## BSI Standards Publication

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

Part 3: Telematics data

**bsi.**

## National foreword

This Published Document is the UK implementation of ISO/TS 15143-3:2016.

The UK participation in its preparation was entrusted by Technical Committee B/513, Construction equipment and plant and site safety, to Subcommittee B/513/1, Earth moving machinery (International).

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with a British Standard cannot confer immunity from legal obligations.**

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# TECHNICAL SPECIFICATION

# ISO/TS 15143-3

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# 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 on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 3, *Machine characteristics, electrical and electronic systems, operation and maintenance*.

This part of ISO 15143 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.

# Introduction

This document is a data schema having the purpose of providing data 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). Any number of fleets can be represented, each with its own URL.

Clients 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 third-party application developer to develop applications for purposes deemed appropriate by the end user.

# 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 third-party client applications via the Internet. The data are 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 health.

It is applicable to mobile 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.
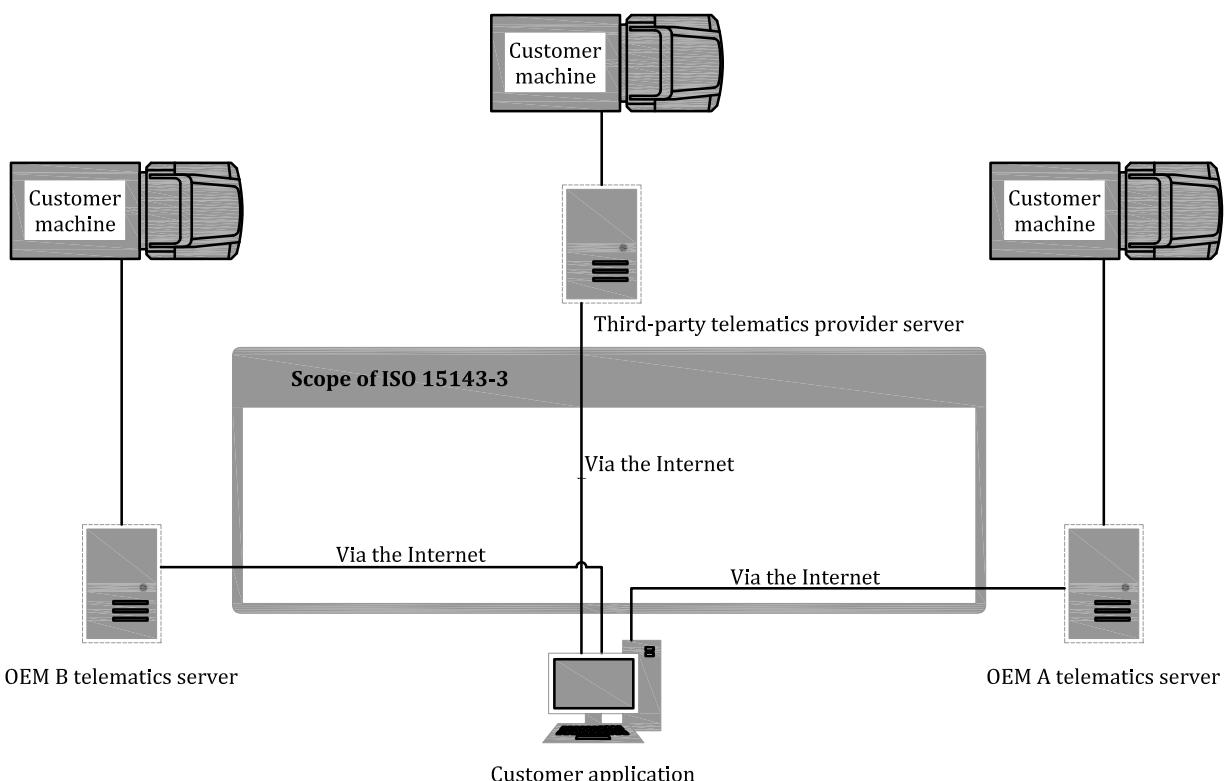


**Figure 1 — Topography of conceptual mixed fleet telematics system within the scope of this document**

## 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: Specific symbols for machines, equipment and accessories*

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

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

ISO 15143-1:2010, *Earth-moving machinery and mobile road construction machinery — Worksite data exchange — Part 1: System architecture*

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

ECMA-404, *The JSON Data Interchange Format*

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

## 3   Terms, definitions and abbreviated terms

For the purposes of this document, the following terms, definitions and abbreviated terms (see Table 1) apply.

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

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

**3.1**
**caution codes referencing number**
ISO/IEC symbol registration number as defined in ISO 7000 and referenced in ISO 6405-1

Note 1 to entry: Caution codes referencing numbers are returned from the telematics provider server and refer to standardized symbols representing various conditions present on EMM.

**3.2**
**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

**3.3**
**data element**
instance of data transmitted by the OEM server to the third-party application adhering to the definition of the quantity or condition described by Clause 11 of this document

**3.4**
**discoverability**
requirement that the data be stored in such a manner that it can be accessed if necessary

**3.5**
**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.

**3.6**
**end user**
organization owning and or operating the mobile machinery

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.

**3.7**
**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 third-party application developer needs to obtain fault code definitions from each OEM.

