

11.14.5 Cumulative power take-off hours schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>
<xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/
common.xsd"/>

  <xs:element name="CumulativePowerTakeOffHoursMessages">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
        <xs:element name="CumulativePowerTakeOffHours" type="CumulativePowerTakeOf
fHours" minOccurs="0" maxOccurs="unbounded" />
      </xs:sequence>
    </xs:complexType>
  </xs:element>
```

</xs:schema>

11.15 Average daily engine load factor

11.15.1 General

The preferred definition of average daily load factor is a percentage calculated as the actual fuel consumed over the previous 24 h period divided by the fuel that would have been consumed during that period if the machine had been continually operated at the engine's rated output. Average daily load factor of the machine is expressed by two fields as shown below. This data element is optional (see [Annex B](#)).

NOTE The specific definition of this data element is established by the OEM and is not restricted to the preferred definition.

- Average daily load factor (AverageLoadFactorLast24)
- Date and time (DateTime)
- Average daily load factor (Percent)

11.15.2 Date and time of average load factor

The date and time indicate when the load factor was registered on the machine. Its format is described in [Clause 9](#).

11.15.3 Average load factor for preceding 24 h period

This field indicates the average load factor during a 24 h period of machine life (whether or not operating) as of the specified data and time. Its data type is decimal and includes all values from 000.00 to 100.00.

11.15.4 Average daily engine load factor endpoint (request)

URL:

/Fleet/Equipment/{identifier}/AverageDailyEngineLoadFactors/{startDateUTC}/{endDateUTC}/{page Number}

SCHEMAS: Time Series, Average Daily Engine Load Factor, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/AverageDailyEngineLoadFactor.xsd>

11.15.5 Average daily engine load factor schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

  <xs:element name="AverageLoadFactorLast24">
    <xs:complexType>
      <xs:sequence>
```

```

        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
        <xs:element name="LoadFactor" type="LoadFactor" minOccurs="0"
maxOccurs="unbounded" />
    </xs:sequence>
</xs:complexType>
</xs:element>

</xs:schema>

```

11.16 Peak daily speed

11.16.1 General

Peak daily speed is the highest achieved travel speed for this machine during the previous 24 h period. Peak daily speed is expressed by three fields as shown below. This data element is optional (see [Annex B](#)).

- Peak daily speed (MaximumSpeedLast24)
 - Date and time (DateTime)
 - Unit used for speed (SpeedUnit)
 - Peak speed (Speed)

11.16.2 Date and time of peak travel speed

The date and time indicate the end of the 24 h period, during which the machine travelled at the reported peak speed. Its format is described in [Clause 9](#).

11.16.3 Units of measure for speed

Speed is to be expressed as kilometres per hour or metres per minute, at the discretion of the telematics provider. If peak daily speed is included in the response, this field shall have the value kilometres per hour, or metres per minute.

11.16.4 Peak speed for the preceding 24 h

This field indicates the highest achieved travel speed by the machine during a 24 h period as of the specified date and time. Its data type is decimal.

11.16.5 Peak daily speed endpoint (request)

URL:

/Fleet/Equipment/{identifier}/PeakDailySpeed/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Speed, Common Schema

The schema (.XSD) file can be found at URN URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/PeakDailySpeed.xsd>

11.16.6 Peak daily speed schema (response)

```

<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"

```

```

        version="1.0.0"
    >

    <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-
3/20190501/common.xsd"/>

    <xs:element name="PeakDailySpeedMessages">
        <xs:complexType>
            <xs:sequence>
                <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
                <xs:element name="Speed" type="Speed" minOccurs="0" maxOccurs="unbounded"
/>
            </xs:sequence>
        </xs:complexType>
    </xs:element>

</xs:schema>

```

11.17 Cumulative load count

11.17.1 General

Lifetime total cumulative number of loads the machine has achieved is expressed by two fields as shown below. The definitions of load and load count are at the discretion of the manufacturer. This data element is optional (see [Annex B](#)).

— Cumulative Load Count (CumulativeLoadCount)

- Date and time (DateTime)
- Cumulative load count (Count)

11.17.2 Date and time of load count

The date and time indicate when the machine last registered a completed load. Its format is described in [Clause 9](#).