**3.8**
**Internet media-type**
two-part identifier for file formats on the Internet

**3.9**
**link**
element to allow the third party or end user to be directed to additional data or resources

**3.10**
**make code**
alphabetic string representing the OEM of a specific piece of equipment

**3.11**
**model**
alphanumeric string representing the machine form type and series as defined by the OEM

**3.12**
**namespace**
set of symbols that are used to organize objects of various kinds, so that these objects may be referred to by name

**3.13**
**namespace URI**
uniquely named elements and attributes in an XML document

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

**3.14**
**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.

**3.15**
**snapshot time**
date and time at which the snapshot of the fleet was created

**3.16**
**telematics provider**
either OEM or third party providing telematics equipment or services

**3.17**
**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 generated by a piece of equipment over a period of time.

**3.18**
**version**
integer that is used to distinguish different versions of the contract

**3.19**
**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 document.

**Table 1 — Abbreviations and acronyms**

| | |
|---|---|
| API | Application programming interface |
| DEF | Diesel exhaust fluid |
| EI | Electronic interface |
| FMI | Failure mode indicator |
| GPS | Global positioning system |
| HREF | Hypermedia reference URL |
| ID | Identification |
| IETF | Internet engineering task force |
| OEM | Original equipment manufacturer |
| PIN | Product identification number |
| REL | Reference attribute |
| SI | *Systeme internationale* (international system of units) |
| SOAP | Simple object access protocol |
| SPN | Suspect parameter number |
| URI | Uniform resource identifier |
| URL | Universal resource location |
| URN | Universal Resource Name |
| UTC | Universal Coordinated Time |
| UTF-8.EI | Unicode transformation format, 8 bit |
| VIN | Vehicle Identification Number |
| XML | Extensible Markup Language |

# 4 Data management and access control

## 4.1 Minimum requesting period

The recommended minimum response period from the telematics provider server to the third-party application is one response per 15 min. The data provider may choose to provide the data less often.

The server supplies the last known data to the application independent of the update rate from the machine to the server. The actual call-in times from the machine can vary due to cell coverage, telematics settings, etc., so the last known data can be significantly older and can remain unchanged between server data transmissions to the application.

## 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://standards.iso.org/iso/15143/-3/ as they become available.

## 4.3   Data element use case

A use case as defined 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 Version 1.0A or OAuth Version 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.

The response is a full snapshot of the fleet. If the fleet contains no equipment at the time of the snapshot, an empty document is returned. To prevent excessively frequent access, the provider may return "503 Service Unavailable" for requests that are more frequent than one per 15 min interval as expressed in 4.1.

OAuth provides client 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 third-party clients by an authorization server, with the approval of the resource owner, or end-user. The client then uses the access token to access the protected resources hosted by the resource server.

# 5   Response formats

This international standard 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://standards.iso.org/iso/15143/-3/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 text/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:

— Namespace 1;

— snapshotTime;

— version;

— Name Space URI.

XML Namespace: XML namespaces provide a simple method for qualifying element and attribute names used in Extensible Markup Language documents by associating them with namespaces identified by URI references.

Declaration Version specifies the version of the XML standard to which the XML document conforms.

The snapshot time is the date and time at which the snapshot of the fleet was created. Its format is described in 11.18.

URL identifies the Internet domain address. < Fleet snapshotTime="2015-05-29T10:57:19Z" version=**"1"** xmlns="http://standards.iso.org/iso/15143/-3"

## 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, previous, next, and 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 8.2.1) or a single piece of equipment (see 8.2.2).

### 8.2   Snapshot endpoint

The set of snapshot endpoints listed in 8.2.1 and 8.2.2 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.

#### 8.2.1   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 Nonproductive Regeneration Hours (CumulativeActiveRegenerationHours);

— Cumulative Non-Productive Idle Hours (CumulativeNonProductiveIdleHours).

### 8.2.2 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 Nonproductive Regeneration Hours (CumulativeActiveRegenerationHours);

— Cumulative Non-Productive Idle Hours (CumulativeNonProductiveIdleHours).

## 8.3   Time series endpoint

### 8.3.1   General

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,

— CumulativeOperatingHr,

— CumulativeFuelUsed,

— FuelUsedinthepreceding24hr,

— Distance,

— CautionCodes,

— CumulativeIdleHours,

— EngineCondition remaining ratio,

— DEFremaining,

— EngineCondition,

— SwitchStatus,

— CumulativePowerTakeOffHours,

— AverageDailyEngineLoadFactor,

— PeakDailySpeed,

— CumulativeLoadCount,

— CumulativePayloadTotals,

— CumulativeNonproductiveRegenerationHours,

— CumulativeIdleNonoperatingHours, and

— FaultCode.

## 8.4 Links

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)

### 8.4.1 Reference attribute (rel)

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

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 (e.g. Location, Fault Code, Switch Status) and contain a URL to one of the time series telematics data endpoints.

### 8.4.2 Hypermedia reference URL (href)

The hypermedia reference URL (href) is a reference to another endpoint. These references are provided so that available data are discoverable by automated systems.

## 9 Date and time formats

All date and time stamps in an EI document are to be formatted as ISO 8601 "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, minutes and seconds are optional.