11.17.3 Cumulative load count

This field indicates the number of loads that has been performed cumulatively by the machine as of the specified date and time. The value is expressed as an unsigned integer, which includes all values from 0 through 4 294 967 295.

11.17.4 Cumulative load count endpoint (request)

URL:

/Fleet/Equipment/{identifier}/CumulativeLoadCount/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Cumulative Load Count, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/CumulativeLoadCount.xsd>

11.17.5 Cumulative load count schema (response)

```

<?xml version="1.0" encoding="utf-8"?>
<xs:schema
    attributeFormDefault="unqualified"
    elementFormDefault="qualified"
    xmlns:xs="http://www.w3.org/2001/XMLSchema"
    targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"

```

```

xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
version="1.0.0"
>

<xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

<xs:element name="CumulativeLoadCountMessages">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
    />
      <xs:element name="CumulativeLoadCount" type="LoadCount" minOccurs="0"
maxOccurs="unbounded" />
    </xs:sequence>
  </xs:complexType>
</xs:element>

</xs:schema>

```

11.18 Cumulative payload total

11.18.1 General

Cumulative total payload moved by the machine is expressed by two fields as shown below. This data element is optional (see [Annex B](#)).

- Cumulative payload totals (CumulativePayloadTotals)
 - Date and time (DateTime)
 - Unit of measure for payload (PayloadUnits)
 - Cumulative payload (Payload)

11.18.2 Date and time of cumulative payload

The date and time indicate when the machine registered the cumulative payload. Its format is described in [Clause 9](#).

11.18.3 Unit of measure for payload

The quantity of payload shall be expressed as load mass in kilograms. If cumulative payload is included in the response, this field shall have the value “kilogram”.

11.18.4 Cumulative payload

This field indicates the quantity of payload that has been moved cumulatively by the machine as of the specified date and time. Its data type is decimal.

11.18.5 Cumulative payload total endpoint (request)

URL:

/Fleet/Equipment/{identifier}/CumulativePayloadTotals/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Cumulative Load Count, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/CumulativePayloadTotals.xsd>

11.18.6 Cumulative payload total schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

  <xs:element name="CumulativePayloadTotalMessages">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
        />
        <xs:element name="CumulativePayloadTotals" type="PayloadTotals"
        minOccurs="0" maxOccurs="unbounded" />
      </xs:sequence>
    </xs:complexType>
  </xs:element>

</xs:schema>
```

11.19 Cumulative non-productive regeneration hours

11.19.1 General

The current lifetime total non-productive regeneration hours of the machine are expressed by two fields as shown below. This data element is optional (see [Annex B](#)).

Non-productive regeneration is the time when the machine is placed in a non-productive state to complete the regeneration process. This field is specific to machines with emissions related after-treatment devices mounted on the machine's engine. Regeneration is the oxidation of exhaust soot collected inside an after-treatment device.

— Cumulative non-productive regeneration hours (CumulativeActiveRegenerationHours)

- Date and time (DateTime)
- Cumulative regeneration hours (Hour)

11.19.2 Date and time for cumulative non-productive regeneration hours

The date and time indicate when the machine registered the value for cumulative non-productive regeneration hours. Its format is described in [Clause 9](#).

11.19.3 Cumulative non-productive regeneration hours

The value is expressed as a decimal eight digits in length with two digits to the right of the decimal point.

NOTE The value domain for operating hours is defined in ISO 15143-2:2010, Table A.2, "time_3" (e.g. hhhhhh.##).

11.19.4 Cumulative hours in non-productive regeneration endpoint (request)

URL:

/Fleet/Equipment/{identifier}/CumulativeActiveRegenerationHours/{startDateUTC}/{endDateUTC}/
{pageNumber}

SCHEMAS: Time Series Cumulative Non-productive Regeneration Hours Schema, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/CumulativeNonproductiveRegenerationHours.xsd>

11.19.5 Cumulative hours in non-productive regeneration schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

  <xs:element name="CumulativeActiveRegenerationHourMessages">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
        <xs:element name="CumulativeActiveRegenerationHours" type="CumulativeActiveRegenerationHours" minOccurs="0" maxOccurs="unbounded" />
      </xs:sequence>
    </xs:complexType>
  </xs:element>

</xs:schema>
```

11.20 Cumulative idle non-operating hours

11.20.1 General

Cumulative idle non-operating hours are the total hours when the engine is running, but the machine is not moving and the machine controls are not operated (e.g. lever or pedal not operated)

Cumulative idle non-operating hours are expressed by two fields as shown below. This data element is optional (see [Annex B](#)).