## 10 Data fields summary

The data elements identified in this document are summarized in Table 2 with the supporting attributes in the order of presentation in the .XML response to a request. The parameters in parentheses in Table 2 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://standards.iso.org/iso/15143/-3 are listed adjacent to data element names and value domain names defined in ISO 15143-2:2010, Tables A.1 and A.2.

**Table 2 — 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 |
| 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 hrs (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) |
| ª    PIN and VIN are interchangeable and mutually exclusive. PIN is the name used in common.xsd | | |

**Table 2** *(continued)*

| Data element | Attributes | |
|---|---|---|
| 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) |
| Cumulative power take off hours (Cumulative-PowerTakeOffHours) | — | 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 (LoadFactor) |
| Peak Daily Speed (MaximumSpeedLast24) | — | Date and time (datetime) |
| | — | Unit used for speed (SpeedUnits) |
| | — | Peak speed (Speed) |
| Cumulative Load Count (CumulativeLoad-Count) | — | Date time (datetime) |
| | — | Cumulative load count (Count) |
| Cumulative Payload Totals (CumulativePay-loadTotals) | — | Date and time (datetime) |
| | — | Unit of measure for payload (weightuom) |
| | — | Cumulative payload (Payload) |
| Cumulative Nonproductive Regeneration Hours (CumulativeActiveRegenerationHours) | — | Date and time (datetime) |
| | — | Cumulative regeneration hour (Hour) |
| Cumulative idle nonoperating hours (Cumula-tiveNonProductiveIdleHours) | — | Date and time (datetime) |
| | — | Cumulative non productive idle (Hour) |
| Diagnostic Trouble Codes (DiagnosticTrou-bleCode) | — | Diagnostic Trouble Code Identifier (CodeIdentifier) |
| | — | Date and time (datetime) |
| | — | Code severity (CodeSeverity) |
| | — | Code description (CodeDescription) |
| | — | Temperature units (temperatureunits) |
| | | Ambient air temperature (airtemp) |
| | | Description of Code Source (CodeSource) |

<sup>a</sup>   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 third-party 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. 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://standards.iso.org/iso/15143/-3, where the filename describes the data element.

NOTE        This document avails 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 a 17 character field. 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://standards.iso.org/iso/15143/-3/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 −90,000 000° to +90,000 000°. 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 −180,000 000° to +180,000 000°. 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://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 machine was at the described location. 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://standards.iso. org/iso/15143/-3/CumulativeOperatingHr.xsd.

### 11.4.5 Operating hours schema (Response)

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

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 hours 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 ending 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://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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.

Cumulating 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 indicates 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://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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.

— **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. 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://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 form. 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 form. 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 machine registered idle hours (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://standards.iso.org/iso/15143/-3/CumulativeIdleHours.xsd.

### 11.9.5 Cumulative idle operating hours schema (response)

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

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 percent fuel remaining

The date and time indicate when the percent 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}/FuelRemaingRatio/{startDateUTC}/{endDateUTC}/{pageNumber}

SCHEMAS: Time Series Fuel Remaining, Common Schema

The schema (.XSD) file can be found at URN http://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 an unsigned integer, which includes all values from 0 through 4 294 967 295.

#### 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://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 serial 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://standards.iso.org/iso/15143/-3/EngineCondition.xsd

### 11.12.6 Engine condition schema (response)

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

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 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 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.

### 11.13.3 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.

### 11.13.41 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://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 takeoff 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 takeoff

The date and time indicate when the date and time when the cumulative power take off hours were registered on the machine. Its format is described in Clause 9.

### 11.14.3 Cumulative power takeoff hours

The value is expressed as a decimal eight digits in length with two digits to the left 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 takeoff hours endpoint (Request)

URL:

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

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

The schema (.XSD) file can be found at URN http://standards.iso.org/iso/15143/-3/CumulativePowerTakeOffHours.xsd

### 11.14.5 Cumulative power takeoff 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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>

<xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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="CumulativePowerTakeOffHours" 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 hour 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}/{pageNumber}

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

The schema (.XSD) file can be found at URN http://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 http://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
```

```
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>
```

```
    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 (WeightUnit)

— 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://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
            xmlns="http://standards.iso.org/iso/15143/-3"
            version="1.0.0"
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 is 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 nonproductve 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 left 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 Nonproductive Regeneration Hours Schema, Common Schema

The schema (.XSD) file can be found at URN http://standards.iso. org/iso/15143/-3/CumulativeNonproductiveRegenerationHours.xsd

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

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

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 nonoperating hours (CumulativeNonproductiveIdleHours)**

  — Date and time (DateTime)

  — Cumulative non-productive idle hours (Hour)

### 11.20.2 Date and time of cumulative idle nonoperating 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 left 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 Nonoperating Hours, Common Schema

The schema (.XSD) file can be found at URN http://standards.iso. org/iso/15143/-3/CumulativeIdleNonoperatingHours.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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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 3.