— Cumulative idle non-operating hours (CumulativeNonproductiveIdleHours)

- Date and time (DateTime)
- Cumulative non-productive idle hours (Hour)

11.20.2 Date and time of cumulative idle non-operating hours

The date and time indicate when the machine registered the idle non-operating hours. Its format is described in [Clause 9](#).

11.20.3 Cumulative idle non-operating hours

The value is expressed as a decimal eight digits in length with two digits to the right of the decimal point.

NOTE The value domain for operating hours is defined in ISO 15143-2:2010, Table A.2, "time 3" (e.g. hhhhhh.##).

11.20.4 Cumulative idle non-operating hours endpoint (Request)

URL:

/Fleet/Equipment/{identifier}/CumulativeNonProductiveIdleHours/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Cumulative Idle Non-operating Hours, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/CumulativeNonproductiveRegenerationHours.xsd>

11.20.5 Cumulative idle non-operating hours schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
    attributeFormDefault="unqualified"
    elementFormDefault="qualified"
    xmlns:xs="http://www.w3.org/2001/XMLSchema"
    targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
    xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
    version="1.0.0"
>

    <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

    <xs:element name="CumulativeNonproductiveIdleHoursMessages">
        <xs:complexType>
            <xs:sequence>
                <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
            />
            <xs:element name="CumulativeNonproductiveIdleHours"
type="CumulativeIdleHours" minOccurs="0" maxOccurs="unbounded" />
            </xs:sequence>
        </xs:complexType>
    </xs:element>

</xs:schema>
```

11.21 Data field descriptions for codes unique to each system

11.21.1 General

The OEM may specify diagnostic codes that alert the owner to the need for non-scheduled machine supports. Each code is expressed by seven fields as shown below. This data element is optional (see [Annex B](#)).

- Diagnostic trouble code (DiagnosticTroubleCode)
 - Date and time (DateTime)
 - Diagnostic trouble code identifier (CodeIdentifier)
 - Code severity (CodeSeverity)
 - Code description (CodeDescription)
 - Temperature unit (TemperatureUnit)
 - Ambient air temperature (AirTemperature)
 - Description of code source (CodeSource)

11.21.2 Diagnostic trouble code identifier

The diagnostic trouble code identifier specifies the identification for the code that occurred at a specific data and time. The diagnostic trouble code concept is defined in SAE J1939-73. The data type is string, and its length is unbounded. This data element is optional (see [Annex B](#)).

The structure and values of the diagnostic trouble code identifier can differ among OEM. Examples of various codes from multiple OEM are shown in [Table 4](#).

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Table 4 — Examples of how codes can be optionally reported by the telematics provider through the API

Manufacturer	Date and time	Diagnostic code identifier	Caution code referencing number identifier	Code severity	Code description	Ambient air temperature	Air temperature unit of measure	Description of code source
OEMA	2015-05-19T16:22:20Z	123.5		Red	Filter plugged			ECU
OEMA	2015-05-19T16:22:20Z		4354	Green		-10	Celsius	HCU
OEMA	2015-05-19T16:22:20Z		1234	Yellow	Short circuit	27	Celsius	
OEMB	2015-05-19T16:22:20Z	34.24		High	Plugged filter			ECU
OEMB	2015-05-19T16:22:20Z	432.1	1200	Low	Engine over speed	10	Celsius	ECU
OEMB	2015-05-19T16:22:20Z		1100	Caution	BOOST PRESSURE SENSOR ERROR (LOW VOLTAGE ERROR)			ECU
OEMC	2015-05-19T16:22:20Z	0001		Caution	Caution code			
OEMC	2015-05-19T16:22:20Z	0002		Event	Event code			

11.21.3 Date and time of code

The date and time indicate when the given code identifier occurred on the machine. Its format is described in [Clause 9](#).

11.21.4 Code severity

The code severity is the severity descriptor of the specific code identifier that occurred. The structure of the code severity can differ among OEM. The data type is string, and its length is unbounded. This data element varies among OEM. This data element is optional (see [Annex B](#)).

11.21.5 Code description

The code description is a string of text that describes the meaning of the code, e.g. "air filter blocked". The structure of the code description for any particular code identifier can differ among OEM. The data type is string, and its length is unbounded. This data element varies among OEM. This data element is optional (see [Annex B](#)).

11.21.6 Unit of measure for ambient air temperature

Temperature is expressed as degrees Celsius. If the unit of measure of ambient air temperature is included in the response, this field shall have the value "Celsius."

11.21.7 Ambient air temperature at time when code was triggered

This field indicates the temperature at the time the code occurred on the machine as of the specified date and time. Its data type is integer, which includes all values from -100 to +100. This field is optional.

11.21.8 Description of code source

The description of code source indicates the machine controller (e.g. ECU) that generated the code on the machine. The structure of the source description for any particular code identifier can differ among OEM.

The data type is string, and its length is unbounded. This data element varies among OEM. This data element is optional (see [Annex B](#)).

11.21.9 Data field descriptions for codes unique to each system endpoint (request)

URL:

[/Fleet/Equipment/{identifier}/Faults/{startDateUTC}/{endDateUTC}/{pageNumber}](#)

SCHEMAS: Time Series Fault Schema, Common Schema

The schema (.XSD) file can be found at URN

<http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/FaultCode.xsd>

11.21.10 Data field descriptions for codes unique to each system schema (response)

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
  attributeFormDefault="unqualified"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  xmlns="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501"
  version="1.0.0"
>

  <xs:include schemaLocation="http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd"/>

  <xs:element name="DiagnosticTroubleCode">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
        <xs:element name="FaultCode" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="CodeIdentifier" type="xs:string"
minOccurs="0" maxOccurs="1"/>
              <xs:element name="CodeDescription" type="xs:string"
minOccurs="0" maxOccurs="1"/>
              <xs:element name="CodeSeverity" type="xs:string" minOccurs="0"
maxOccurs="1"/>