**Table 3 — Examples of how codes might be optionally reported by the OEM or third party telematics supplier through the API**

| Manu-facturer | Date and time | Diag-nostic code identi-fier | Caution code ref-erencing number identifier | Code severity | Code description | Ambi-ent air temper-ature | Air tem-perature unit of measure | De-scrip-tion 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 | 1000.21 | 3400 | Med | Circuit has an issue | | | TCU |
| 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://standards.iso.org/iso/15143/-3/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://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/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"/>
                            <xs:element name="CodeDescription" type="xs:string"/>
                            <xs:element name="CodeSeverity" type="xs:string"/>
                            <xs:element name="AirTemperature" type="xs:integer"/>
                            <xs:element name="TemperatureUnit" type="xs:string"/>
                            <xs:element name="CodeSource" 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>
```

# 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 IETFRFC 7231. The responses shown in Table 4 are used in IETFRFC 7231. Specifically, the responses given by Table 4 are used in this protocol.

**Table 4 — Syntax errors**

| Error | Response |
|---|---|
| Client 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 [IETFRFC 7231 changes this to Payload too large] |
| | 414 Request-URL Too Long |
| | 415 Unsupported Media Type |
| | 417 Expectation Failed |
| | 426 Upgrade Required [Update per IETFRFC 7231] |
| Server error 5XX | 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 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 15143-3**

| 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 | Produc-tivity | Health | Real time | Pro-cessed time |
| 11.2 Machine header Information | | | | | | | | | | | | X |
| http://standards.iso.org/iso/15143/-3/common.xsd | | basic_machine_data | | | | | | | X | X | | |
| 11.2.2 | Telematics unit installation date | | componet_instal-lation_date | componet_in-stallation_date_1 | 2016-01-22 T00:00:00Z | YYYY_MM_DDTHH_MM_SSZ | | datetime_5 | | | | |
| 11.2.3 | Equipment make | | machine_manu-facturer | machine_manu-facturer_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 | 4WDL 35 | 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_iden-tification_num-ber_PIN | product_iden-tification_num-ber_PIN_1 | DW744KXK-BE641036 | string | 17 char | product_identifica-tion_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://standards.iso.org/iso/15143-3/Locations.xsd | | | | | | | | | | | | |
| 11.3.2 Date and time of location | machine_running_state | machine_running_date_and_time | machine_running_date_and_time_2 | 2016-01-22T15:31:42Z | 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_dechimal_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://standards.iso.org/iso/15143-3/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 | 2016-01-22T15:58:19Z | YYYY_MM_DDTHH_MM_SSZ | | | datetime_5 | | | | |
| 11.4.3 Operating hours | | operating_hours | operating_hours_1 | 1 234,56 | HHHHH.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 | Produc-tivity | Health | Real time | Pro-cessed time |
| 11.5 Cumulative fuel used | | | | | | | | | | X | | X |
| http://standards.iso.org/iso/15143-3/cumulativefuelused.xsd | | | | | | | | | | | | |
| 11.5.2 | Date and time of cumulative fuel used | machine_running_state | machine_run-ning_date_and_time | machine_run-ning_date_and_time_2 | 2015-12-31 T22:44:26Z | YYYY_MM_DDTHH_MM_SSZ | | datetime_5 | | | | |
| 11.5.3 | Unit of meas-ure of fuel used to date | | | --- | litre | char | 5 | → | | | | |
| 11.5.4 | Amount of fuel used to date | | cumulative_fuel | cumulative_fuel_1 | 7 405,8 | dici-malLLLLL.ll | | volume_4 | | | | |
| 11.6 Fuel used in the preceding 24hr (alter-native, not preferred) | | | | | | | | | | X | | X |
| http://standards.iso.org/iso/15143-3/FuelUsedinthepreceding24hr.xsd | | | | | | | | | | | | |
| 11.6.2 | Date and time of fuel used in the preceding 24 hours | machine_run-ning_state | machine_run-inng_date_and_time | machine_run-ning_date_and_time_2 | 2015-12-31 T22:44:26Z | YYYY_MM_DDTHH_MM_SSZ | | datetime_5 | | | | |
| 11.6.3 | Unit of meas-ure 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)*

| Section | Data element name | Classification scheme item value | Data element concept name | Name | Example | Unit | Range | Value domain | Produc-tivity | Health | Real time | Pro-cessed time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11.7 | Cumulative distance travelled | | | | | | | | | X | | X |
| http://standards.iso.org/iso/15143-3/Distance.xsd | | | | | | | | | | | | |
| 11.7.2 | Date and time of distances | machine_running_state | machine_running_date_and_time | machine_running_date_and_time_2 | 2015–12–31T22:44:26Z | 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 | 92 478,9 | DDDD.d | | length_8 | | | | |
| 11.8 | Caution codes referencing number | | | | | | | | | X | X | |
| http://standards.iso.org/iso/15143-3/CautionCode.xsd | | | | | | | | | | | | |
| 11.8.2 | Date and time of code | machine_running_state | machine_running_date_and_time | machine_running_date_and_time_3 | 2015–12–31T22:44:26Z | 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 | Cumulative idle operating hours. | | | | | | | | X | | | X |
| http://standards.iso.org/iso/15143/-3/CumulativeIdleHours.xsd | | | | | | | | | | | | |
| 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 | 2015-12-31T22:44:26Z | YYYY_MM_DDTHH_MM_SSZ | | datetime_5 | | | | |
| 11.9.3 | Cumulative idle operating hours | | idle_operating_hours | idle_operating_hours_1 | 1 234,56 | decimalHH_HH.hh | | time_3 | | | | |
| 11.10 Fuel remaining ratio | | | | | | | | | X | X | | X |
| http://standards.iso.org/iso/15143/-3/FuelRemaining.xsd | | | | | | | | | | | | |
| 11.10.2 | Date and time of percent fuel remaining | machine_running_state | machine_running_date_and_time | machine_running_date_and_time_2 | 2015-12-31T22:44:26Z | 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 | Produc-tivity | Health | Real time | Pro-cessed time |
| 11.11 Percent of DEF remaining | | | | | | | | | X | X | | X |
| http://standards.iso.org/iso/15143/3/DEFremaining.xsd | | | | | | | | | | | | |
| 11.11.2 | Date and time of percent DEF remaining | machine_run-ning_state | machine_run-inng_date_and_time | machine_run-ning_date_and_time_2 | 2015–12–31 T22:44:26Z | YYYY_MM_DDTHH_MM_SSZ | | dtetime_5 | | | | |
| 11.11.3 | Percent of DEF remaining | machine_man-agement_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_capac-ity | def_tank_capac-ity_1 | 100 | Unsigned integer | 0 to 4294967295 | volume_4 | | | | |
| 11.12 Engine Condition | | | | | | | | | | X | X | |
| http://standards.iso.org/iso/15143/3/EngineCondition.xsd | | | | | | | | | | | | |
| 11.12.2 | Date and time of engine running | machine_run-ning_state | machine_run-ning_date_and_time | machine_run-ning_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_num-ber_1 | RG6090R011885 | string | | character_strings_1 | | | | |
| 11.12.4 | Engine running | machine_run-ning_state | engine_condition | engine_condi-tion_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 | |
| http://standards.iso.org/iso/15143-3/SwitchStatus.xsd | | | | | | | | | | | | |
| 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 | 2015-12-31T22:44:26Z | 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 takeoff hours (CumulativePowerTakeOffHours) | | | | | | | | | X | | X |
| http://standards.iso.org/iso/15143-3/CumulativePowerTakeOffHours.xsd | | | | | | | | | | | | |
| 11.14.2 | Date and time of cumulative power takeoff | machine_running_state | machine_running_date_and_time | machine_running_date_and_time_2 | 2015-12-31T22:44:26Z | YYYY_MM_DDTHH_MM_SSZ | | datetime_5 | | | | |
| 11.14.3 | Total power takeoff hr | power_takeoff_hours | power_takeoff_hours | power_takeoff_hours_1 | 1 234,56 | 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 |
| http://standards.iso.org/iso/15143/-3/AverageDailyEngineLoadFactor.xsd | | | | | | | | | | | | |
| 11.15.2 | Date and time of average load factor | machine_running_state | machine_running_date_and_time | machine_running_date_and_time_2 | 2015-12-31T22:44:26Z | 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 |
| http://standards.iso.org/iso/15143/-3/PeakDailySpeed.xsd | | | | | | | | | | | | |
| 11.16.2 | Date and time of peak travel speed | machine_running_state | machine_running_date_and_time | machine_running_date_and_time_2 | 2015-12-31T22:44:26Z | YYYY_MM_DDTHH_MM_SSZ | | datetime_5 | | | | |
| 11.16.3 | Unit of measure for speed | | --- | --- | Kilometersperhour | 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 | Produc-tivity | Health | Real time | Pro-cessed time |
| 11.17 | Cumulative load count | | | | | | | | X | | | X |
| http://standards.iso.org/iso/15143-3/CumulativeLoadCount.xsd | | | | | | | | | | | | |
| 11.17.2 | Date and time of load count | machine_work-ing_state | machine_work-ing_date_and_time | machine_work-ing_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 pay-load total | | | | | | | | X | | | X |
| http://standards.iso.org/iso/15143-3/CumulativePayloadTotals.xsd | | | | | | | | | | | | |
| 11.18.2 | Date and time of cumulative payload | machine_work-ing_state | machine_work-ing_date_and_time | machine_run-ning_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 | | | — | kiilograms | char | 9 | | | | | |
| 11.18.4 | Cumulative payload total | | payload_total | payload_total_1 | 1 234,56 | 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 | Produc-tivity | Health | Real time | Pro-cessed time |
| 11.19 Cumulative non-productive regen-eration hours | | | | | | | | | | X | | X |
| http://standards.iso.org/iso/15143/-3/CumulativeNonproductiveRegenera-tionHours.xsd | | | | | | | | | | | | |
| 11.19.2 | Date and time of cumulative non-produc-tive regenera-tion hours | machine_run-ning_state | machine_run-ning_date_and_time | machine_run-ning_date_and_time_2 | 2015–12–31 T22:44:26Z | YYYY_MM_DDTHH_MM_SSZ | | datetime_5 | | | | |
| 11.19.3 | Cumulative idle nonoper-ating hours | | idle_nonoperat-ing_hours | idle_nonoperat-ing_ours_1 | 1 234,56 | Decimal HHHH.hh | | time_3 | | | | |
| 11.20 Cumulative idle nonoperating hours | | | | | | | | | X | | | X |
| http://standards.iso.org/iso/15143/-3/CumulativeIdleNonoperatingHours.xsd | | | | | | | | | | | | |
| 11.20.2 | Date and time of cumulative idle nonoper-ating hours | machine_work-ing_state | machine_work-ing_date_and_time | machine_work-ing_date_and_time_2 | 2015–12–31 T22:44:26Z | YYYY_MM_DDTHH_MM_SSZ | | datetime_5 | | | | |
| 11.20.3 | Cumulative idle nonoper-ating hours | | idle_nonoperat-ing_hours | idle_operating-hours_1 | 1 234,56 | 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 | | | | | | | | | | X | X | |
| http://standards.iso.org/iso/15143-3/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 | | | | |
| 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_descripton | trouble_code_descripton_1 | INFO 0C3 523865.09 The SSM has lost CAN communication with the VCU | string | unbounded | code_character_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 |
| 11.21.6 | 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**

| Section | Who uses the data? | | How are the data used? | ISO I5143-1:2010 |
|---|---|---|---|---|
| | Site manager (Productivity) | Machine manager (Health) | Data usage scenarios | Table 1 List of sub-ser-vices |
| **11.2 Machine header informa-tion** | x | x | These data are used by the third-party application to identify the data element through the data schema. | Construction management |
| **11.2.2 Telemat-ics unit installa-tion date** | | x | These data are 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 Equip-ment make** | x | x | These data are used to identify the OEM of the machine. I can be used to plan and track machine utilization by OEM for mixed fleets. | Construction management |
| **11.2.4 Equip-ment model** | x | x | These data are used to identify the machine form, size and model of the ma-chine. 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 as-signed 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 | These data are used to identify a par-ticular machine. It is assigned by an OEM when a PIN or VIN is not available. It is intended to extend the application of Part 3 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 identifi-cation number (VIN)** | x | x | This 17 character field uniquely identifies the machine. It is used to 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 geofenc-ing 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)*