              <xs:element name="AirTemperature" type="xs:integer"
minOccurs="0" maxOccurs="1"/>
              <xs:element name="TemperatureUnit" type="xs:string"
minOccurs="0" maxOccurs="1"/>
              <xs:element name="CodeSource" type="xs:string" minOccurs="0"
maxOccurs="1"/>
            </xs:sequence>
            <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

12 Data schemas

12.1 Common schema

This schema is shared among all endpoints and is used to structure the fleet element and the related complex types. See [Annex C](#).

12.2 Time series schema

This schema is shared among the time series overview endpoints and is used to structure the fleet element and the related hyperlinks and metadata. See [Annex D](#).

13 Syntax errors

Providers shall follow the standard HTTP protocol as specified in IETF RFC 7231. The responses shown in [Table 5](#) are used in IETF RFC 7231. Specifically, the responses given by [Table 5](#) are used in this protocol.

Table 5 — Syntax errors

Error	Response
Customer application error 4XX	400 Bad Request
	402 Payment Required
	403 Forbidden
	404 Not Found
	405 Method Not Allowed
	406 Not Acceptable
	408 Request Timeout
	409 Conflict
	410 Gone
	411 Length Required
	413 Payload Too Large [IETF RFC 7231 changes this to Payload too large]
	414 Request-URL Too Long
	415 Unsupported Media Type
	417 Expectation Failed
Server error 5XX	426 Upgrade Required [Update per IETF RFC 7231]
	429 Too many requests
	500 Internal Server Error
	501 Not Implemented
	502 Bad Gateway
	503 Service Unavailable
	504 Gateway Timeout
	505 HTTP Version Not Supported

Annex A (informative)

Relationship between this document and ISO 15143-2

A.1 Data element cross-references

[Table A.1](#) presents a detailed cross-referencing of the data elements defined in this document and related data defined in ISO 15143-2:2010, Table A.1, and their value domain as defined in ISO 15143-2:2010, Table A.2.

NOTE ISO/TS 15143-3 data items are expressed by using “CamelCase”. When referencing these items availing the data dictionary presented in ISO 15143-2, “CamelCase” expression is modified to “snake_case” expression, and vice versa.

Table A.1 — Relationship between data defined in this document and related data defined in ISO 15143-2

This document		ISO 15143-2:2010 Table A.1		This document			ISO 15143-2:2010 Table A.2		Use case		Time stamp	
Section	Data element name	Classification scheme item value	Data element concept name	Name	Example	Unit	Range	Value domain	Productivity	Health	Real time	Processed time
11.2	Machine header Information								X	X		X
http://icmanet.or.jp/english2017/ISO/15143/-3/20190501/common.xsd												
11.2.2	Telematics unit installation date	basic_machine_data	component installation_date_1	component installation_date_1	2016-01-22 T00:00:00Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.2.3	Equipment make		machine_manufacturer	machine_manufacturer_1	ABDC OEM	string	unbounded	character_string_1				
11.2.4	Equipment model		machine_model	machine_model_1	123A	string	unbounded	character_string_1				
11.2.5	Equipment ID		local_machine_id	local_machine_id_1	4WDL35	string	unbounded	machine_local_id_1				
11.2.6	Serial Number		Machine_serial_number	Machine_serial_number_1	12345abc	string	unbounded	character_string_1				
11.2.7	Product Identification Number (PIN/VIN)		product_identification_number_PIN	product_identification_number_PIN_1	DW744KXK-BE641036	string	17 char	product_identification_number_1				

Table A.1 (continued)

This document		ISO 15143-2:2010 Table A.1		This document			ISO 15143-2:2010 Table A.2		Use case		Time stamp	
Section	Data element name	Classification scheme item value	Data element concept name	Name	Example	Unit	Range	Value domain	Productivity	Health	Real time	Processed time
11.3	Last known location									X		X
http://www.jcmanet.or.jp/english2017/ISO/15143-3/20190501/Locations.xsd												
11.3.2	Date and time of location	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_2	2016-01-22 T15:31:42Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.3.3	Latitude of location		machine_running_position	Latitude_measure	53.9876	Degree DD.dd	±90.0000000	latitude_measure_decimal_1				
11.3.4	Longitude of location		machine_running_position	longitude_measure	-84.35963	degree DD.dd	±180.00000	longitude_measure_decimal_1				
11.3.5	Altitude of location		machine_running_position	altitude_measure	352	decimal MM.mm		altitude_measure_decimal_1				
11.3.6	Unit of measure of altitude				metre	string		↑				
11.4	Operating hours (Health)									X		X
http://www.jcmanet.or.jp/english2017/ISO/15143-3/20190501/CumulativeOperatingHr.xsd												
11.4.2	Date and time of cumulative operating hours	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_2	2016-01-22 T15:58:19Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.4.3	Operating hours		operating_hours	operating_hours_1	1 234.56	HHHH.hh		time_3				

Table A.1 (continued)

This document		ISO 15143-2:2010 Table A.1		This document			ISO 15143-2:2010 Table A.2		Use case		Time stamp	
Section	Data element name	Classification scheme item value	Data element concept name	Name	Example	Unit	Range	Value domain	Productivity	Health	Real time	Processed time
11.5	Cumulative fuel used									X		X
11.5.2	Date and time of cumulative fuel used	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.5.3	Unit of measure of fuel used to date			—	litre	char	5	↓				
11.5.4	Amount of fuel used to date		cumulative_fuel	cumulative_fuel_1	7405.8	decimal LLLL.Ll		volume_4				
11.6	Fuel used in the preceding 24hr (alternative, not preferred)									X		X
11.6.2	Date and time of fuel used in the preceding 24 hours	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.6.3	Unit of measure of fuel used in the preceding 24 hours			—	litre	char	5	↓				
11.6.4	Fuel used in the preceding 24 hours		cumulative_fuel	cumulative_fuel_2	123.45	decimal LLLL.Ll		volume_4				

Table A.1 (continued)

This document		ISO 15143-2:2010 Table A.1		This document			ISO 15143-2:2010 Table A.2		Use case		Time stamp	
Section	Data element name	Classification scheme item value	Data element concept name	Name	Example	Unit	Range	Value domain	Productivity	Health	Real time	Processed time
11.7	Cumulative distance travelled									X		X
11.7.2	Date and time of distances	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.7.3	Unit of measure of distance		—	—	kilometre	char	9					
11.7.4	Cumulative distance travelled		distance_traveled	distance_traveled_1	92478.9	DDDD.d		length_8				
11.8	Caution codes referencing number									X	X	
11.8.2	Date and time of code	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_3	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.8.3	IEC/ISO Symbol Reference Number identifier		caution_code_referencing_number	caution_code_referencing_number_1	TBD	string	unbounded	caution_code_1				
11.8.4	Code description		caution_code_description	caution_code_description_1	TBD	string	unbounded	character_strings_1				

Table A.1 (continued)

This document		ISO 15143-2:2010 Table A.1		This document			ISO 15143-2:2010 Table A.2		Use case		Time stamp	
Section	Data element name	Classification scheme item value	Data element concept name	Name	Example	Unit	Range	Value domain	Productivity	Health	Real time	Processed time
11.9	Cumulative idle operating hours								X			X
11.9.2	Date and time of cumulative idle operating hours	machine_working_state	machine_working_date_and_time	machine_working_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.9.3	Cumulative idle operating hours		idle_operating_hours	idle_operating_hours_1	1234.56	decimal HHHH.hh		time_3				
11.10	Fuel remaining ratio								X	X		X
11.10.2	Date and time of percent fuel remaining	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.10.3	Fuel Remaining Ratio	machine_management_data	fuel_remaining_ratio	fuel_remaining_ratio_1	80.8	percentage	0.00 to 100.00	rate_percent_2				
11.10.4	Unit of measure for fuel tank capacity			—	litre	char	5	↓				
11.10.5	Fuel tank capacity	basic_machine_data	fuel_tank_capacity	fuel_tank_capacity_1	1 234	Unsigned integer	0 to 4294967295	volume_4				

Table A.1 (continued)

This document		ISO 15143-2:2010 Table A.1		This document			ISO 15143-2:2010 Table A.2		Use case		Time stamp	
Section	Data element name	Classification scheme item value	Data element concept name	Name	Example	Unit	Range	Value domain	Productivity	Health	Real time	Processed time
11.11	Percent of DEF remaining								X	X		X
11.11.2	Date and time of percent DEF remaining	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.11.3	Percent of DEF remaining	machine_management_data	def_remaining_ratio	def_remaining_ratio_1	0	percentage	0.00-100.00	rate_percent_2				
11.11.4	Unit of measure for DEF tank capacity			—	litre	string	5	↓				
11.11.5	Def tank capacity	basic_machine_data	def_tank_capacity	def_tank_capacity_1	100	Unsigned integer	0 to 4294967295	volume_4				
11.12	Engine Condition									X	X	
11.12.2	Date and time of engine running	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_3	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.12.3	Engine number	basic_machine_data	engine_number	engine_number_1	RG6090R011885	string		character_strings_1				
11.12.4	Engine running	machine_running_state	engine_condition	engine_condition_2	0: Stop 1: Start	boolean		condition_5				

Table A.1 (continued)

This document		ISO 15143-2:2010 Table A.1		This document			ISO 15143-2:2010 Table A.2		Use case		Time stamp	
Section	Data element name	Classification scheme item value	Data element concept name	Name	Example	Unit	Range	Value domain	Productivity	Health	Real time	Processed time
11.13	Digital input state									X	X	
11.13.2	Date and time of digital input set response	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_3	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.13.3	Digital input number	basic_machine_data	digital_input_number	digital_input_number_1	5	Unsigned integer	0 to 4294967295	code_integer_1				