| Section | Who uses the data? | | How are the data used? | ISO I5143-1:2010 **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 machinel | 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 |
| **11.14 Cumulative power takeoff hours** | x | x | The production manager could compile the time the power take off was driving an implement such as a mower or sprayer or site drainage pump. The service manager uses the power take off usage to schedule preventative maintenance on the implement. | Machine construction |

**Table A.2** *(continued)*

| Section | Who uses the data? | | How are the data used? | ISO I5143-1:2010 Table 1 List of sub-services |
|---|---|---|---|---|
| | Site manager (Productivity) | Machine manager (Health) | Data usage scenarios | |
| **11.15** **Average daily load factor** | x | x | The average daily load factor is used to optimize machine size and capacity to identify machines that are under or over loaded. | Machine construction |
| **11.16** **Peak daily speed** | | x | The peak daily travel speed is used to monitor excessive machine speed to identify machine misuse or underuse. | Machine construction |
| **11.17** **Cumulative load count** | x | | The cumulative load count is used by the production manager to monitor the number of cycles performed by the machine over a given period. | Equipment and supply |
| **11.18** **Cumulative payload total** | x | | For machines with payload monitoring systems installed, the production manager monitors the total payload lifted, hauled or processed by the machine. | Equipment and supply |
| **11.19** **Cumulative non-productive regeneration hours** | x | x | The production manager can monitor the time spent operating the exhaust regeneration system on machines fitted with after treatment systems. | Machine construction |
| **11.20** **Cumulative idle non-operating hours** | x | | The production manager can monitor the time spent with the unit idling in a non-productive state. | Machine construction |
| **11.21** **Data field descriptions for codes unique to each system** | | x | The fault code can alert the owner to the need for non-scheduled machine support, and may be 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. | Machine construction |

# Annex B
(informative)

# Data support and collection

An OEM or third-party provider need not supply all data elements defined in this document, several of which are identified as optional.

Not all the data points identified are necessarily received by the third-party application or the end user and not all data collected by the OEM or third-party provider are provided directly to the customer.

The OEM or third-party provider provides data as it deems appropriate.

Data collected according to this document may be collected by third-party retrofit telematics systems operating with servers provided as part of the telematics system and those third-party systems may be operated completely independently of the OEM.

# Annex C
## (informative)

# Common schema

The common schema can be accessed at the URN: http://standards.iso.org/iso/15143/-3/common.xsd.

The developer is encouraged to access the schema from this location to ensure the use of the most up-to-date version of the schema.

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema
        attributeFormDefault="unqualified"
        elementFormDefault="qualified"
        xmlns:xs="http://www.w3.org/2001/XMLSchema"
        targetNamespace="http://standards.iso.org/iso/15143/-3"
        xmlns="http://standards.iso.org/iso/15143/-3"
        version="1.0.0"
>
    <xs:element name="Fleet">
        <xs:complexType>
            <xs:sequence>
                <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
                <xs:element name="Equipment" maxOccurs="unbounded">
                    <xs:complexType>
                        <xs:sequence>
                            <xs:element name="EquipmentHeader" type="EquipmentHeader"
maxOccurs="1"/>
                            <xs:element name="AverageLoadFactorLast24" type="LoadFactor"
minOccurs="0" maxOccurs="1" />
                            <xs:element name="Location" type="Location" minOccurs="0"
maxOccurs="1" />
                            <xs:element name="CumulativeActiveRegenerationHours"
type="CumulativeActiveRegenerationHours" minOccurs="0" maxOccurs="1" />
                            <xs:element name="CumulativeIdleHours"
type="CumulativeIdleHours" minOccurs="0" maxOccurs="1" />
                            <xs:element name="CumulativeIdleNonOperatingHours"
type="CumulativeIdleHours" minOccurs="0" maxOccurs="1" />
                            <xs:element name="CumulativeLoadCount" type="LoadCount"
minOccurs="0" maxOccurs="1" />
                            <xs:element name="CumulativeOperatingHours"
type="CumulativeOperatingHours" minOccurs="0" maxOccurs="1" />
                            <xs:element name="CumulativePowerTakeOffHours"
type="CumulativePowerTakeOffHours" minOccurs="0" maxOccurs="1" />
                            <xs:element name="CumulativePayloadTotals"
type="PayloadTotals" minOccurs="0" maxOccurs="1" />
                            <xs:element name="DEFRemaining" type="DEFRemaining"
minOccurs="0" maxOccurs="1" />
                            <xs:element name="Distance" type="Distance" minOccurs="0"
maxOccurs="1" />
                            <xs:element name="EngineStatus" type="EngineStatus"
minOccurs="0" maxOccurs="1" />
                            <xs:element name="FuelUsed" type="FuelUsed" minOccurs="0"
maxOccurs="1" />
                            <xs:element name="FuelUsedLast24" type="FuelUsed"
minOccurs="0" maxOccurs="1" />
                            <xs:element name="FuelRemaining" type="FuelRemaining"
minOccurs="0" maxOccurs="1" />
                            <xs:element name="MaximumSpeedLast24" type="Speed"
minOccurs="0" maxOccurs="1" />
                        </xs:sequence>
                    </xs:complexType>
                </xs:element>
            </xs:sequence>
```

```
            <xs:attribute name="version" type="xs:unsignedInt" use="required"/>
            <xs:attribute name="snapshotTime" type="xs:dateTime" use="required"/>
        </xs:complexType>
    </xs:element>

    <xs:simpleType name="serno">
        <xs:restriction base="xs:string">
            <xs:minLength value="1"/>
            <xs:maxLength value="17"/>