11.13.4	Digital input state	machine_running_state	digital_input_state	digital_input_state_1	0: off 1: on	boolean	0 or 1	condition_1				
11.14	Cumulative power take-off hours (CumulativePowerTakeOffHours)									X		X
11.14.2	Date and time of cumulative power take-off	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.14.3	Total power take-off hr		power_take-off_hours	power_take-off_hours_1	1234.56	Decimal DDDD.dd		time_3				

Table A.1 (continued)

This document		ISO 15143-2:2010 Table A.1		This document			ISO 15143-2:2010 Table A.2		Use case		Time stamp	
Section	Data element name	Classification scheme item value	Data element concept name	Name	Example	Unit	Range	Value domain	Productivity	Health	Real time	Processed time
11.15	Average daily engine load factor									X		X
11.15.2	Date and time of average load factor	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.15.3	Average load factor for preceding 24hr		engine_load_factor	engine_load_factor_1	98.76	percentage	0.00 - 100.00	rate_percent_2				
11.16	Peak daily speed									X		X
11.16.2	Date and time of peak travel speed	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.16.3	Unit of measurement for speed			—	kilometers per hour	string		↓				
11.16.4	Peak speed for preceding 24 hours	machine_running_state	peak_daily_speed	peak_daily_speed_1	1234.56	Decimal DDDD.dd		velocity_3				

Table A.1 (continued)

This document		ISO 15143-2:2010 Table A.1			This document			ISO 15143-2:2010 Table A.2		Use case		Time stamp	
Section	Data element name	Classification scheme item value	Data element concept name	Name	Example	Unit	Range	Value domain	Productivity	Health	Real time	Pro- cessed time	
11.17	Cumulative load count												
http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/CumulativeLoadCount.xsd													
11.17.2	Date and time of load count	machine_working_state	machine_working_date_and_time	machine_working_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5					
11.17.3	Cumulative load count		load_count	load_count_1	166	Unsigned integer	0 to 4294967295	code_integer_1					
11.18	Cumulative payload total												
http://www.jcmanet.or.jp/english2017/ISO/15143/-3/20190501/CumulativePayloadTotals.xsd													
11.18.2	Date and time of cumulative payload	machine_working_state	machine_working_date_and_time	machine_running_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5					
11.18.3	Unit of measure for payload			—	kilograms	char	9						
11.18.4	Cumulative payload total		payload_total	payload_total_1	1234.56	Decimal DDDD.dd		weight_1					

Table A.1 (continued)

This document		ISO 15143-2:2010 Table A.1		This document			ISO 15143-2:2010 Table A.2		Use case		Time stamp	
Section	Data element name	Classification scheme item value	Data element concept name	Name	Example	Unit	Range	Value domain	Productivity	Health	Real time	Processed time
11.19	Cumulative non-productive regeneration hours									X		X
11.19.2	Date and time of cumulative non-productive regeneration hours	machine_running_state	machine_running_date_and_time	machine_running_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.19.3	Cumulative idle non-operating hours		idle_nonoperating_hours	idle_nonoperating_hours_1	1234.56	Decimal HHHH.hh		time_3				
11.20	Cumulative idle non-operating hours								X			X
11.20.2	Date and time of cumulative idle non-operating hours	machine_working_state	machine_working_date_and_time	machine_working_date_and_time_2	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.20.3	Cumulative idle non-operating hours		idle_nonoperating_hours	idle_operating_hours_1	1234.56	Decimal HHHH.hh		time_3				

Table A.1 (continued)

This document		ISO 15143-2:2010 Table A.1		This document			ISO 15143-2:2010 Table A.2		Use case		Time stamp	
Section	Data element name	Classification scheme item value	Data element concept name	Name	Example	Unit	Range	Value domain	Productivity	Health	Real time	Processed time
11.21 Data field descriptions for codes unique to each system http://www.jrcmanet.or.jp/english2017/ISO/15143-3/20190501/FaultCode.xsd												
11.21.2	Diagnostic Trouble Code identifier	machine_running_state	active_trouble_code	active_trouble_code_1	523865.9	Numeric string	unbounded	code_alphanumeric_1		X	X	
11.21.3	Date and time of code		machine_running_date_and_time	machine_running_date_and_time_3	2015-12-31 T22:44:26Z	YYYY_MM_DDTHH_MM_SSZ		datetime_5				
11.21.4	Code severity		trouble_code_severity	trouble_code_severity_1	INFO	string	unbounded	code_character_1				
11.21.5	Code description		trouble_code_description	trouble_code_description_1	INFO OBC 523865.09 The SSM has lost CAN communication with the VCU	string	unbounded	code_character_1				
11.21.6	Unit of measure for ambient air temperature	machine_running_state			Celsius	string	9	↓				
11.21.7	Ambient Air temperature of time when code was triggered		ambient_air_temperature	ambient_air_temperature_2	34	Integer	-100 to +100	celsius_temperature_2				