        </xs:restriction>
    </xs:simpleType>

    <xs:simpleType name="percent">
        <xs:restriction base="xs:decimal">
            <xs:totalDigits value="3"/>
            <xs:fractionDigits value="2"/>
            <xs:minInclusive value="000.00"/>
            <xs:maxInclusive value="100.00"/>
        </xs:restriction>
    </xs:simpleType>

    <xs:simpleType name="lat">
        <xs:restriction base="xs:decimal">
            <xs:totalDigits value="8"/>
            <xs:fractionDigits value="6"/>
            <xs:minInclusive value="-90.000000"/>
            <xs:maxInclusive value="+90.000000"/>
        </xs:restriction>
    </xs:simpleType>

    <xs:simpleType name="long">
        <xs:restriction base="xs:decimal">
            <xs:totalDigits value="9"/>
            <xs:fractionDigits value="7"/>
            <xs:minInclusive value="-180.000000"/>
            <xs:maxInclusive value="+180.000000"/>
        </xs:restriction>
    </xs:simpleType>

    <xs:simpleType name="fueluom">
        <xs:restriction base="xs:string">
            <xs:enumeration value="litre"/>
        </xs:restriction>
    </xs:simpleType>

    <xs:simpleType name="defuom">
        <xs:restriction base="xs:string">
            <xs:enumeration value="litre"/>
        </xs:restriction>
    </xs:simpleType>

    <xs:simpleType name="odometeruom">
        <xs:restriction base="xs:string">
            <xs:enumeration value="kilometre"/>
        </xs:restriction>
    </xs:simpleType>

    <xs:simpleType name="altitudeuom">
        <xs:restriction base="xs:string">
            <xs:enumeration value="metre"/>
        </xs:restriction>
    </xs:simpleType>

    <xs:complexType name="EquipmentHeader">
        <xs:sequence>
            <xs:element name="UnitInstallDateTime" minOccurs="0" maxOccurs="1"
type="xs:dateTime"/>
            <xs:element name="OEMName" minOccurs="0" maxOccurs="1" type="xs:string"/>
            <xs:element name="Model" minOccurs="0" maxOccurs="1" type="xs:string"/>
            <xs:element name="EquipmentID" minOccurs="0" maxOccurs="1" type="xs:string"/>
            <xs:element name="SerialNumber" minOccurs="0" maxOccurs="1" type="serno" />
```

```
            <xs:element name="PIN" minOccurs="0" maxOccurs="1" type="serno" />
        </xs:sequence>
    </xs:complexType>

    <xs:complexType name="Location">
        <xs:sequence>
            <xs:element name="Latitude" type="lat"/>
            <xs:element name="Longitude" type="long"/>
            <xs:element name="Altitude" type="xs:decimal" minOccurs="0" maxOccurs="1"/>
            <xs:element name="AltitudeUnits" type="altitudeuom" minOccurs="0"
maxOccurs="1"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:complexType name="CumulativeActiveRegenerationHours">
        <xs:sequence>
            <xs:element name="Hour" type="xs:decimal"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:complexType name="CumulativeOperatingHours">
        <xs:sequence>
            <xs:element name="Hour" type="xs:decimal"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:complexType name="CumulativeIdleHours">
        <xs:sequence>
            <xs:element name="Hour" type="xs:decimal"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:complexType name="CumulativePowerTakeOffHours">
        <xs:sequence>
            <xs:element name="Hour" type="xs:decimal"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:complexType name="EngineStatus">
        <xs:sequence>
            <xs:element name="EngineNumber" type="xs:string"/>
            <xs:element name="Running" type="xs:boolean"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:complexType name="DEFRemaining">
        <xs:sequence>
            <xs:element name="Percent" type="percent"/>
            <xs:element name="DEFTankCapacityUnits" type="defuom"/>
            <xs:element name="DEFTankCapacity" type="xs:decimal"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:complexType name="FuelUsed">
        <xs:sequence>
            <xs:element name="FuelUnits" type="fueluom"/>
            <xs:element name="FuelConsumed" type="xs:unsignedInt"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:complexType name="FuelRemaining">
        <xs:sequence>
            <xs:element name="Percent" type="percent"/>
```

```
            <xs:element name="FuelTankCapacityUnits" type="fueluom" minOccurs="0"/>
            <xs:element name="FuelTankCapacity" type="xs:unsignedInt" minOccurs="0"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:complexType name="Links">
        <xs:sequence>
            <xs:element name="rel" type="xs:string" minOccurs="1" />
            <xs:element name="href" type="xs:string" minOccurs="1" />
        </xs:sequence>
    </xs:complexType>

    <xs:complexType name="LoadFactor">
        <xs:sequence>
            <xs:element name="Percent" type="percent"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:complexType name="LoadCount">
        <xs:sequence>
            <xs:element name="Count" type="xs:unsignedInt"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:complexType name="PayloadTotals">
        <xs:sequence>
            <xs:element name="PayloadUnits" type="weightuom"/>
            <xs:element name="Payload" type="xs:decimal"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:simpleType name="weightuom">
        <xs:restriction base="xs:string">
            <xs:enumeration value="kilogram"/>
        </xs:restriction>
    </xs:simpleType>

    <xs:complexType name="Speed">
        <xs:sequence>
            <xs:element name="SpeedUnits" type="speeduom"/>
            <xs:element name="Speed" type="xs:decimal"/>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

    <xs:simpleType name="speeduom">
        <xs:restriction base="xs:string">
            <xs:enumeration value="kilometres per hour"/>
            <xs:enumeration value="metres per minute"/>
        </xs:restriction>
    </xs:simpleType>

    <xs:complexType name="Distance">
        <xs:sequence>
            <xs:element name="OdometerUnits" type="odometeruom"/>
            <xs:element name="Odometer">
                <xs:simpleType>
                    <xs:restriction base="xs:decimal">
                        <xs:fractionDigits value="1"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:element>
        </xs:sequence>
        <xs:attribute name="datetime" type="xs:dateTime" use="required"/>
    </xs:complexType>

</xs:schema>
```