11.21.8	Description of code source	basic_machine_data	DTC_source	DTC_source_1	TBD			code_character_1				

A.2 Data element use cases

The use case for each of the data elements identified in in this document can be found in [Table A.2](#).

Table A.2 — Data element use cases

Referenced subclause	Who uses the data?		How are the data used? Data usage scenarios	ISO 15143-1:2010, Table 1 List of sub-services
	Site manager (productivity)	Machine manager (health)		
11.2 Machine header information	x	x	This data is used by the customer application to identify the data element through the data schema.	Construction management
11.2.2 Telematics unit installation date		x	This data is used to confirm the date when the telematics unit was installed. For the OEM, this date is possibly the date of manufacture of the machine. For a third party telematics provider this date is possibly the date of the installation of the retrofitted device.	Construction management
11.2.3 Equipment make	x	x	This data is used to identify the OEM of the machine. It can be used to plan and track machine utilization by OEM for mixed fleets.	Construction management
11.2.4 Equipment model	x	x	This data is used to identify the machine form, size and model of the machine. It can be used to plan utilization of the machine for a particular task.	Construction management
11.2.5 Equipment ID (identification)		x	Equipment ID (identification) is used to identify a particular machine. It is assigned by the machine owner or end user. It is used to track machine utilization by specific machine.	Construction management
11.2.6 Serial number	x	x	This data is used to identify a particular machine. It is assigned by an OEM when a PIN or VIN is not available. It is intended to extend the application of this document to machines other than EMM or mobile road construction machinery. It is used to track machine utilization by specific machine.	Construction management
11.2.7 Product Identification number (PIN) or vehicle identification number (VIN)	x	x	This 17-character field uniquely identifies the machine. It is used to track machine utilization by specific machine.	Construction management
11.3 Last known location	x	x	Identify the machine location. Latitude, Longitude and Elevation are used to plot the machine location on a map to plan service routes for fueling, greasing, etc. Other uses include geofencing and theft alarms.	Equipment and supply
11.4 Operating hours	x	x	The hour meter value on the machine is used to schedule servicing and to monitor the utilization of the machine.	Equipment and supply

Table A.2 (continued)

Referenced subclause	Who uses the data?		How are the data used?	ISO 15143-1:2010, Table 1 List of sub-services
	Site manager (productivity)	Machine manager (health)	Data usage scenarios	
11.5 Cumulative fuel used	x	x	The cumulative fuel use is used to monitor the costs of the fuel used by the machine and to compare that costs to similar machines.	Equipment and supply
11.6 Fuel used in the preceding 24 hours	x		The fuel used in the last 24 hours is used to account for the cost of the fuel and to analyse the utilization of the machine.	Equipment and supply
11.7 Cumulative distance travelled	x	x	To identify the service timing (i.e. tyre change) — Customer could review history of machines to see how many kilometres travelled, to help plan maintenance or resale — Tyre replacement planning — Typically distance travelled is measured using an on board odometer	Equipment and supply
11.8 Caution codes referencing number	x	x	The caution codes referencing numbers are used to identify the operating health of specific subsystems on the machine. Fault codes are an indicator of components operating out of tolerance or failure. Depending upon the severity, service and parts may be required.	Equipment and supply
11.9 Cumulative idle operating hours	x		Idle operating hours are an indication of the utilization of the machine and may be used to enforce worksite operational policies intended to reduce fuel usage.	Equipment and supply
11.10 Fuel remaining ratio	x		The fuel remaining ratio in the fuel tank is used to schedule fuel delivery to the machine.	Equipment and supply
11.11 Def remaining ratio	x		The percent of DEF remaining is used to schedule DEF delivery to the vehicle	Equipment and supply
11.12 Engine condition	x		The production manager could compile the time the engine was running and use that to evaluate an operator. A production manager could identify when machines are operated outside of normal working hours.	Machine construction
11.13 Digital input state	x	x	Generally, telematics units feature unassigned digital inputs that can be used to transmit the status of discrete sensors installed on the machine. Examples include pressure and temperature switches, interlock switches, proximity position sensors and the like.	Equipment and supply