# Annex D
## (informative)

# Time series schema

The Fleet Time Series schema can be accessed at the URN: http://standards.iso.org/iso/15143/-3/FleetTS.xsd.

The developer is encouraged to access the schema from this location to ensure the use of the most up-to-date version of the schema.

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

    <xs:include schemaLocation="http://standards.iso.org/iso/15143/-3/common.xsd"/>

    <xs:element name="Fleet">
        <xs:complexType>
            <xs:sequence>
                <xs:element name="Links" type="Links" minOccurs="1" maxOccurs="unbounded"
/>
                <!-- This collection would contain self, current, next, and last pages.-->
                <xs:element name="Equipment" maxOccurs="unbounded">
                    <xs:complexType>
                        <xs:sequence>
                            <xs:element name="EquipmentHeader" type="EquipmentHeader"
maxOccurs="1"/>
                            <xs:element name="Links" type="Links" minOccurs="1"
maxOccurs="unbounded" />
                            <!-- This collection would contain links to the different
time-series endpoints below. -->
                        </xs:sequence>
                    </xs:complexType>
                </xs:element>
            </xs:sequence>
            <xs:attribute name="version" type ="xs:unsignedInt" use="required"/>
            <xs:attribute name="snapshotTime" type ="xs:dateTime" use="required"/>
        </xs:complexType>
    </xs:element>

</xs:schema>
```

# Bibliography

[1]     ISO 6165, *Earth-moving machinery — Basic types — Identification and terms and definitions*

[2]     ISO 7000[1]), *Graphical symbols for use on equipment — Registered symbols*

[3]     ISO 22242, *Road construction and road maintenance machinery and equipment — Basic types — Identification and description*

[4]     SAE J1939 Ed. 201308, *Serial Control and Communications Heavy Duty Vehicle Network*

[5]     SAE J1939-73, *Application Layer — Diagnostics*

---

1)    Available at http://www.iso.org/obp/ui/

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